No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

(No Model.) 13 Sheets—Sheet 1.

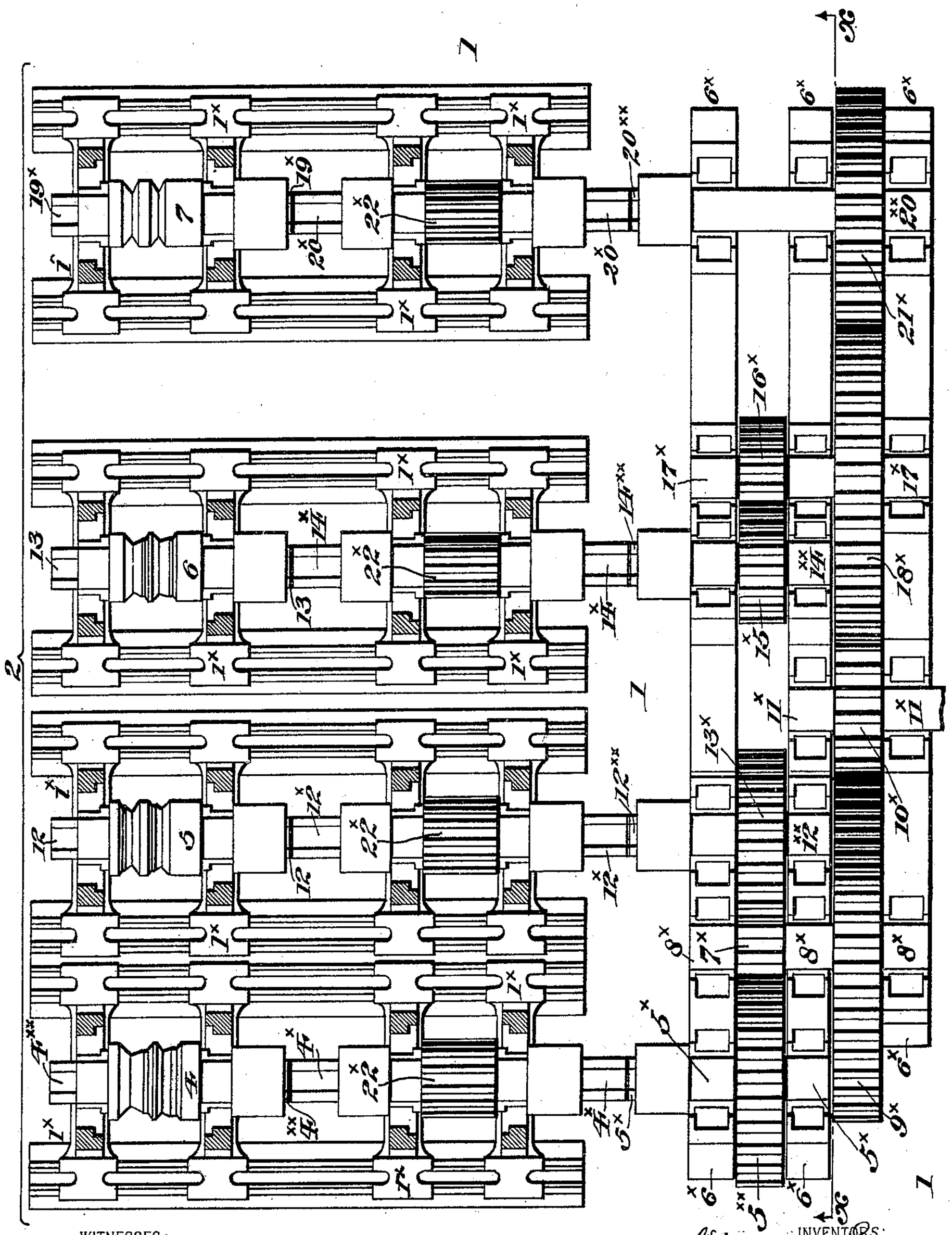

Fig. 1.

WITNESSES:

L. Louville,

P. F. Dagles.

INVENTORS:

William D. Eynon.

BY John R. Eynon.

Wedderburn & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

(No Model.) 13 Sheets—Sheet 2.

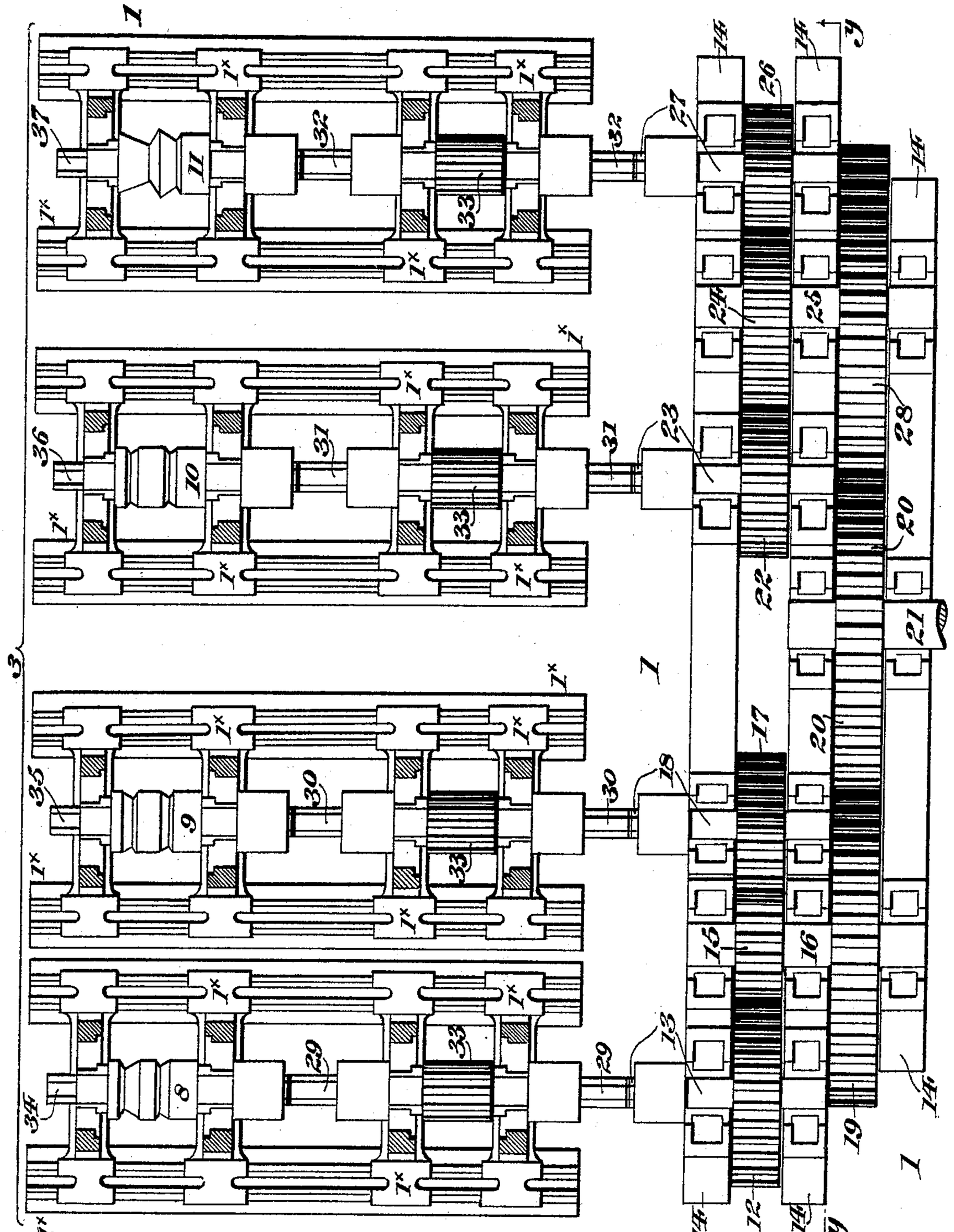

Fig. 2.

WITNESSES:

L. Dorville,

P. F. Eagles.

INVENTORS:

William D. Eynon.

John R. Eynon.

BY Wilders Reim & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

(No Model.)

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Fig. 3.

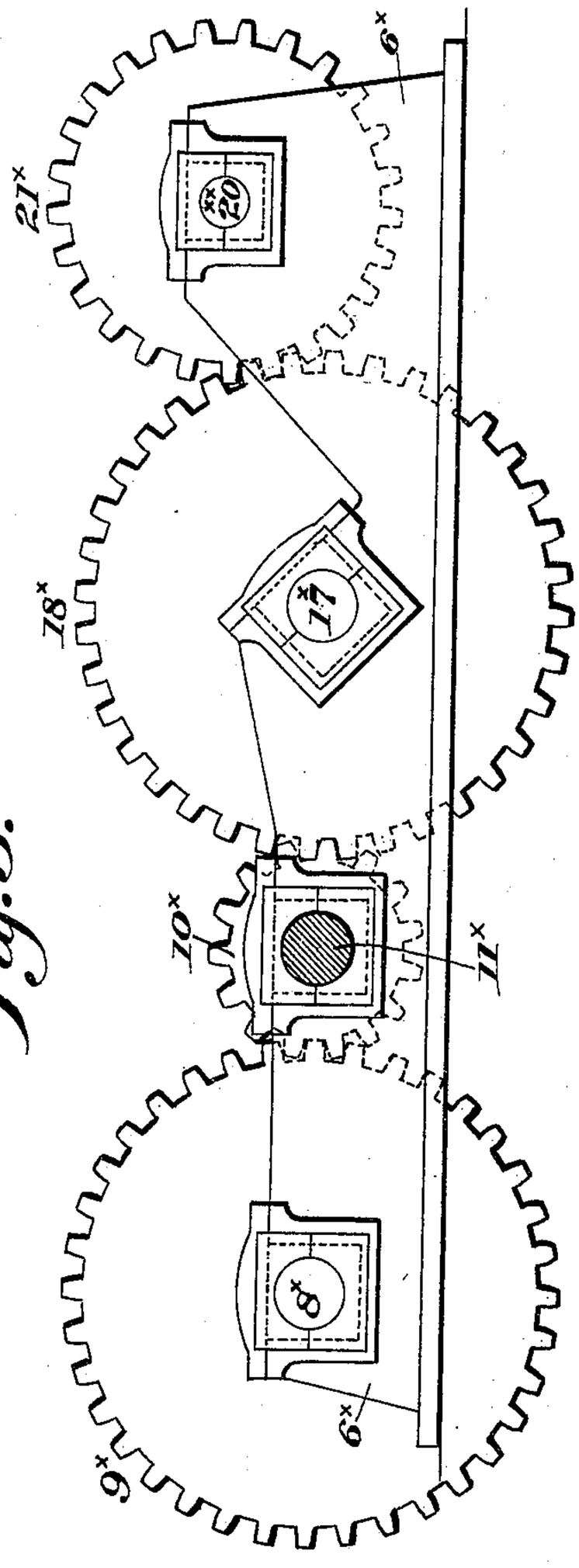
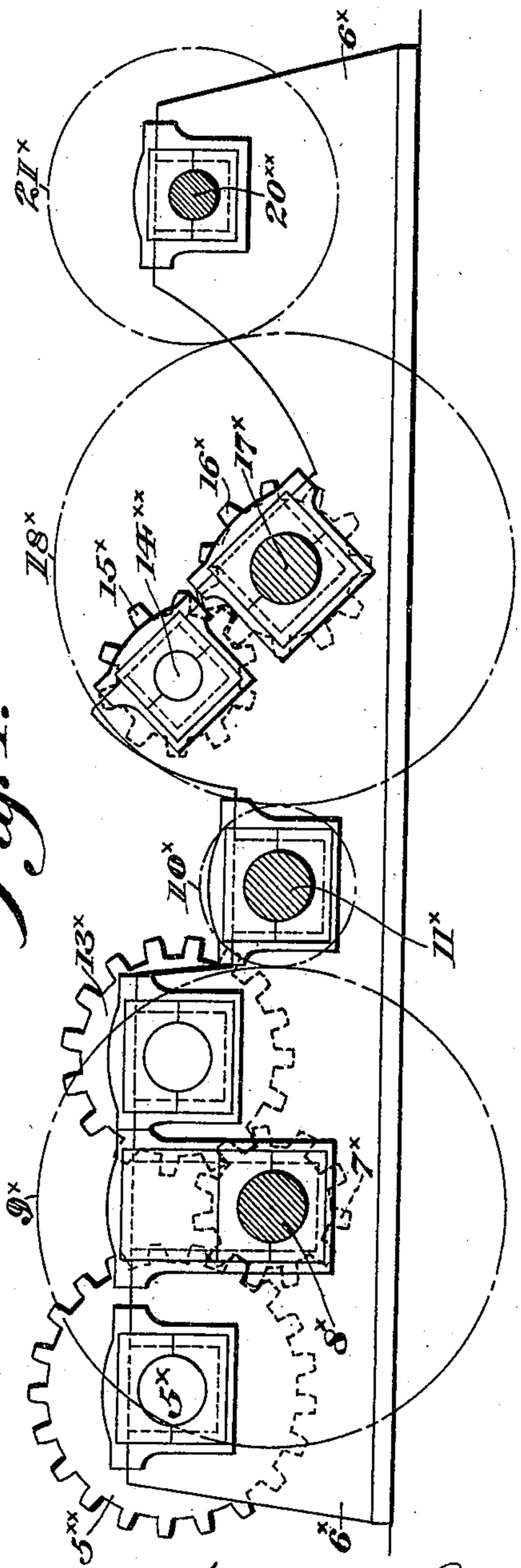


Fig. 4.



WITNESSES:

L. Orville,

P. F. Dagles.

INVENTORS:

William D. Eynon,

John R. Eynon,

BY Wiedersheim & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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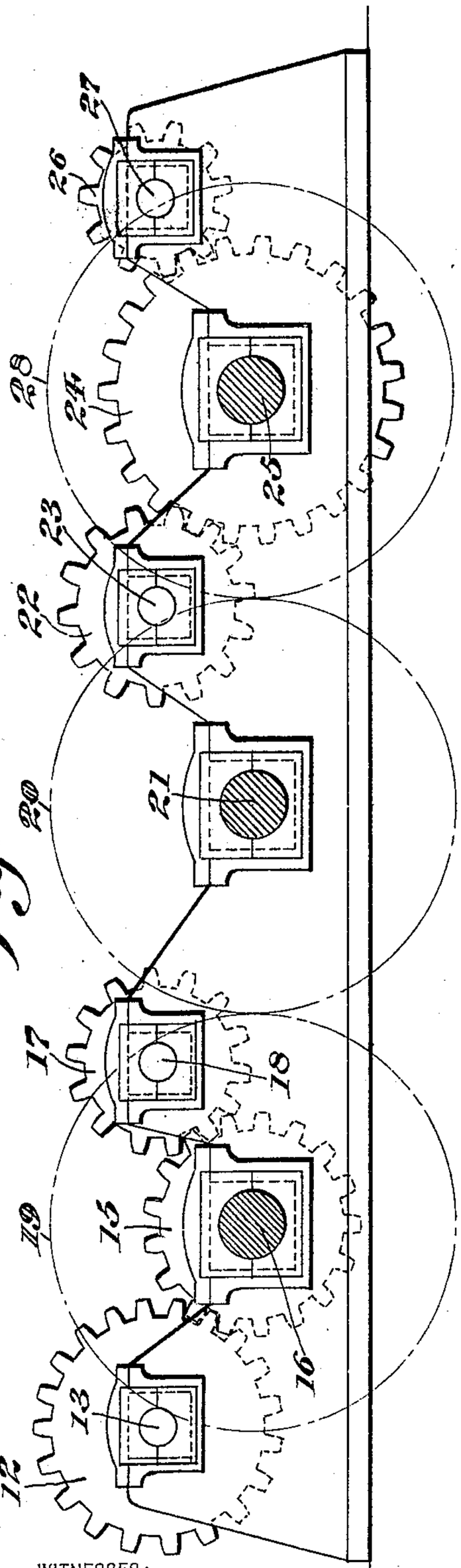

fig. 5.

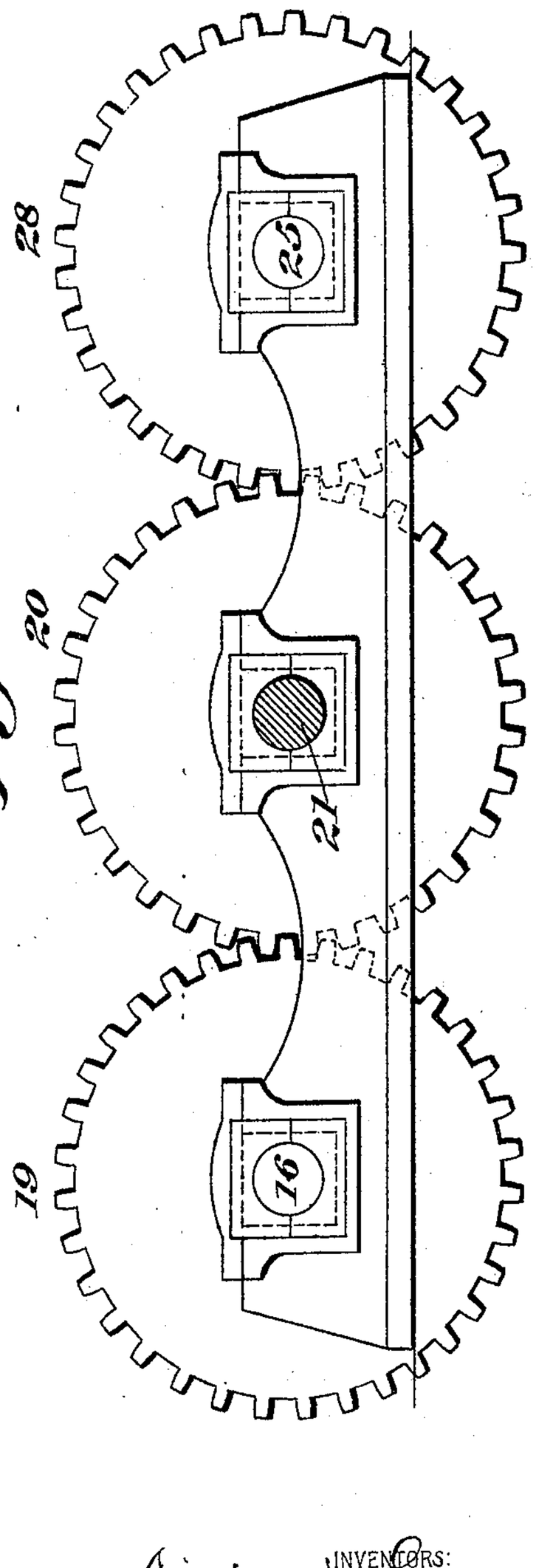

fig. 6.

WITNESSES:

L. Orville,

P. F. Eagles.

INVENTORS:

William D. Eynon.

BY John R. Eynon.

Wickersham & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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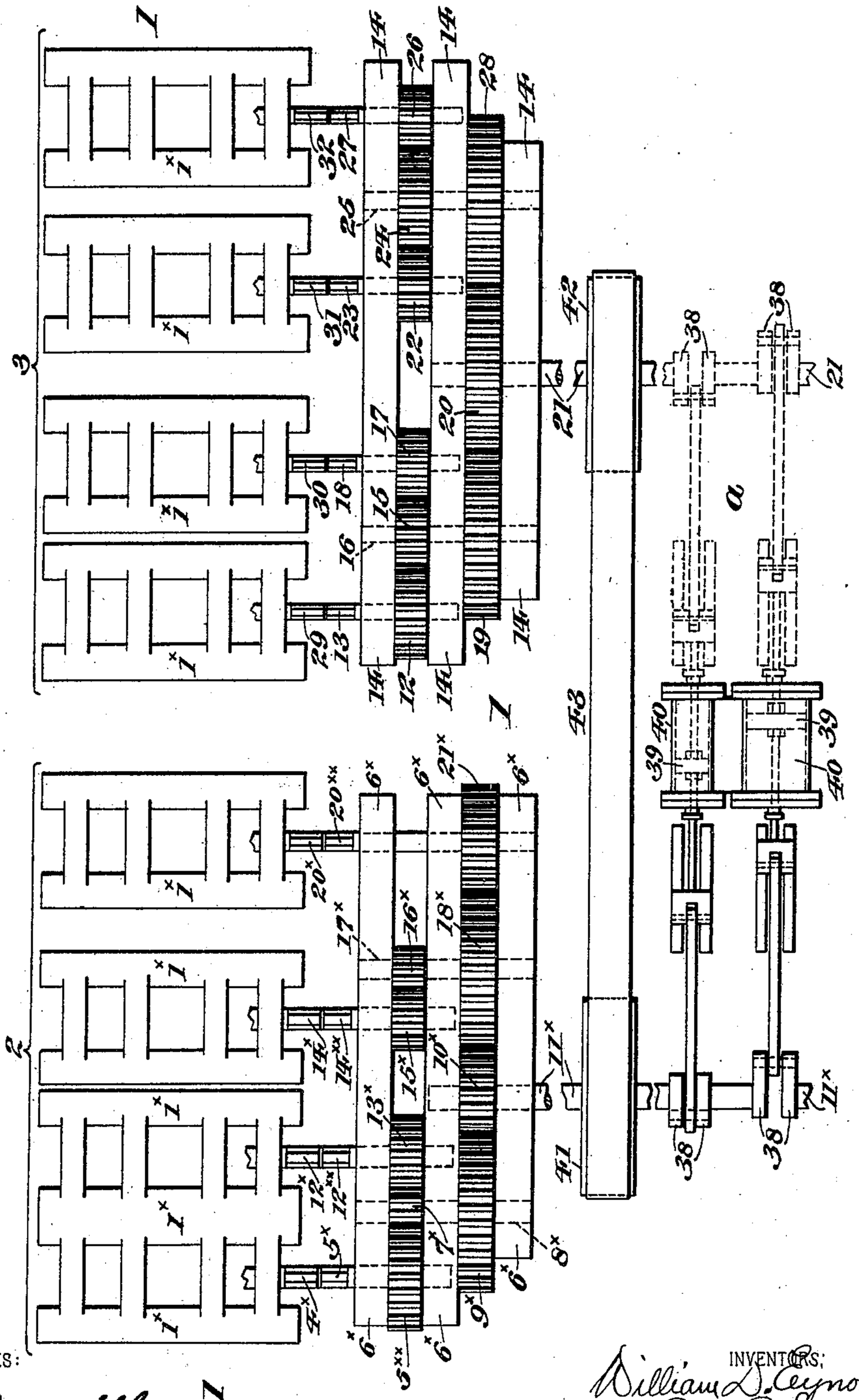
Fig. 7.



WITNESSES:

L. Dorville,

P. F. Dagles.

INVENTORS:

William D. Eynon,

BY John R. Eynon,

Diedrich & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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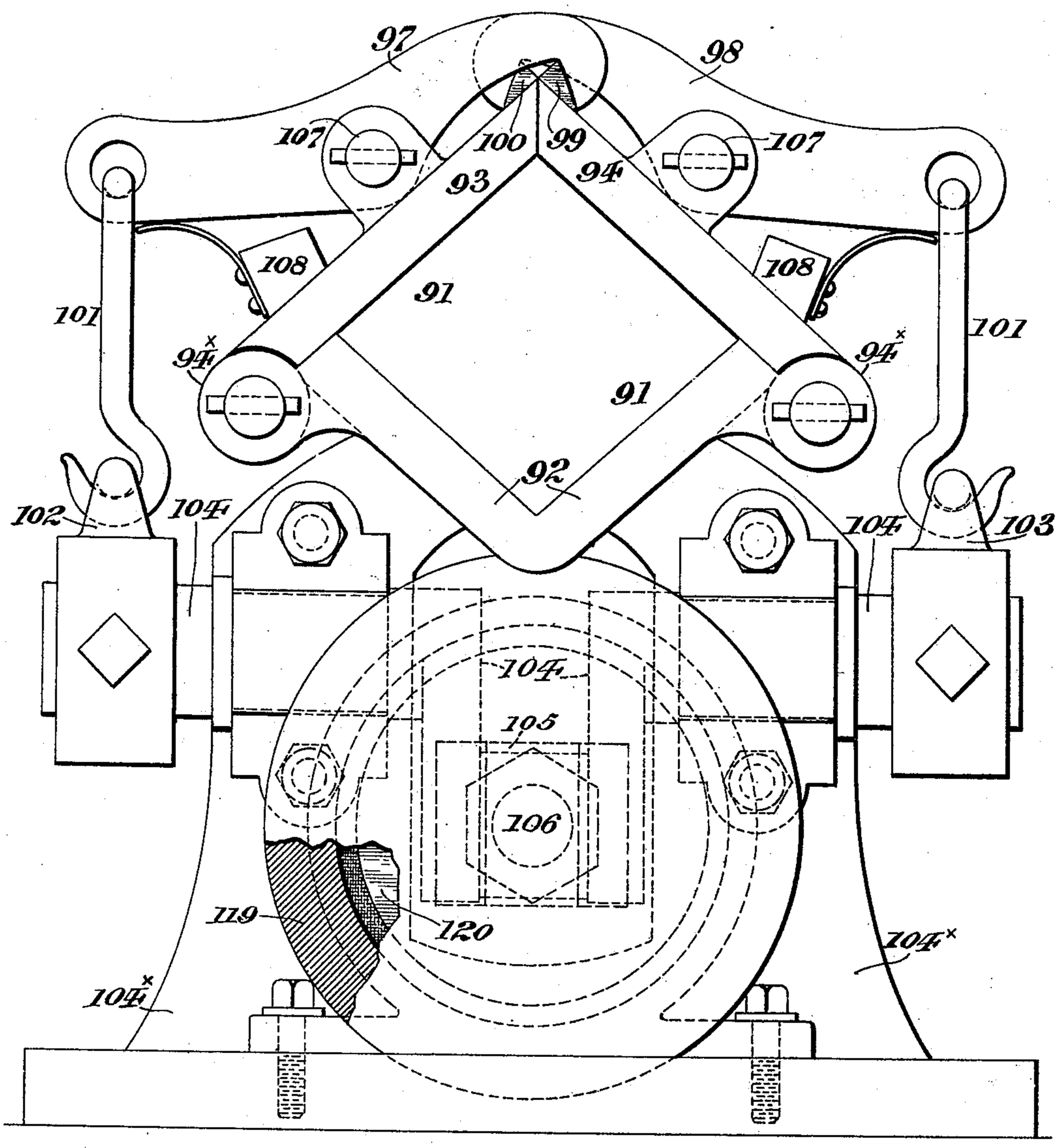
Fig. 8.



WITNESSES:

L. Dowville,

P. F. Dagles.

INVENTORS:

William D. Eynon.

John R. Eynon.

BY Widenheim & Fairbanks.

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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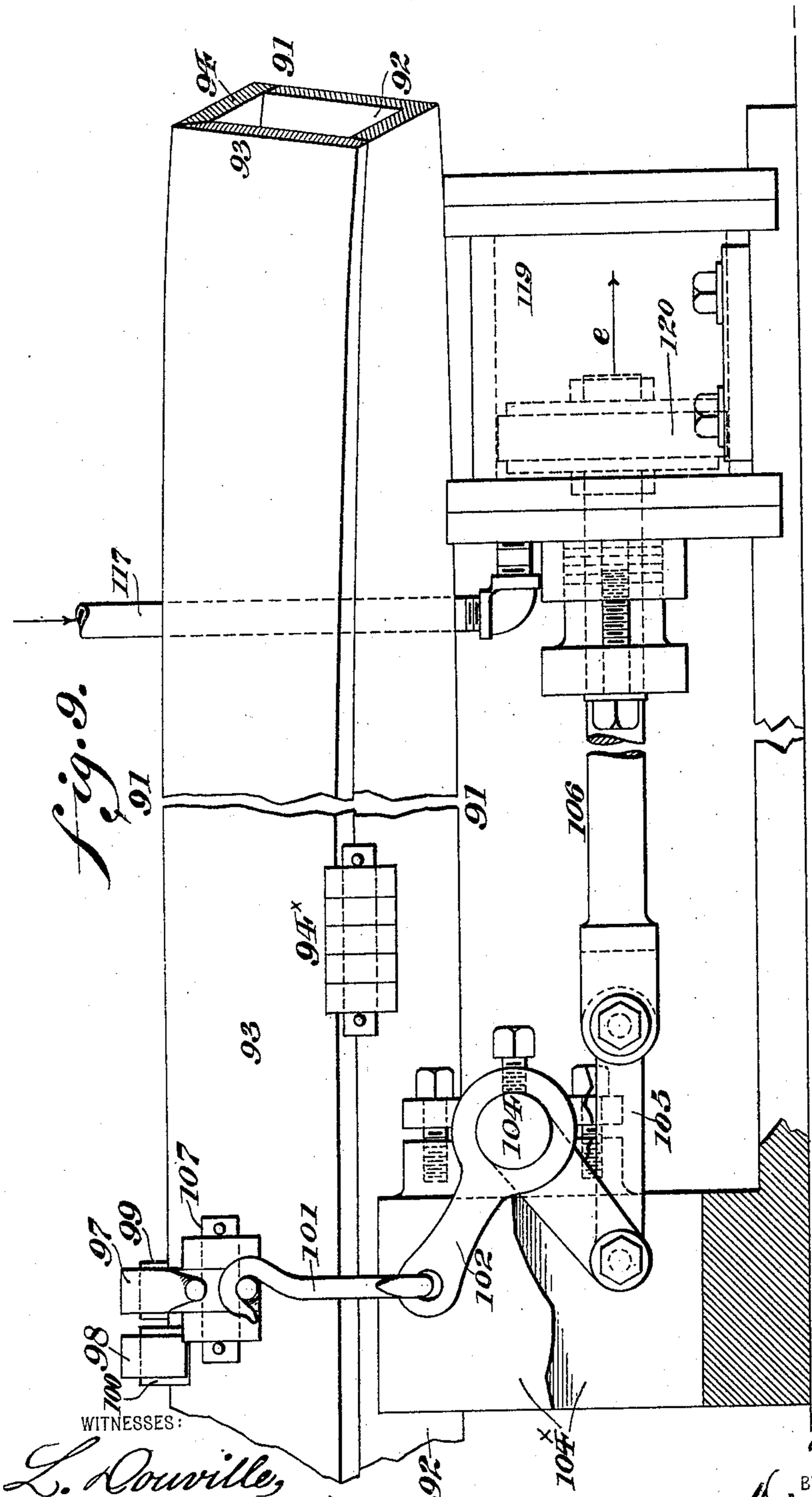
Fig. 9.



No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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fig. 10.

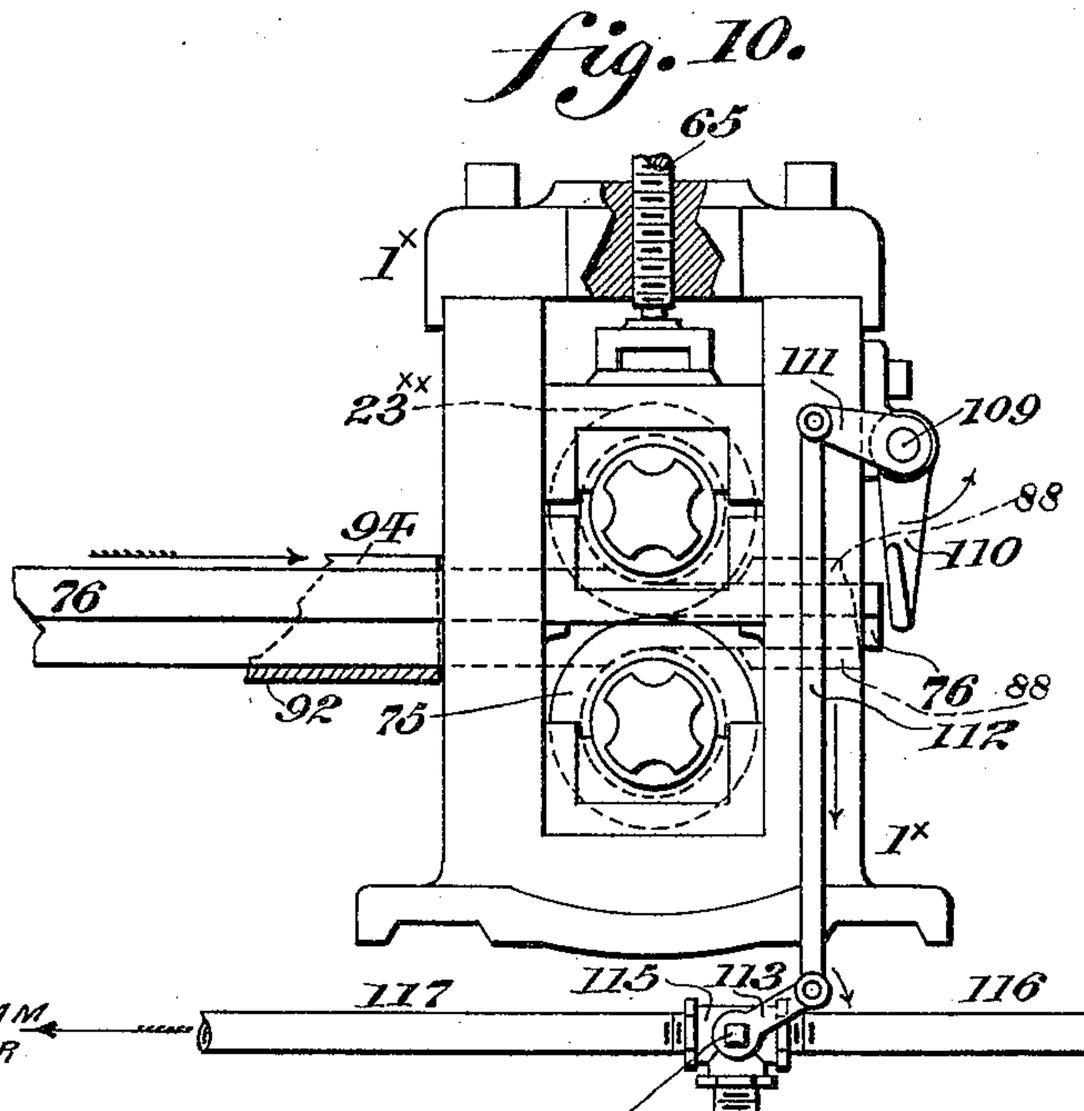


fig. 10.a

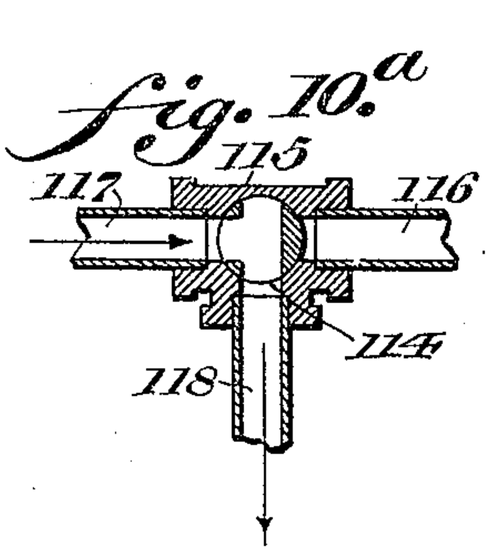


fig. 10.b

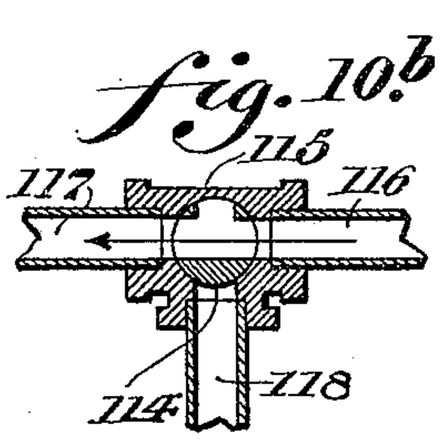
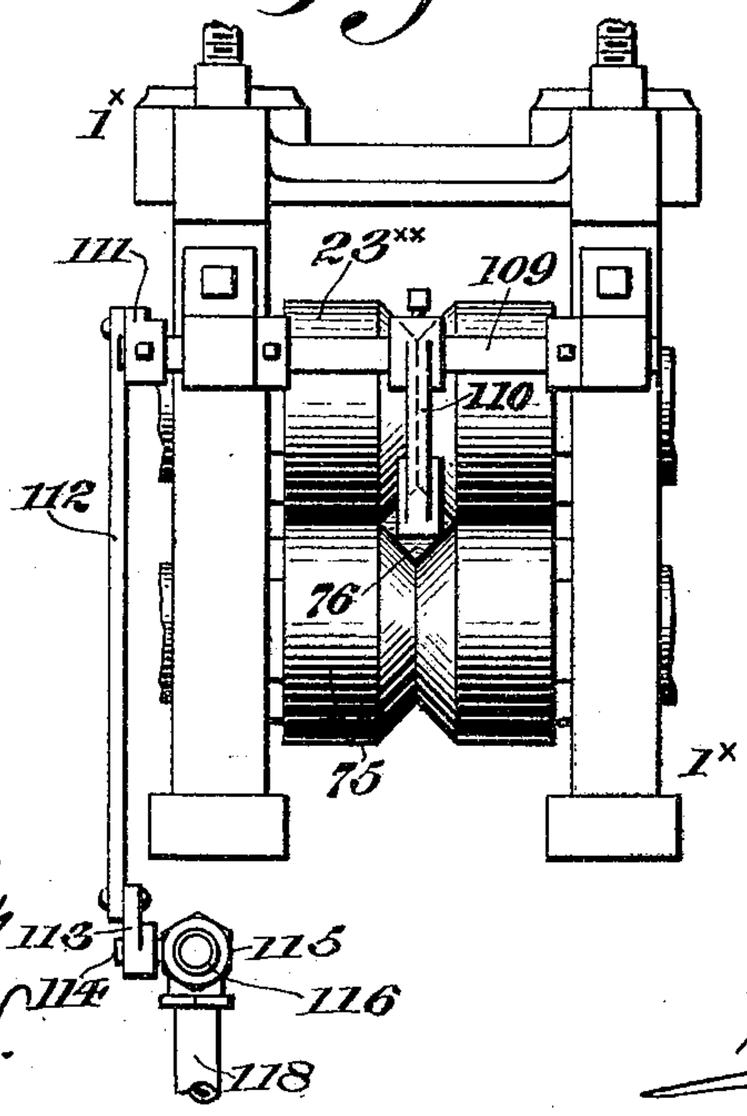


fig. 11.



WITNESSES:

L. Dourville,

P. F. Eagles.

INVENTORS:

William D. Eynon.,

BY John R. Eynon

Dieterich & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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fig. 12.

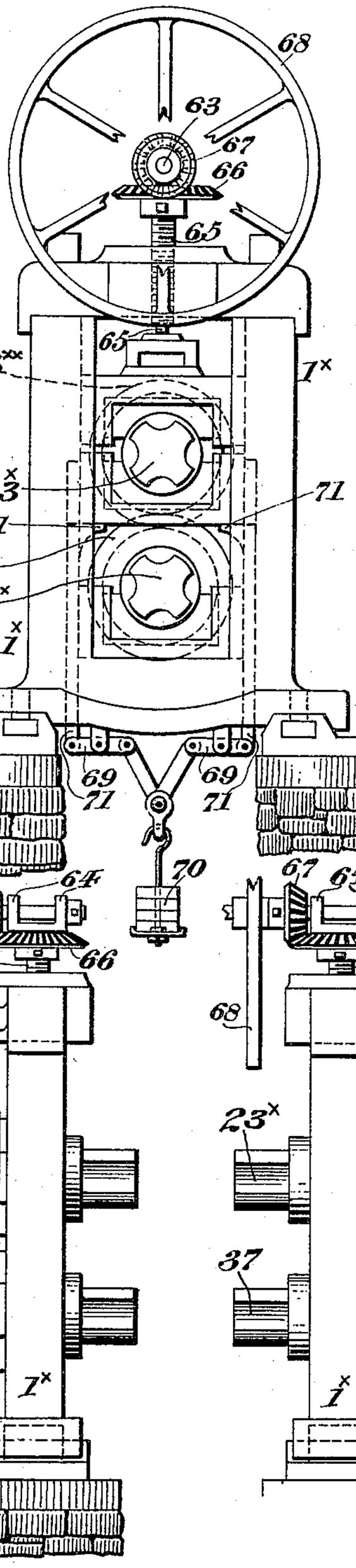


fig. 15.

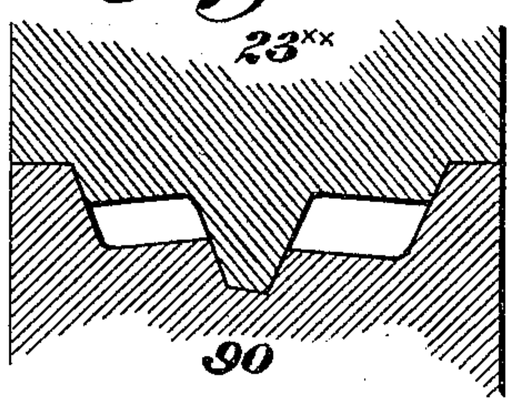


fig. 13.

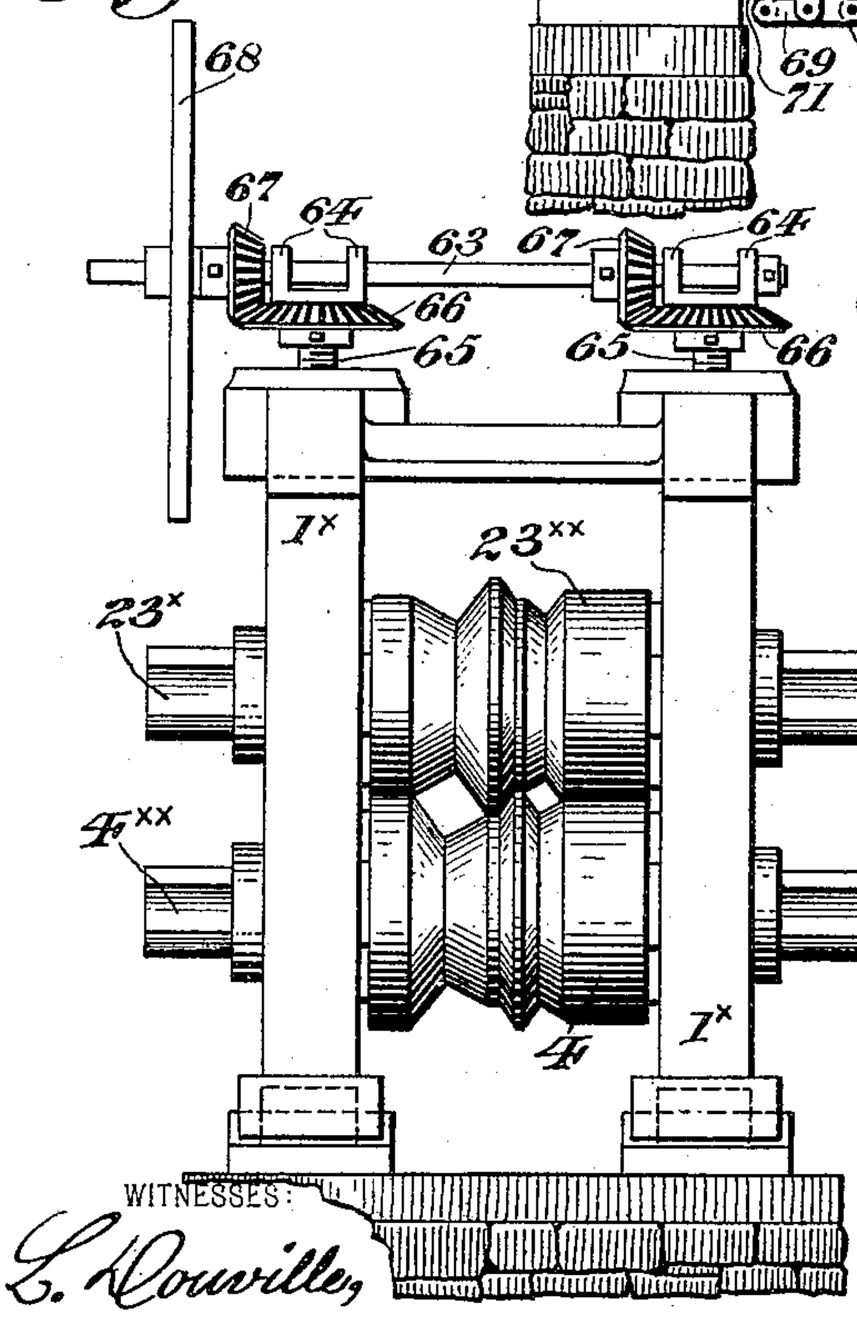
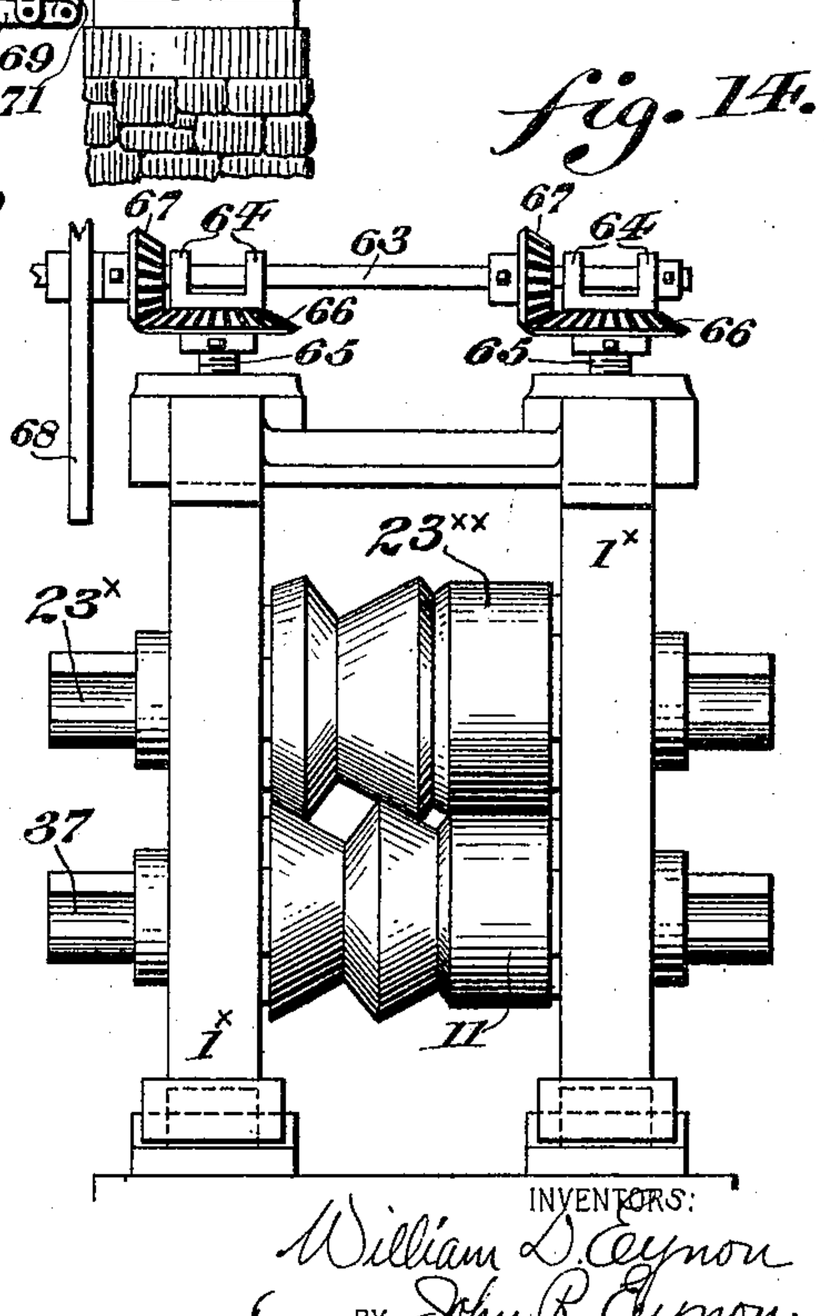


fig. 14.



WITNESSES:

L. Louville,

P. F. Eagles.

INVENTORS:

William D. Eynon

BY John R. Eynon.

Wiedersheim & Talibaks.

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

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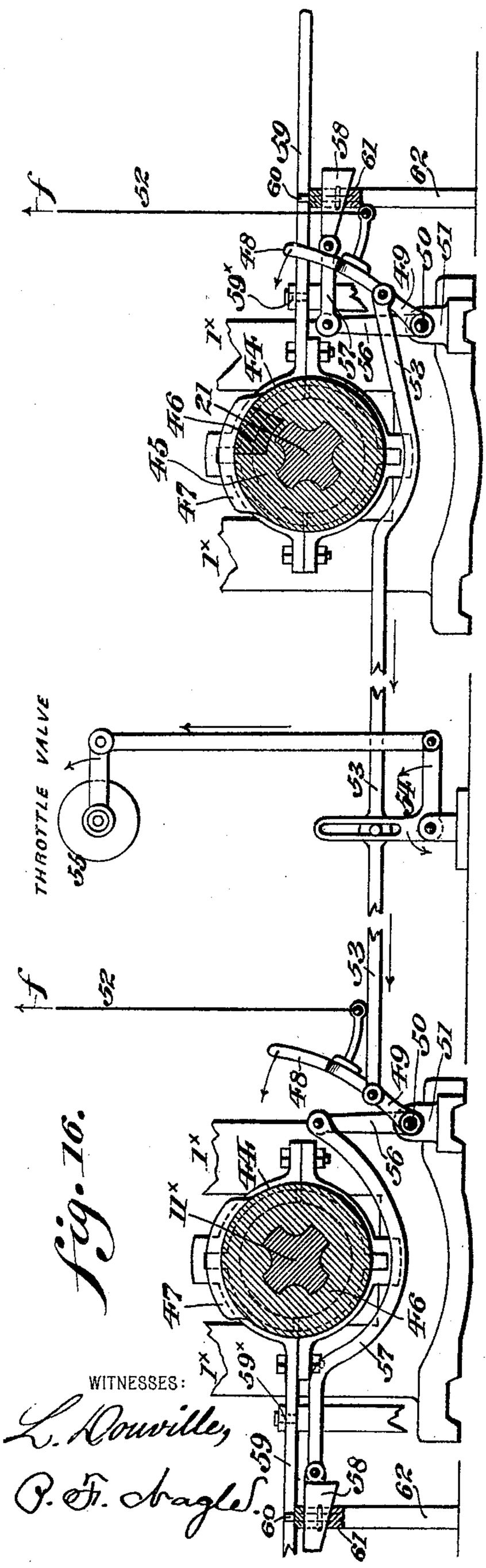

Fig. 16.

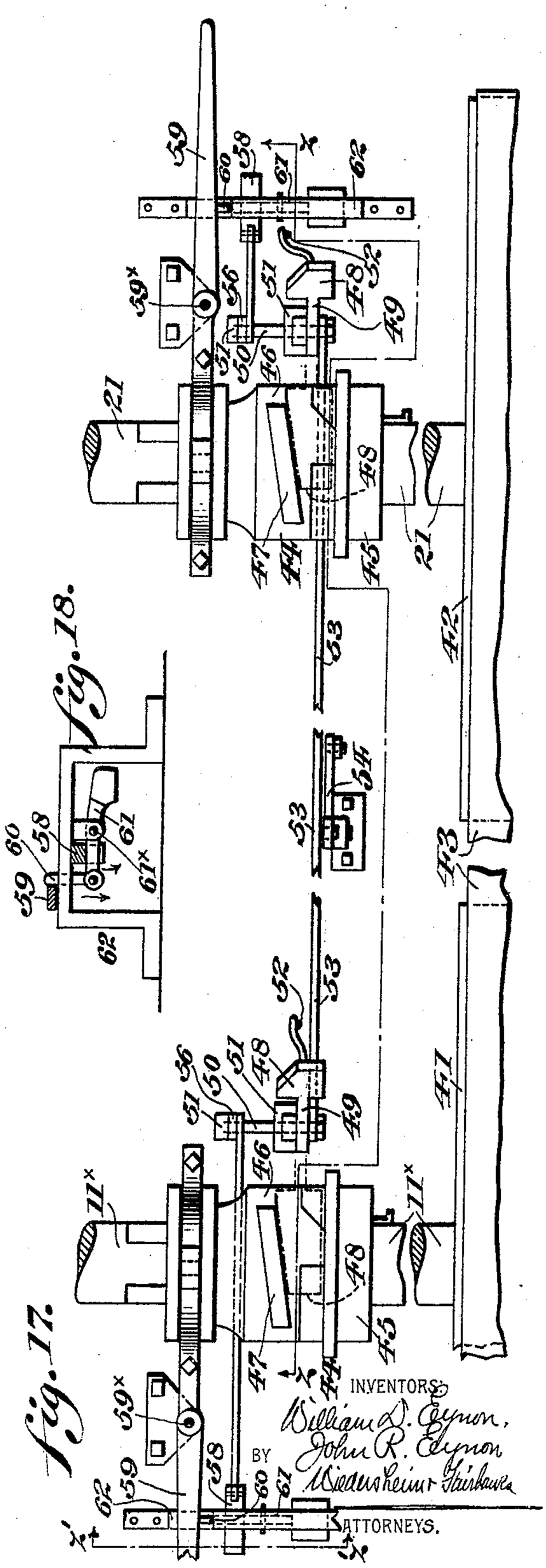

Fig. 17.

Fig. 18.

WITNESSES:

L. Dowville,

P. F. Dagle.

INVENTORS:

William D. Eynon,

John R. Eynon

BY Wiedenheimer & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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Fig. 19.

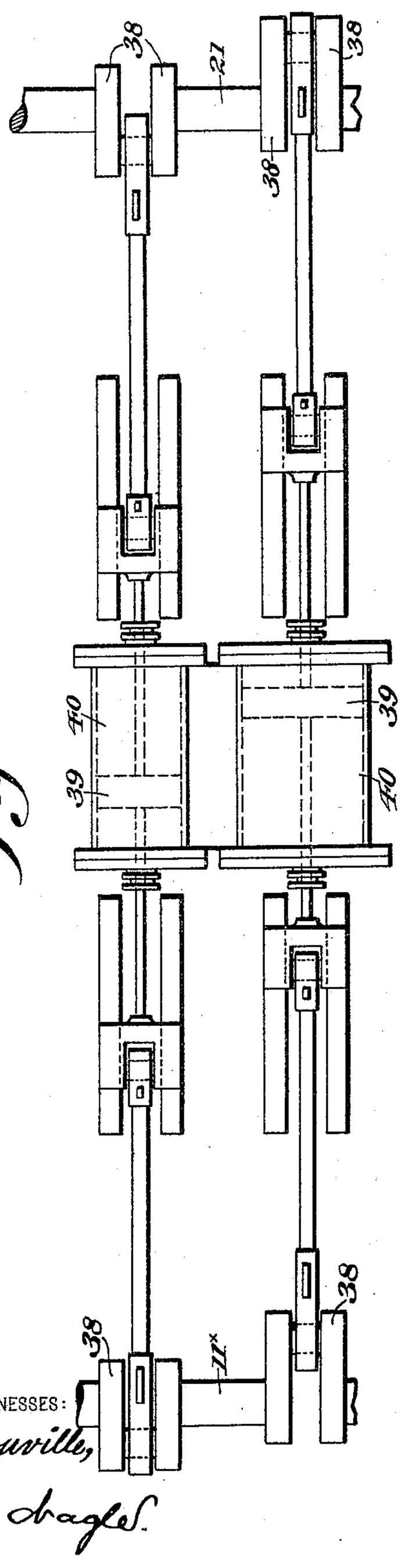
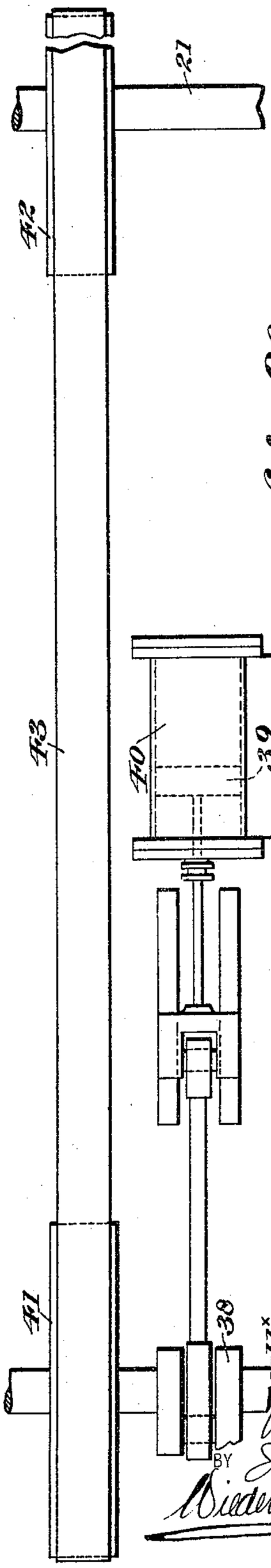


Fig. 20.



WITNESSES:

L. Dourville,

P. F. Dagles.

INVENTORS

William D. Eynon.

John R. Eynon,

BY Wiedersheim & Fairbanks

ATTORNEYS.

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W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

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Fig. 23.

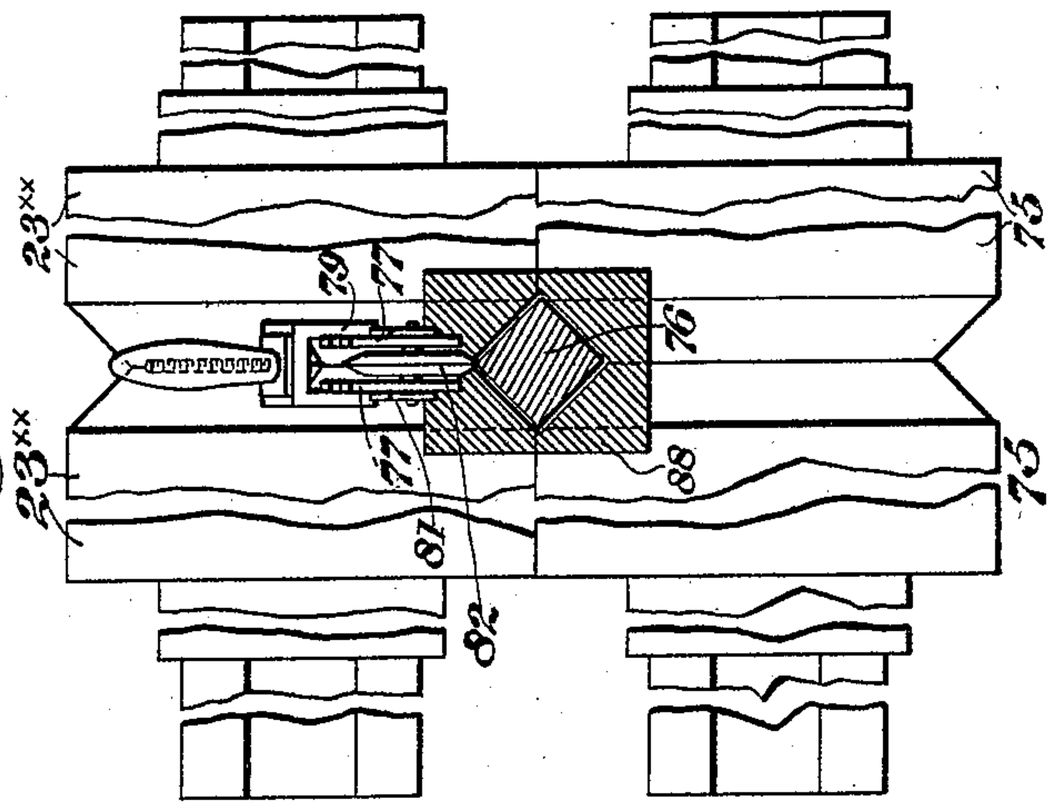
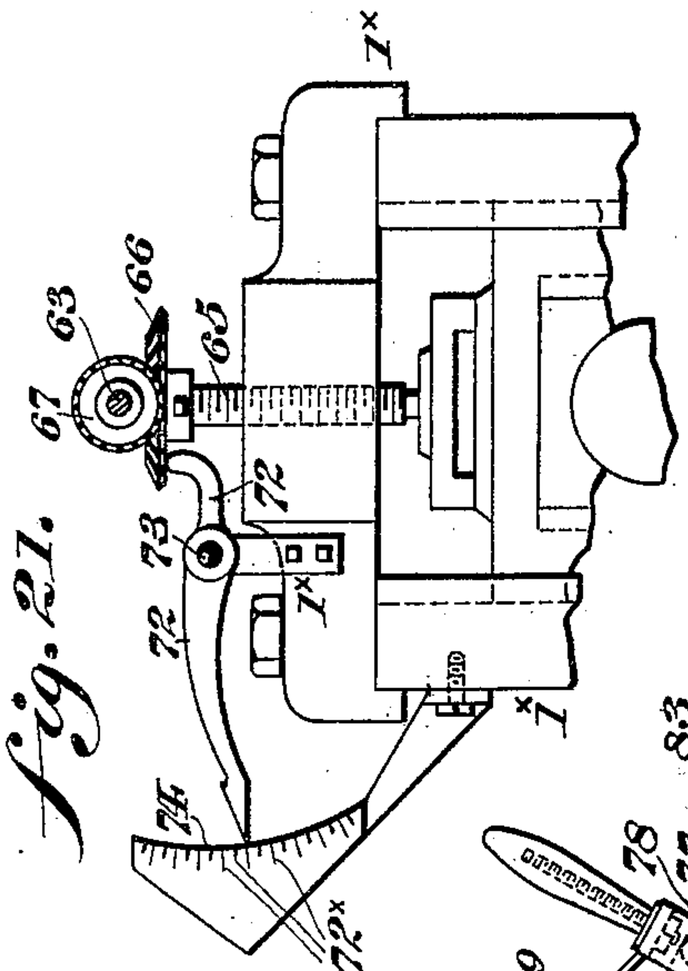


Fig. 21.



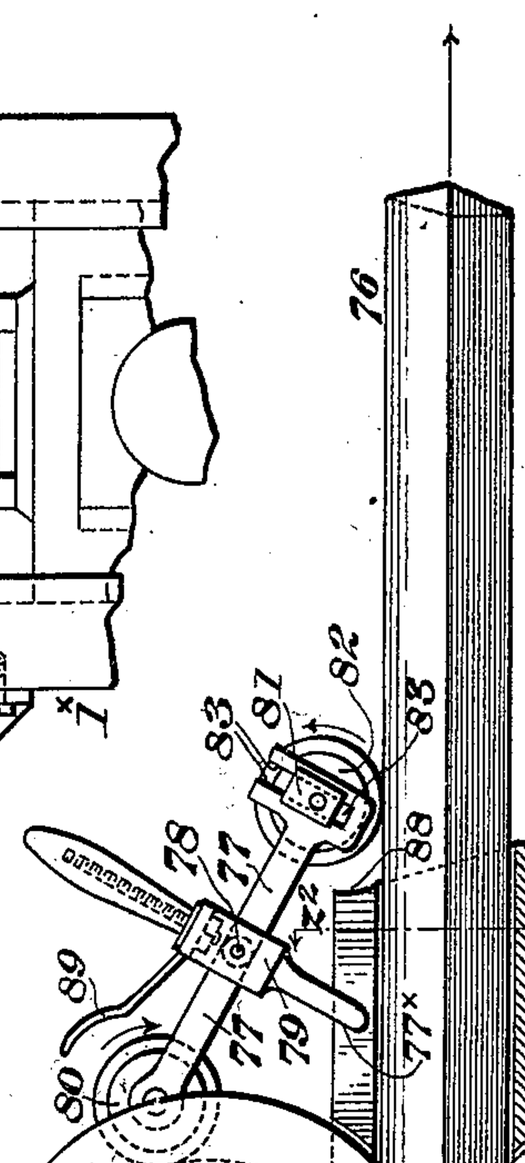


Fig. 24.

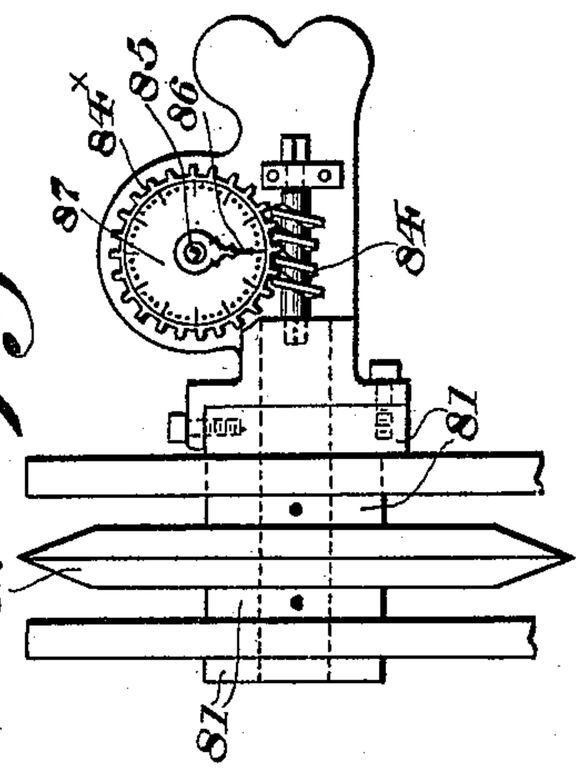
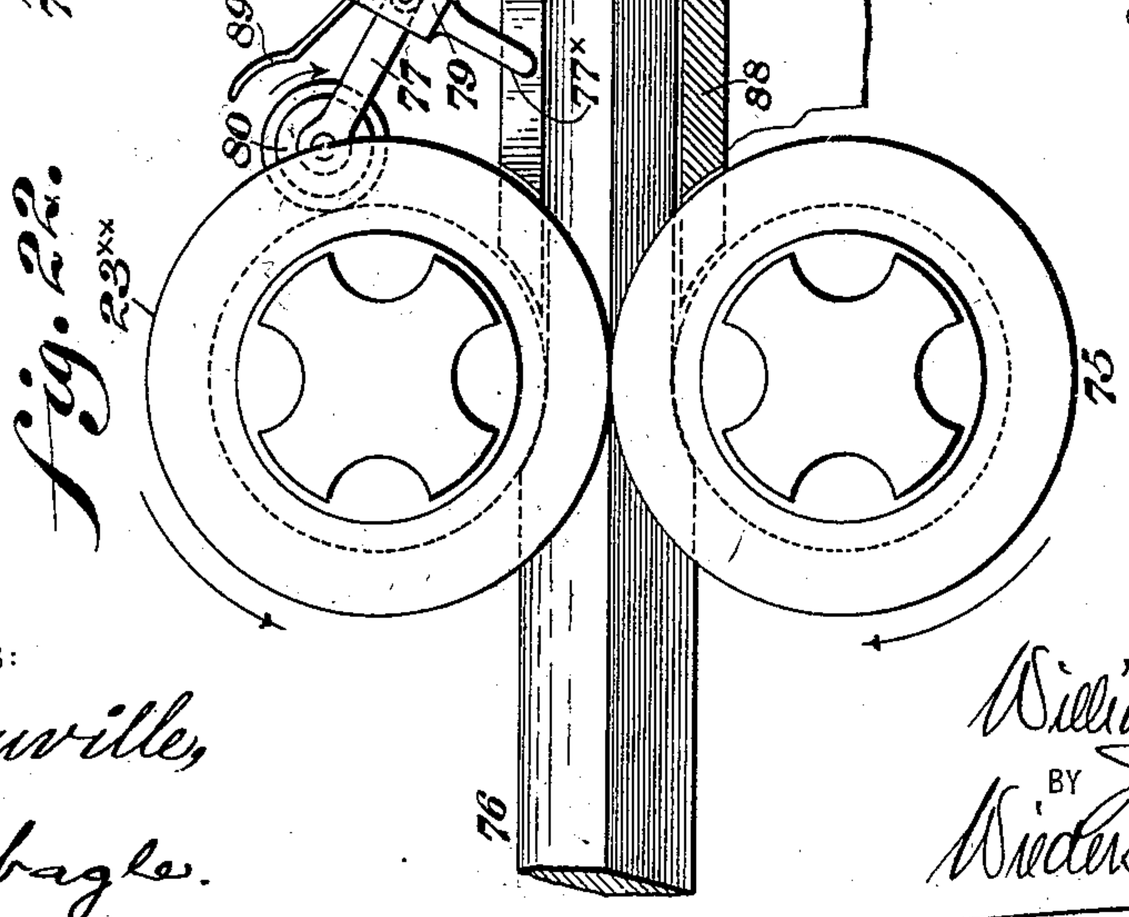


Fig. 22.



WITNESSES:

L. Louville,

P. H. Eagles.

INVENTORS:

William D. Eynon,

BY John R. Eynon

Wiedersheim & Fairbanks

ATTORNEYS.

No. 616,092. Patented Dec. 20, 1898.

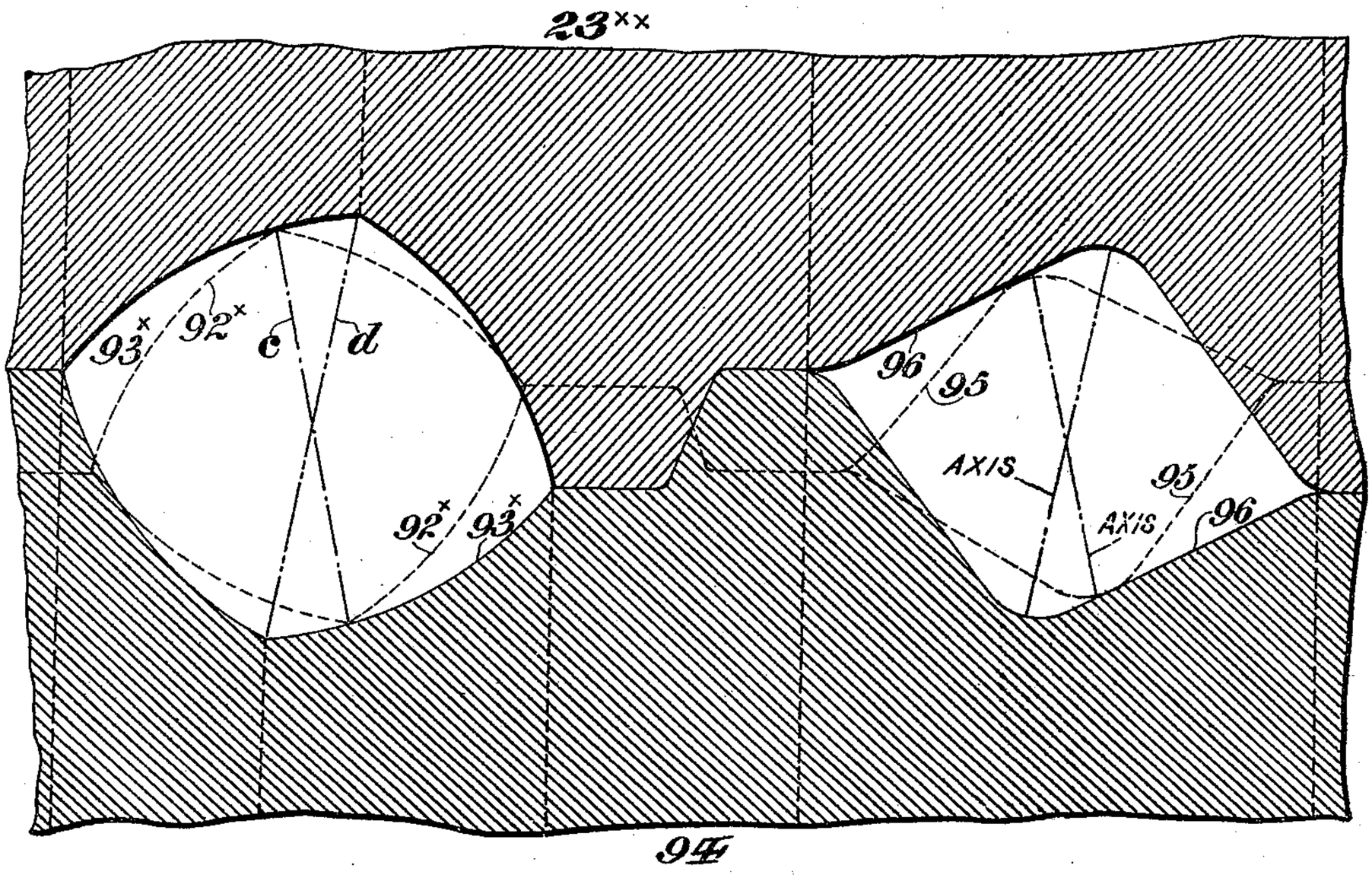
W. D. & J. R. EYNON.

CONTINUOUS ROLLING MILL.

(Application filed Mar. 31, 1898.)

(No Model.) 13 Sheets—Sheet 13.

fig. 25.



WITNESSES:

L. Dorville,

P. F. Dagle.

INVENTORS:

William D. Eynon.

BY John R. Eynon.

Wiedersheim & Fairbanks

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WILLIAM D. EYNON AND JOHN R. EYNON, OF PHILADELPHIA, PENNSYLVANIA.

CONTINUOUS ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 616,092, dated December 20, 1898.

Application filed March 31, 1898. Serial No. 675,836. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM D. EYNON and JOHN R. EYNON, citizens of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented new and useful Improvements in Continuous Rolling-Mills, which improvements are fully set forth in the following specification and accompanying drawings.

Our invention relates to improvements in continuous rolling-mills; and it consists of mechanism whereby the mill is rendered more convenient of access and effective in its operation than mills of a similar character now in use.

It also consists in so arranging the several parts of the mill that the time and expense ordinarily required for repairs to the same are reduced to a minimum, as are also the first cost and maintenance of the mill.

It also consists in combining the mill and engine in such a manner that the desired speed is imparted to the rolls arranged in groups of two or more pairs.

It further consists in the exclusive employment of spur-gears and in so arranging the gearing that two or more pairs of rolls may be driven without the use of bevel-gears.

It also consists in so arranging grooves in the several rolls that the torsional strain on a bar when the same is passing from one pair of rolls to the next pair is reduced to a minimum.

It also consists of a guide which directs a bar from the grooves in one pair of rolls to those in the next pair, said guide being operated by the bar when the latter is passing from one pair of rolls to the next pair and in such a manner as to automatically raise the lids of the guide when the forward end of a bar is engaged by the grooves in the next pair of rolls, so that said bar may bulge without coming in contact with the lids of the guide, should bulging occur, due to the bar being fed faster by a pair of rolls than it is taken up by the next pair.

It also consists of mechanism for indicating the relative speed of a bar as it passes from one pair of rolls to the next pair as compared with the speed of the rolls between which said bar is passing.

It also consists of mechanism for indicating the draft of the rolls, so that the latter may be adjusted with great exactness in order to insure the correct working of the same.

It also consists of mechanism whereby the mill can be disconnected from the engine that drives it simultaneously with the shutting off of the steam to the engine, so that there will be no danger of breakage from delay in stopping.

It further consists of novel details of construction, all as will be hereinafter fully set forth, and particularly pointed out in the claims.

Figures 1 and 2 represent plan views of certain portions of a rolling-mill embodying our invention. Fig. 3 represents a side elevation of a portion of the gearing seen in Fig. 1. Fig. 4 represents a partial side elevation and partial vertical section of certain of the parts seen in Fig. 1, the section being taken on line $x\,x$, Fig. 1. Fig. 5 represents a partial side elevation and partial vertical section of certain of the parts seen in Fig. 2, the section being taken on line $y\,y$ Fig. 2. Fig. 6 represents a side elevation of certain of the parts seen in Fig. 2. Fig. 7 represents a plan view, on a reduced scale, of certain of the parts shown in Figs. 1 and 2 and the manner of driving the gearing in order to impart motion to the several rolls, which latter, however, are omitted for the sake of clearness of illustration. Fig. 8 represents, on an enlarged scale, an end elevation, partly in section, of a guide employed in connection with our invention. Fig. 9 represents, on a reduced scale, a side elevation, partly in section, of the parts seen in Fig. 8. Fig. 10 represents an end elevation of a pair of rolls and frame in which the same are journaled and a portion of the mechanism for operating the lid of the guide seen in Figs. 8 and 9. Fig. 10^a represents a vertical section of a three-way cock employed in connection with our invention. Fig. 10^b represents a sectional view of the parts seen in Fig. 10^a with the plug shown in a different position from that

seen in Fig. 10ª. Fig. 11 represents a front elevation of the parts seen in Fig. 10. Fig. 12 represents an end elevation of a pair of rolls and frame in which the same are journaled and also the mechanism for adjusting the draft of said rolls. Fig. 13 represents a front elevation of the parts seen in Fig. 12. Fig. 14 represents a front elevation of a pair of rolls and their adjuncts. Fig. 15 represents, on an enlarged scale, a vertical section of portions of a pair of rolls employed. Fig. 16 represents a partial side elevation and partial vertical section of the mechanism for starting and stopping the mills, the section being taken on line $z\ z$ in Fig. 17. Fig. 17 represents a plan view of certain of the parts seen in Fig. 16. Fig. 18 represents a partial end elevation and partial vertical section of certain of the parts seen in Fig. 17, the section being taken on line $z'\ z'$ in Fig. 17. Fig. 19 represents a plan view of the driving mechanism for the rolls of the mill. Fig. 20 represents a plan view of a modification of the driving mechanism seen in Fig. 19. Fig. 21 represents an end elevation of certain detached portions of the mill. Fig. 22 represents an end elevation of a pair of rolls and portions of the mechanism for indicating the speed of said rolls and that of a bar passing between them. Fig. 23 represents a partial front elevation and partial vertical section of the parts seen in Fig. 22, the section being taken on line $z^2\ z^2$ in Fig. 22. Fig. 24 represents a front elevation of the speed-indicator seen in Figs. 22 and 23. Fig. 25 represents a vertical section, on an enlarged scale, of portions of a pair of rolls, showing the axial movement imparted to a billet during its progression.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings, 1 designates a rolling-mill, which in the present instance consists of two distinct sets of frames $1^{\times}$, as seen at 2 and 3 in Figs. 1, 2, and 7, said frames having journaled therein the rolls 4 to 11, inclusive, and which constitute the lower or bottom rolls of the series, it being evident that the rolls are worked in pairs, consisting of a top and a bottom roll.

The shaft $4^{\times}$, which may be coupled to the shaft $4^{\times\times}$ of the roll 4, may likewise be coupled to a shaft $5^{\times}$, journaled in the standards $6^{\times}$ and having secured thereon a spur-gear $5^{\times\times}$, driven by an idler $7^{\times}$, secured to a shaft $8^{\times}$, journaled in the standards $6^{\times}$, it being noted that the shaft $8^{\times}$ has also secured thereto a gear-wheel $9^{\times}$, which is driven by a pinion $10^{\times}$ on the main driving-shaft $11^{\times}$ for the rolls journaled in the set 2 of frames $1^{\times}$.

The shaft 12 of the roll 5 may be coupled in any well-known manner to a shaft $12^{\times}$ and the latter to a shaft $12^{\times\times}$, which has secured thereto a spur-gear $13^{\times}$, which is driven by the idler $7^{\times}$.

The shaft 13 of the roll 6 may be coupled to a shaft $14^{\times}$, likewise coupled to a shaft $14^{\times\times}$, which has firmly secured thereon a gear-wheel $15^{\times}$, with which meshes a gear-wheel $16^{\times}$, secured to a shaft $17^{\times}$, which latter also carries an idler $18^{\times}$, driven by the pinion $10^{\times}$.

The shaft $19^{\times}$ of the roll 7 may be coupled to a shaft $20^{\times}$ and the latter to a shaft $20^{\times\times}$, which has secured thereon a gear-wheel $21^{\times}$, driven by the idler $18^{\times}$.

It will be apparent that the number of teeth in each of the gear-wheels hereinbefore referred to may be such relatively to each other that the proper speed may be imparted thereby to the rolls 4 to 7, inclusive.

The shafts $4^{\times}$, $12^{\times}$, $14^{\times}$, and $20^{\times}$ each carry a pinion $22^{\times}$, which meshes with a similar pinion (which is not shown in the drawings for the sake of clearness of illustration) on each of a number of shafts located directly above said shafts $4^{\times}$, $12^{\times}$, $14^{\times}$, and $20^{\times}$, so that the motion imparted to the said shafts $4^{\times}$, $12^{\times}$, $14^{\times}$, and $20^{\times}$ will be transmitted to the shafts located above them, so that the same may impart motion in the usual manner to the shafts $23^{\times}$ of the top or upper rolls $23^{\times\times}$ of each pair of rolls.

The lower roll 8 of a pair of rolls is driven by a gear-wheel 12, secured to a shaft 13, journaled in the standards 14, it being noted that said gear-wheel is driven by an idler or pinion 15, secured to a shaft 16, journaled in the standards 14.

The lower rolls 9 of a pair of rolls is driven by a gear-wheel 17, secured to a shaft 18, journaled in standards 14, it being noted that said gear-wheel 17 is driven by the idler 15.

The shaft 16 has secured thereon a gear-wheel 19, which is driven by a gear-wheel 20, secured to the main driving-shaft 21 for the rolls journaled in the set 3 of frames $1^{\times}$.

The lower roll 10 of a pair of rolls is driven by a gear-wheel 22, secured to a shaft 23, journaled in the standards 14, it being noted that said gear-wheel 22 is driven by an idler 24, secured to a shaft 25, journaled in the standards 14.

The lower roll 11 of a pair of rolls is driven by a gear-wheel 26, secured to a shaft 27, journaled in the standards 14, it being noted that said gear-wheel 26 is driven by the idler 24.

The shaft 25 has secured thereon a gear-wheel 28, which is driven by the gear-wheel 20 on the main driving-shaft 21.

Journaled in the frames $1^{\times}$ of the set 3 of frames are the shafts 29, 30, 31, and 32, each of which carries a pinion 33, the object of which is substantially the same as that described in connection with the pinions $22^{\times}$.

The shaft 34 of the roll 8 may be coupled to the shaft 29, and the latter may be coupled to the shaft 13, and likewise the shaft 35 of the roll 9 may be coupled to the shaft 30, and the latter may be coupled to the shaft 18 in any well-known manner.

The shaft 36 of the roll 10 and the shaft 37 of the roll 11 may be coupled in any well-known manner to the shafts 31 and 32, re-

spectively. The shaft 31 may be coupled to the shaft 23 and the shaft 32 may be coupled to the shaft 27, so that the gear-wheels 22 and 26 will impart motion to the rolls 10 and 11, respectively.

The main driving-shafts $11^{\times}$ and 21 may be driven by the mechanism seen in Fig. 19, it being noted that said shafts are provided with cranks 38, which are operated by the pistons 39 in the cylinders 40, it being understood that said cylinders are provided with the customary inlet and exhaust ports, valves, gear, &c., which are not shown in the drawings, since the same form no part of the present invention.

If desired, the cranks 38 of the shaft 21 and parts between them and the cylinders 40 may be dispensed with, and in lieu thereof pulleys 41 and 42 may be secured to the shafts $11^{\times}$ and 21, respectively, and a belt 43 passed around said pulley, so that the motion imparted to the shaft $11^{\times}$ by the pistons 39 may be transmitted to the shaft 21 through the medium of said belt 43, as will be seen in Figs. 7 and 20, it being of course understood that a single or double acting engine may be employed, as may be desired.

In Fig. 7 a portion of the driving mechanism seen in Fig. 19 is shown in dotted lines, as at *a*, it being understood that said portion shown dotted corresponds to the parts seen in full lines on the right-hand side of Fig. 19 and beyond the cylinders 40, it being evident that when the four sets of cranks 38 are employed the belt 43 may be dispensed with.

It will be evident that, if desired, an additional pulley may be applied to either or both the shafts $11^{\times}$ and 21, whereby power can be transmitted by a belt therefrom to another mill or set of rolls similar to that indicated at 2 and 3. It will also be apparent that, if desired, when a double-acting engine is employed to actuate the shafts $11^{\times}$ and 21 the belt 43 (seen in Fig. 7) can be dispensed with and power transmitted from the pulleys 41 and 43 to other mills or sets of rolls.

The stopping mechanism for the main driving-shafts $11^{\times}$ and 21 consists of a clutch 44, carried by each of said shafts, as best seen in Figs. 16 and 17.

The shafts $11^{\times}$ and 21 are each formed in two lengths, one length of each of said shafts having firmly secured thereto the member 45 of a clutch 44, while the other length of each of said shafts carries the members 46 of a clutch 44, said member 46 being adapted to slide longitudinally on the length of shaft which carried the same and being mounted thereon in such a manner that when a rotary motion is imparted to said member 46 it will transmit a similar motion to the length of shaft on which it is mounted.

The member 46 of a clutch 44 is provided with a projection 47, with which engages at certain times a wedge 48, forming part of an arm 49, secured to a shaft 50, journaled in suitable supports 51. Either of the arms 49 may be operated by a cord, chain, &c., 52, and the motion imparted to one of said arms 49 will be transmitted to the other by reason of the link 53, which connects both of said arms 49. The link 53 also operates a bell-crank lever 54, so that the latter may either open or close the throttle-valve 55, according to the position of said bell-crank lever.

Each shaft 50 has secured thereto an arm 56, which operates a link 57, connected to a wedge 58, so that motion from either arm 49 may be transmitted to said wedge 58, for a purpose to be hereinafter described.

59 designates levers adapted to operate the members 46 of the clutches 44, so as to cause them to either engage with or be disconnected from the members 45 of the clutches 44, according to requirements.

Each lever 59 is retained in its normal position by a stop 60, pivoted to a lever 61, which, as seen in Fig. 18, is freely suspended in a frame 62, it being noted that the lever 61 is operated by the wedge 58, for a purpose hereinafter explained.

The mechanism for adjusting the draft of a pair of rolls consists of a shaft 63, journaled in ears 64, swiveled in the screw-threaded stems 65, each of which has a bevel gear-wheel 66 secured thereon, it being noted that the bevel gear-wheels 66 mesh with the bevel gear-wheels 67, secured to the shaft 63, the latter being each provided with a wheel 68 for rotating the same. The top or upper journal-boxes of each pair of rolls are kept at all times in contact with the lower extremities of the stems 65 by the mechanism seen in Fig. 12, and which consists of the levers 69, operated by the weight 70 and in such a manner as to cause the bars or brackets 71, on which the top or upper journal-boxes rest, to keep the latter at all times in contact with the stems 65.

It will be seen on referring to Fig. 21 that the under side of the bevel gear-wheel 66 acts as an abutment for one extremity of a lever 72, fulcrumed, as at 73, to the frame $1^{\times}$, it being noted that said lever 72 acts as a pointer for indicating, in connection with the graduated scale 74, the draft of the rolls journaled in the frame $1^{\times}$, as seen in said Fig. 21.

In practice a draft-indicating device similar to that just described is employed with each pair of rolls.

In Fig. 22 is shown a device for indicating the speed of the rolls $23^{\times\times}$ and 75 and that of the bar 76 being drawn between them, said device consisting of an arm 77, pivoted, as at 78, to any suitable support, as at 79, it being noted that said arm 77 has journaled in one extremity thereof a roller 80, which contacts with the roll $23^{\times\times}$ and receives motion from the same when the latter is in operation, said support 79 being inserted in the opening $77^{\times}$ when the indicator is in operation. The other extremity of the arm 77 has loosely fitted therein a box 81, in which is journaled the roller 82, which is in contact with the bar 76, it being apparent that said bar 76 in being

drawn from one pair of rolls to the next pair will impart during its progression a rotary motion to said roller 82 and that the latter will not be interfered with by any irregularities in the bar 76, as the box 81 may accommodate itself to such irregularities by raising and lowering in the slot 83 more or less, according to the extent of the irregularities in the bar 76, should such exist. The rotation of the roller 82 is transmitted to a worm 84, which operates a worm-wheel $84^{\times}$, secured to a shaft 85, which carries a finger or pointer 86 for indicating the speed of the roller 82, and consequently that of the bar 76, the dial 87 of the speed-indicator (seen in Fig. 24) being stationary, and it being understood that the roller 80 operates parts which correspond substantially to those bearing the numerals 84, 85, 86, and 87. (Seen in Fig. 24.)

It will of course be understood that the indicating device seen in Figs. 22 to 24, inclusive, can be applied with equal readiness to the receiving pair or delivery pair of rollers without departing from the spirit of our invention.

When a bar 76 in passing from one pair of rolls to the next pair leaves a roller 82 the latter, as also the extremity of the arm 77, which carries the same, drops by gravity, and said roller 82 will come in contact with a stationary guide 88 for a bar 76, said guide serving also as a brake to stop the rotary motion imparted to a roller 82 by a bar 76. It will be apparent that when the extremity of the arm 77 which carries the roller 82 drops its opposite extremity, which carries the roller 80, will rise, and in so doing will cause said roller 80 to come in contact with a brake 89, which stops the rotation of the roller 80 as imparted to the same by a roll, as $23^{\times\times}$. The object in stopping the rollers 80 and 82, as hereinbefore described, and immediately after a bar 76 has been drawn from between a pair of rolls, such as $23^{\times\times}$ and 75, is to prevent the rollers 80 and 82 from rotating after a bar 76 has left a roller 82, it being apparent that if the brakes 88 and 89 were not employed the momentum of the rollers 80 and 82 would carry their respective fingers or points 86 beyond the desired point, and thereby fail to indicate the correct speed of said rollers as imparted thereto by the roll $23^{\times\times}$ and bar 76, respectively. The guides 88 are secured to their respective frames $1^{\times}$ in the usual manner.

The portion 90 of the bottom roll (seen in Fig. 15) illustrates the manner of forming the grooves therein, so as to produce flat bars when working in connection with the roll $23^{\times\times}$, (seen in said Fig. 15,) it being apparent that by providing the roll $23^{\times\times}$ with a tongue and the roll 90 with a groove in substantially the manner indicated and in addition shaping the recesses on either side and providing overlapping joints, substantially as shown, the liability of bars when passing between the rolls of being carried around by sticking to either of said rolls $23^{\times\times}$ or 90 is entirely removed, it being also apparent that it is not necessary to turn the bar, as the joints in the rolls are reversed as the bar progresses through the same.

91 designates a guide, (best seen in Figs. 8 and 9,) the same consisting of a stationary lower V or similar shaped portion 92 and lids 93 and 94, hinged thereto, as at $94^{\times}$, it being noted that said guide 91 is given an axial turn or twist, as best seen in Fig. 9, the object of said twist being to so turn a bar, as 76, for instance, when passing from one pair of rolls to the next pair that the forward end of said bar may be so deflected by the twist in the guide 91 that said forward end may be brought in the proper position to enter the grooves $92^{\times}$ (shown in dotted lines in Fig. 25) in a pair of rolls, which receive the grooves $93^{\times}$ in the rolls $23^{\times\times}$ and 94, (seen in said Fig. 25,) it being noted that the axis *c* of the grooves $92^{\times}$ does not coincide with the axis *d* of the grooves $93^{\times}$; but said axes are so disposed relatively to each other that they lie in different planes.

The explanations in connection with the grooves $92^{\times}$ and $93^{\times}$ apply also to the grooves 95 and 96, (seen in Fig. 25,) and one or more guides 91 may be located between each pair of rolls, so as to guide one or more bars from the grooves in any one pair of rolls to the grooves in the next pair, and so on throughout the entire series of rolls.

We desire to call especial attention to the fact that the unrecessed portions of the peripheries of the rolls $23^{\times\times}$, 4, and 11, &c., which extend from the working grooves of said rolls toward the frame $1^{\times}$, are cylindrical or of substantially uniform diameter, whereby another set of grooves can be cut therein, so that the rolling can be done with equal facility, which is not the case when conical rolls are employed.

We also desire to emphasize another function attained by rolls constructed substantially as seen in Figs. 13 and 14, since it will be apparent that when it is desired to roll bars of different sizes the desired adjustment can be readily made by shifting each roll longitudinally. For instance, if the roll $23^{\times\times}$ is shifted to the left and the roll 11 to the right it will be seen that while the thickness of the bar in one direction remains unchanged its dimensions in the opposite direction have increased, a function which cannot be effected by conically-grooved rolls. In like manner it will be apparent that by separating and longitudinally shifting in opposite directions the rolls seen in Fig. 15 the same effect is attained as has been above explained. The means for enabling the boxes of the rolls to be longitudinally shifted, being well known to those skilled in this art, is believed to require no further description, since the same *per se* forms no part of the present invention.

The lids 93 and 94 have pivoted thereto the catches 97 and 98, respectively, said catch 97 engaging a lug 99 on the lid 94 and the catch 98 engaging a lug 100 on the lid 93, so as to prevent said lids 93 and 94 from opening except at the proper time. The catches 97 and

98 are each provided with a hook 101 for connecting the catch 97 to an arm 102 and the catch 98 to an arm 103, it being noted that the arms 102 and 103 are secured to a crank-shaft 104, journaled in a standard $104^{\times}$ and connected by means of a link 105 to a piston-rod 106, so that the latter when moving in the direction indicated by the arrow *e* in Fig. 9 may rock the crank-shaft 104, and thereby open the lids 93 and 94 by exerting a pull upon the hooks 101, which latter in turn cause the catches 97 and 98 to rotate on their pivots 107, and thereby release their hold on the lugs 99 and 100, and when said catches come in contact with the blocks 108 they can no longer rotate on their pivots 107, and consequently the catch 97 and lid 93 at this period move as one on a hinge $94^{\times}$ and for a purpose to be hereinafter described.

Journaled in each frame $1^{\times}$ is a shaft 109, (see Figs. 10 and 11,) which has secured thereto the arms 110 and 111, the latter being connected by means of a link 112 to an arm 113, secured to the plug 114 of a three-way cock 115, so that the latter may be either opened or closed by the action of the arm 110, as is evident. The cock 115 has connected thereto the pipes 116, 117, and 118, it being noted that the pipe 117 leads from the cock 115 to the steam-cylinder 119, within which the piston 120 of the piston-rod 106 is located.

The operation is as follows: The wheels 68 (seen in Figs. 12, 13, and 14) are rotated by hand in one direction or the other until a pointer 72 (seen in Fig. 21) registers with a desired notch or graduation $72^{\times}$ on the scale 74, and when said pointer coincides with the desired graduation the rotation of the wheel 68 is stopped, it being understood that each frame $1^{\times}$ of the mill is provided with a wheel 68 and registering mechanism connected therewith, as described. The rotation of a wheel 68 in one direction or another will regulate the draft of a pair of rolls employed in connection therewith. It will be apparent that when the clutch mechanism seen in Figs. 16 and 17 is in the position seen in Fig. 17 the several pairs of rolls in the mill 1 will be in operation, and a bar 76 to be worked is then fed to the rolls 4 and $23^{\times\times}$, (see Figs. 1 and 13,) said bar being fed by the latter to the roll 5 and a roll $23^{\times\times}$, located above the same, the latter pair of rolls feeding the bar 76 to the next pair of rolls, and so on throughout the entire series, and after a bar 76 has been drawn between the last pair of rolls 11 and $23^{\times\times}$ (see Figs. 2 and 14) it is finished and may be transferred to any desired point. When it is desired to stop the rolls, either cord 52 (best seen in Fig. 16) is pulled in the direction indicated by the arrows *f*, thereby causing the wedges 48 to be brought in the path of the projections 47, and thereby separate the members 46 of the clutches 44 from the members 45 thereof, and thus stop all the rolls in the mill 1 at the same instant. A pull upon either cord 52 will cause the wedges 58 to move in the present instance from right to left, and in so doing will cause each arm 61 (seen in Figs. 16 and 18) to turn on its axis $61^{\times}$, and thereby cause the stop 60, pivoted thereto, to lower, so as to be withdrawn from the path of an arm 59, so that the latter may be free to turn on its axis $59^{\times}$, when a member 46 of a clutch 44 is separated from a member 45 by the action of a wedge 48. It is to be noted that the throttle-valve 55 will be closed simultaneously with the separation of the members 46 from the members 45 of the clutches 44, due to the bell-crank lever 54 and parts connected therewith and so clearly seen in Fig 16. When the forward end of a bar 76 comes in contact with an arm 110, it will cause the latter to rock its shaft 109 and cause the link 112 to lower, and thereby cause the plug 114 of the cock 115 to occupy the position seen in Fig. 10^{b}, and when said plug is in this position the live steam will flow through the pipes 116 and 117 and enter the cylinder 119 and cause the piston 120 therein to move in the direction indicated by the arrow *e* in Fig. 9, and thereby rock the shaft 104, and thus open the lids 93 and 94 of the guide or conveyer 91 at about the period that the bar or billet 76 hits the arm 110, so that said lids will not interfere with a bar 76 should the same bulge while passing between two sets of rolls, it being apparent that bulging of a bar 76 occurs when the same is fed by one pair of rolls faster than it is taken up by the next pair. When a bar 76 is no longer in contact with an arm 110, the latter will return of its own weight to its normal position, as seen in Figs. 10 and 11, and rotate the plug 114, so that the same will occupy the position seen in Fig. 10^{a}, and when in this position the steam in the cylinder 119 will escape through the pipe 117 and plug 114 and finally through the pipe 118 to the open air or any desired point, it being noted that when the plug 114 is in the position seen in Fig. 10^{a} the live steam in the pipe 116 is shut off from the pipe 117, and thereby permits the steam from the cylinder 119 to follow the course indicated by the arrows in said Fig. 10^{a}. When the steam has escaped from a cylinder 119, the lids 93 and 94 of a guide 91 close of their own weight and interlock automatically, and said lids in closing will rock the shaft 104, and thus cause the piston-rod to exert a pull on the piston 120 and in a direction opposite to that indicated by the arrow *e* in Fig. 9, and thereby return the piston 120 to its normal position, as seen in said Fig. 9.

It is to be understood that the draft regulating and indicating device seen in Figs. 12, 13, 14, and 21 and also the speed-indicating device seen in Figs. 22, 23, and 24 are employed in connection with each pair of rolls and that a guide 91 and connected parts seen in Figs. 8 and 9 is located between two adjacent pairs of rolls, so as to impart the proper

twist to a bar 76 for the purpose hereinbefore described.

It will be apparent that the speed-indicating device and also the guide 91, hereinbefore described, may be increased or diminished in number, according to the number of grooves in each pair of rolls.

Especial attention is called to the fact that we employ no bevel-gearing to transmit power from one set of rolls to the other, since only spur-gears are used, whereby the construction is greatly simplified throughout and more effective results are obtained than in prior devices where bevel-gears have been employed.

It will be evident that in the construction seen in Figs. 8 and 9 we need not in every instance employ cylinders containing a piston actuated by fluid-pressure, since the lids or covers 93 and 94 can be operated by means of an electric motor, cog-wheels, or a system of levers, the proper connections having been made thereto from the tripping mechanism seen in Fig. 10, and we do not therefore desire to be limited in every instance to the exact construction of the fluid-actuating mechanism we have shown in the present instance. It will also be understood that the arm 110 (seen in Fig. 10) may be located at other points without departing from the spirit of our invention.

Especial emphasis is laid upon the function attained by the indicating devices seen in Figs. 21 to 24, inclusive, it being understood that the same are operated in conjunction with each other, the reading or indication upon the dial or disk 24 being compared with the reading on the scale seen in Fig. 21, whereupon the necessary adjustment of the rolls relative to each other can be readily made. It will also be apparent that changes may be made in the details of the clutch mechanism seen in Figs. 16 to 18, inclusive, without involving a departure from our invention, the principal object thereof being to enable the main shafts $11^{\times}$ and 21 to be simultaneously thrown out of operation at the time the throttle-valve is closed. It will further be apparent that other changes may be made by those skilled in the art without departing from the spirit of our invention, and we do not therefore desire to be limited in every instance to the exact construction we have herein shown and described.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$, so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spur-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter gears being mounted on the shafts $5^{\times}$ and $12^{\times\times}$ respectively, which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears of rolls adjacent to said rolls 4 and 5, a spur-gear $16^{\times}$ secured to said shaft $17^{\times}$ and adapted to mesh with and drive the spur-gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear-wheel $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$, and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to the roll 7.

2. In a rolling-mill, a main driving-shaft 21, a spur-gear 20 secured thereon and adapted to mesh with the spur-gears 19 and 28 secured to the shafts 16 and 25 respectively, a pinion 15 secured to the shaft 16 and adapted to mesh with the spur-gears 12 and 17, whereby the two latter impart motion to the rolls 8 and 9 respectively, and to gears 33 mounted on the shafts 29 and 30, said gears 33 being adapted to mesh with and drive similar gears belonging to the rolls adjacent to said rolls 8 and 9, and a spur-gear 24 secured to the shaft 25, which carries said gear 28, and adapted to mesh with and drive the spur-gears 22 and 26, whereby the motion of the two latter may be imparted to the rolls 10 and 11 respectively, and also to the gears 33, the latter being secured to the shafts 31 and 32, and said gears 33 being adapted to drive similar gears belonging to the rolls adjacent to the rolls 10 and 11.

3. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$, so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spur-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter gears being mounted on the shafts $5^{\times}$ and $12^{\times\times}$ respectively, which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears of rolls adjacent to said rolls 4 and 5, a spur-gear $16^{\times}$ secured to said shaft $17^{\times}$ and adapted to mesh with and drive the spur-gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear-wheel $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$ and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to the roll 7, in combination with an engine-cylin-

der, a piston and piston-rod therein and connections common to said rod and shaft $11^{\times}$, for operating the latter.

4. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$ so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spur-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter gears being mounted on the shafts $5^{\times}$ and $12^{\times\times}$ respectively, which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears and rolls adjacent to said rolls 4 and 5, a spur-gear $18^{\times}$ secured to said shaft $17^{\times}$, a gear $16^{\times}$ carried by the shaft $17^{\times}$ and adapted to mesh with and drive the gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear-wheel $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$ and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to the roll 7, in combination with a crank-shaft 21, gearing and rolls actuated thereby, a double-acting engine located between said shafts and connections from the piston-rods of said engines, to each of said crank-shafts, the latter having pulleys thereon for transmitting power from said shafts.

5. In a rolling-mill, a crank-shaft $11^{\times}$ having a pulley thereon, a spur-gear $10^{\times}$ mounted thereon and in mesh with spur-gears $9^{\times}$ and $18^{\times}$, a shaft $8^{\times}$ on which the gear $9^{\times}$ is mounted, a gear $7^{\times}$ also mounted on said shaft $8^{\times}$, gears $5^{\times\times}$ and $13^{\times}$ meshing with said gear $7^{\times}$, means for transmitting power from the gears $5^{\times\times}$ and $13^{\times}$ to rolls 4 and 5, a shaft $17^{\times}$ on which the gear $18^{\times}$ is mounted, a gear $16^{\times}$ mounted on said shaft $17^{\times}$, a gear $15^{\times}$ in mesh with said gear $16^{\times}$, rolls 6 and 7, power-transmission devices for actuating the latter rolls and also other rolls located in proximity to said rolls 4, 5, 6 and 7, a crank-shaft 21, having a pulley mounted thereon, a spur-gear 20 mounted on said shaft 21, a gear 19 in mesh with the gear 20, a shaft 16 carrying said gear 19 and also a gear 15, gears 12 and 17 meshing with said gear 15, shafts 13 and 18 carrying said gears 12 and 17 respectively, rolls 8 and 9, means for actuating said rolls from said shafts 13 and 18 respectively, a gear 28 in mesh with said gear 20, a gear 24, a shaft on which said gears 28 and 24 are mounted, gears 22 and 26 in mesh with said gear 24, shafts 23 and 27 on which said gears 22 and 26 are mounted, rolls 10 and 11 adapted to be actuated from said shafts 23 and 27, other rolls located in proximity to said rolls 8, 9, 10 and 11, means for actuating said other rolls, a double-acting engine located intermediate said crank-shafts $11^{\times}$ and 21 and connections from the piston-rods of said engine to said crank-shafts.

6. In a rolling-mill, a plurality of main shafts, a throttle-valve controlling fluid-pressure by means of which said shafts are operated, clutches mounted on said shafts, each clutch consisting of a plurality of members having a projection thereon, wedges adapted to contact with said projections so as to separate said clutch members, means for operating said wedges in unison, and connections common to said means and throttle-valve.

7. In a rolling-mill, a plurality of main shafts, clutches common thereto, said clutches consisting of members 45 and 46, each of the latter having the projection 47 thereon, levers suitably fulcrumed and provided with wedges adapted to be brought into contact with said projections so as to separate said clutch members, a link common to said levers, devices for rendering the clutch-shifting mechanism temporarily inoperative, a lever suitably fulcrumed in proximity to said clutches and operated in unison therewith, a throttle-valve and connections common to said lever and throttle-valve.

8. In a rolling-mill, an indicator device, the same consisting of rollers rotatably supported, the journals of one of said rollers being mounted in a movable box, worms movable in unison with the journals of said rollers, gears suitably supported and actuated by said worms, a registering device adjacent said gears, and braking devices for said rollers.

9. In a rolling-mill, the clutches 44 consisting of the members 45 and 46, each of the latter having the projection 47 thereon, the wedges 48 adapted to be brought in contact with said projections so as to separate said members, a link common to a pair of said wedges, whereby the latter can be moved in unison, levers adapted to be operated by the members 46, pins 60 for retaining said levers in their normal positions, wedges 58 for removing said pins from the path of the levers 59, and a lever suitably fulcrumed and operated by said link, a throttle-valve and connections common to said valve and lever.

10. In a rolling-mill, a device for ascertaining the relative draft of a bar of metal as compared with the speed of the rolls operating thereupon, said device consisting of a plurality of rollers suitably supported, one of said rollers being adapted to be applied to one of the rolls and the other to said bar, and an indicating device for each of said rollers and operated thereby.

11. In a rolling-mill, the rollers 80 and 82 rotatably supported and adapted to indicate the relative speed of a pair of rolls to that of the metal being drawn between the same, speed-registering devices operated by said rollers, and brake devices for the latter.

12. In a rolling-mill, a plurality of sets of rolls, having diamond or V shaped grooves

therein, the grooves of an alining set of rolls having their axes turned at an angle to each other, a trough-shaped axially-turned guide located intermediate said rolls for the purpose of turning the metal during its progress therebetween, lids attached to said guide, levers pivoted to said lids for opening and closing the latter, an arm adapted to be operated by the metal when the latter is being drawn between said rolls and devices intermediate said arm and levers whereby said lids are operated at proper intervals.

13. In a rolling-mill, a plurality of rolls, frames or housings therefor, threaded stems mounted in the upper portion of the latter, bevel-gears carried by said stems, a shaft also provided with bevel-gears in mesh with said first-mentioned gears, a pointer operated by the adjustment of one of said stems, and a graduated scale adjacent said pointer in combination with an indicator provided with rollers, means for supporting said indicator so that one of said rollers shall contact with a roll while the other of said rollers contacts with the metal which is being rolled, and indicating devices attached to said rollers and adapted to be operated in conjunction therewith, the readings upon said scale and indicating device being adapted to be compared with each other.

14. In a rolling-mill, a pointer operated by the adjustment of the journal-boxes of an upper roll, and a scale adjacent said pointer, in combination with an indicating device provided with rollers one of which is adapted to contact with a roll and the other with the metal which is being rolled, said rollers having indicating devices attached thereto.

15. In a rolling-mill, an axially-turned guide, lids hinged to said guide, levers pivotally mounted on said lids, blocks on said lids adapted to form stops for said levers, interlocking devices common to the ends of said levers and said lids, a movable arm adapted to be operated by the metal in the act of rolling and devices intermediate said arm and said levers, whereby the rocking of said arm operates said levers and lids.

16. In a rolling-mill, a guide adapted to turn the metal during its progression between a pair of adjacent rolls, said guide consisting of a trough, lids hinged to each side and extending longitudinally thereof, levers pivotally mounted on said lids, interlocking devices common to said levers and lids, means for closing said lids and means for automatically actuating said levers, so as to unlock the latter and open said lids.

17. In a rolling-mill, a guide adapted to turn the metal during its progress through a pair of rolls, the latter having grooves therein in different planes, lids pivoted to said guide, levers pivoted to said lids, connections from the levers to a crank-shaft, a cylinder having a piston therein, connections common to said piston and crank-shaft, a fluid-pressure pipe provided with a throttle-valve leading into one end of said cylinder, and means for causing said fluid-pressure to be introduced into said cylinder at a point prior to the entrance of the billet into its guide.

18. In a rolling-mill, a guide adjusted to turn the metal as it passes through the same, so as to bring the forward end of the metal in alinement with grooves whose axes are in different planes from those of the grooves of the feeding cylindrical rolls, hinged lids attached to said guide, levers pivoted to said lids and adapted to open and close the same, devices actuated by fluid-pressure for operating said lids, a valve controlling said fluid-pressure, an arm adapted to be operated by the metal when the latter is being drawn between the rolls, and connections common to said arm and valve whereby said lids may be operated at the proper intervals.

19. In a rolling-mill, a plurality of sets of cylindrical rolls each having grooves therein, the axes of said grooves being turned at an angle to each other, guides located intermediate each pair of rolls, said guides being turned axially for the purpose of imparting an axial movement to the metal which is being rolled, lids pivotally attached to the sides of said guides, means for automatically opening and closing said lids, and interlocking devices for the latter.

20. In a rolling-mill, a plurality of rolls, a plurality of main shafts by which said rolls are actuated, clutch mechanism common to said rolls, a throttle-valve controlling the engine operating said main shafts, means for operating said clutch mechanism and throttle simultaneously, guides intermediate said rolls, lids for said guides, and means for automatically opening and closing said lids.

21. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$, so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spur-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter gears being mounted on the shafts $5^{\times}$ and $12^{\times\times}$ respectively which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears of rolls adjacent to said rolls 4 and 6, a spur-gear $16^{\times}$ secured to said shaft $17^{\times}$ and adapted to mesh with and drive the spur-gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear-wheel $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$, and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to the roll 7, in combination with an engine-cylinder, a piston and piston-rod therefor, connections

common to said rod and to cranks on said main shaft $11^{\times}$, a pulley mounted on the latter, another driving-shaft 21 suitably supported and adapted to actuate a set of rolls, a pulley mounted on said shaft 21 and a belt or other power-transmission device common to said pulleys.

22. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$, so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spring-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter being mounted on the shafts $5^{\times}$ and $12^{\times\times}$, which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears of rolls adjacent to said rolls 4 and 6, a spur-gear $16^{\times}$ secured to said shaft $17^{\times}$ and adapted to mesh with and drive the spur-gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$ and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to said roll 7, in combination with a second main driving-shaft 21, a spur-gear 20 secured thereon and adapted to mesh with the spur-gears 19 and 28 secured to the shafts 16 and 25 respectively, a pinion 15 secured to the shaft 16 and adapted to mesh with the spur-gears 12 and 17, whereby the two latter impart motion to the rolls 8 and 9 respectively and to gears 33 mounted on the shafts 29 and 30, said gears 33 being adapted to mesh with and drive similar gears belonging to the rolls adjacent to said rolls 8 and 9, a spur-gear 24 secured to the shaft 25, which carries said gear 28 and adapted to mesh with and drive the spur-gears 22 and 26, whereby the motion of the two latter may be imparted to the rolls 10 and 11 respectively and also to the gears 33, the latter being secured to the shafts 31 and 32 and said gears 33 being adapted to drive similar gears belonging to the rolls adjacent to the rolls 10 and 11 and means for actuating said shafts $11^{\times}$ and 21.

23. In a rolling-mill, a main driving-shaft $11^{\times}$ having a spur-gear $10^{\times}$ secured thereon and adapted to mesh with and drive the spur-gears $9^{\times}$ and $18^{\times}$, so as to impart motion to their shafts $8^{\times}$ and $17^{\times}$ respectively, a spur-gear $7^{\times}$ secured to the shaft $8^{\times}$ and adapted to mesh with and drive the spur-gears $5^{\times\times}$ and $13^{\times}$, the latter being mounted on the shafts $5^{\times}$ and $12^{\times\times}$, which latter transmit power to the rolls 4 and 5 and to the spur-gears $22^{\times}$ mounted on the shafts $4^{\times}$ and $12^{\times}$, said gears $22^{\times}$ being adapted to drive similar gears of rolls adjacent to said rolls 4 and 6, a spur-gear $16^{\times}$ secured to said shaft $17^{\times}$ and adapted to mesh with and drive the spur-gear $15^{\times}$ connected to the shaft $14^{\times\times}$ and also the shaft $14^{\times}$ and the roll 6, the gear $22^{\times}$ on the shaft $14^{\times}$ being adapted to mesh with a similar gear actuating a roll located in proximity to the roll 6, a spur-gear $21^{\times}$ meshing with said gear $18^{\times}$ and secured to the shaft $20^{\times\times}$ and means for transmitting power from the gear $21^{\times}$ to the alining gear $22^{\times}$ on the shaft $20^{\times}$ and thence to the roll 7, said gear $22^{\times}$ being adapted to drive a similar gear belonging to the roll adjacent to said roll 7, in combination with a second main driving-shaft 21, a spur-gear 20 secured thereon and adapted to mesh with the spur-gears 19 and 28 secured to the shafts 16 and 25 respectively, a pinion 15 secured to the shaft 16 and adapted to mesh with the spur-gears 12 and 17, whereby the two latter impart motion to the rolls 8 and 9 respectively and to the gears 33 mounted on the shafts 29 and 30, said gears belonging to the rolls adjacent to said rolls 8 and 9, a spur-gear 24 secured to the shaft 25, which carries said gear 28 and adapted to mesh with and drive the spur-gears 22 and 26, whereby the motion of the two latter may be imparted to the rolls 10 and 11 respectively and also to the gears 33, the latter being secured to the shafts 31 and 32, and said gears 33 being adapted to drive similar gears belonging to the rolls adjacent to the rolls 10 and 11, an engine-cylinder located intermediate said main shafts $11^{\times}$ and 21, a piston and piston-rod for said cylinder, connections common to said piston-rod and to cranks on one of said main shafts, pulleys mounted on each of the latter and a belt or other power-transmission device common to said pulleys.

24. In a rolling-mill, a plurality of rolls, one of the latter having a tongue provided with inclined sides and walls extending at an obtuse angle therefrom on either side, said walls being continued and inclined outwardly, while the other of said rolls has a groove therein corresponding to the contour of said tongue and walls extending at an obtuse angle from the sides of said groove said walls being extended so as to overlap the contiguous walls of the adjacent roll.

25. In a rolling-mill, a plurality of rolls, a plurality of main shafts, gearing common to said shafts and rolls, mechanism for operating said shafts, clutch-shifting devices for the latter, a valve for controlling said mechanism and means for actuating said valve and clutch-shifting devices simultaneously.

26. In a rolling-mill, a plurality of rolls, a main shaft, gearing intermediate said rolls and shaft, mechanism for rotating said shaft, clutch-shifting devices whereby the rotation of said shaft can be controlled, a valve controlling said mechanism and means for actuating said valve and clutch-shifting devices simultaneously.

27. In a rolling-mill, a plurality of sets of cylindrical rolls, V-shaped grooves therein,

the axes of said grooves being turned at an angle to each other, trough-shaped axially-turned guides intermediate said rolls, lids pivotally attached to each side of said guides and extending longitudinally thereof, devices for locking said lids in closed position and means for automatically opening said lids.

28. In a rolling-mill, the combination with a plurality of sets of rolls of a trough-shaped axially-turned guide, lids pivotally attached to each side of the latter, devices for locking said lids in closed position and means for automatically unlocking and opening said lids.

29. In a rolling-mill, a shaft $11^{\times}$, a spur-gear $10^{\times}$ mounted thereon and in mesh with spur-gears $9^{\times}$ and $18^{\times}$, a shaft $8^{\times}$, on which the gear $9^{\times}$ is mounted, a gear $7^{\times}$ also mounted on said shaft $8^{\times}$, gears $5^{\times\times}$ and $13^{\times}$ meshing with the gear $7^{\times}$, means for transmitting power from the gears $5^{\times\times}$ and $13^{\times}$ to rolls 4 and 5, a shaft $17^{\times}$ on which the gear $18^{\times}$ is mounted, a gear $16^{\times}$ mounted on said shaft $17^{\times}$, a gear $15^{\times}$ in mesh with the gear $16^{\times}$ and power-transmission devices for rotating the roll 6, in combination with means for rotating the rolls arranged in proximity to said rolls 4, 5, and 6.

WILLIAM D. EYNON.
JOHN R. EYNON.

Witnesses:
WM. MCCARTER,
ALBERT HAGERMAN.