No. 612,010. Patented Oct. 11, 1898.

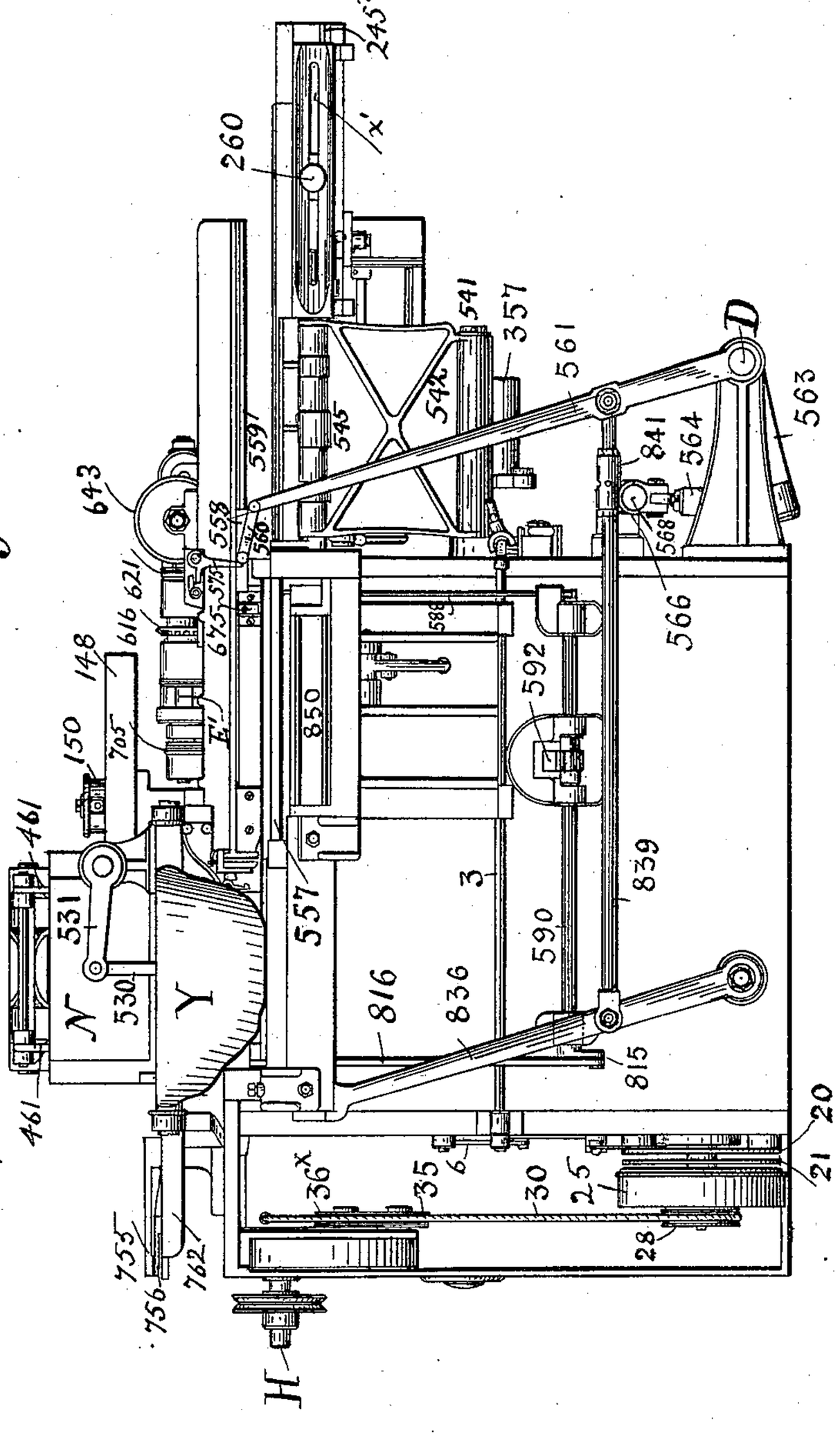
W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 1.

Fig. 1.



WITNESSES:

Henry V. Brown.

Reuben Hall.

INVENTOR

William Berri

BY

Walter O Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

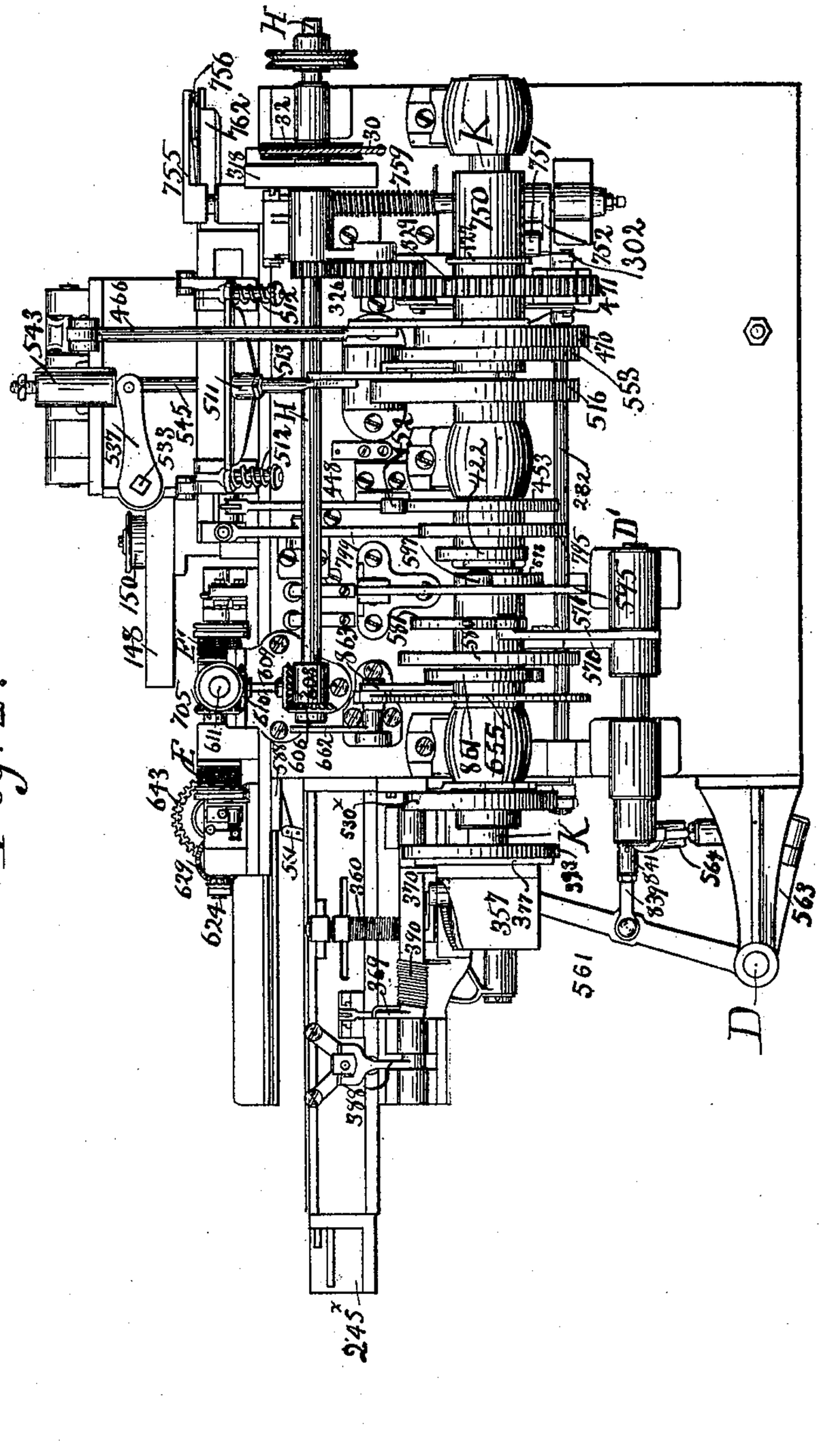
W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 2.

Fig. 2.



WITNESSES

Henry N. Brown.

Abraham G. Ketz.

William Berri INVENTOR.

BY

Walter Brown

his ATTORNEY

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 3.

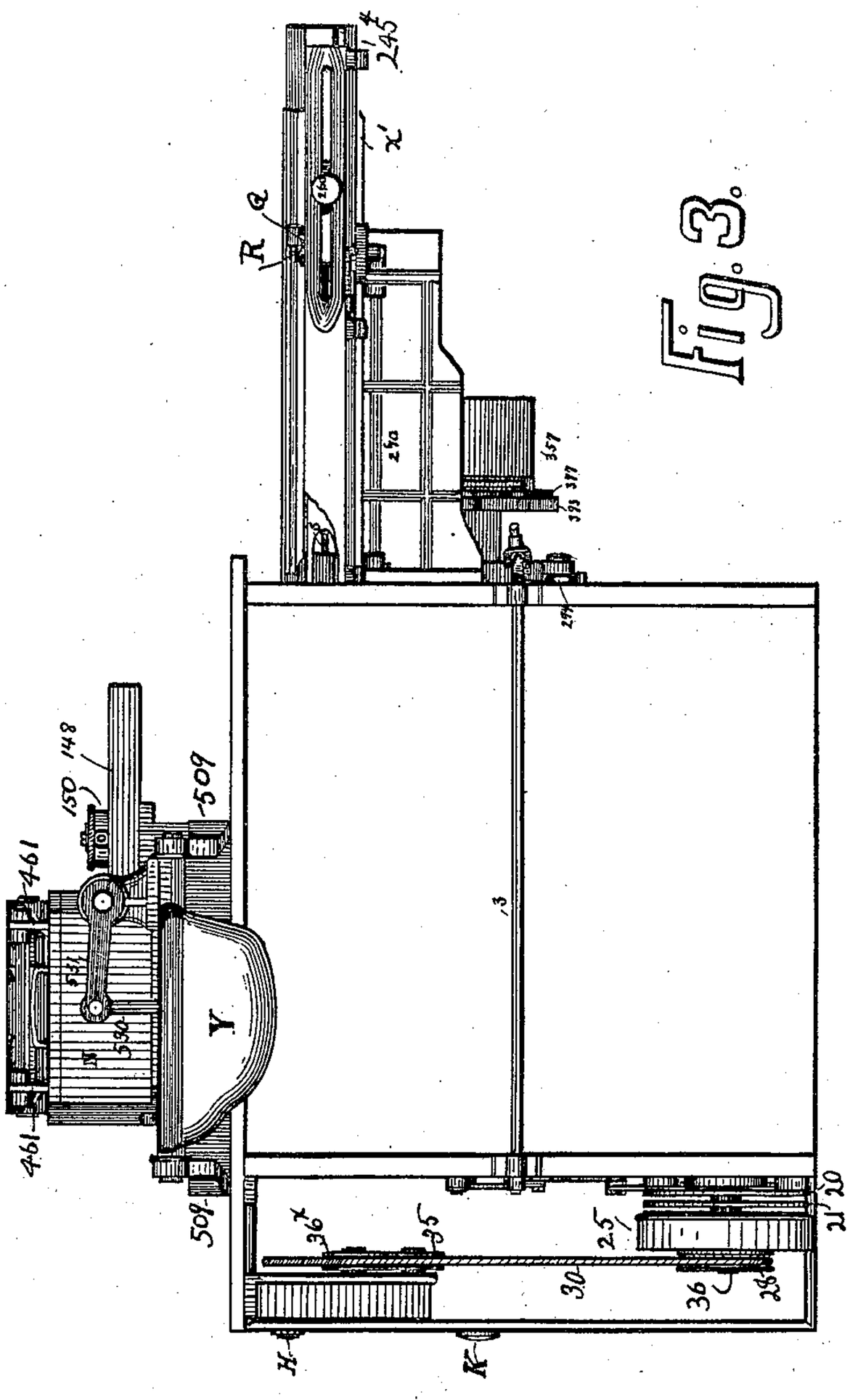


Fig. 3.

WITNESSES:
Henry V. Brown.
Reuben H. Katz.

INVENTOR
William Berri
BY
Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(No Model.) (Application filed Mar. 10, 1897.) 41 Sheets—Sheet 4.

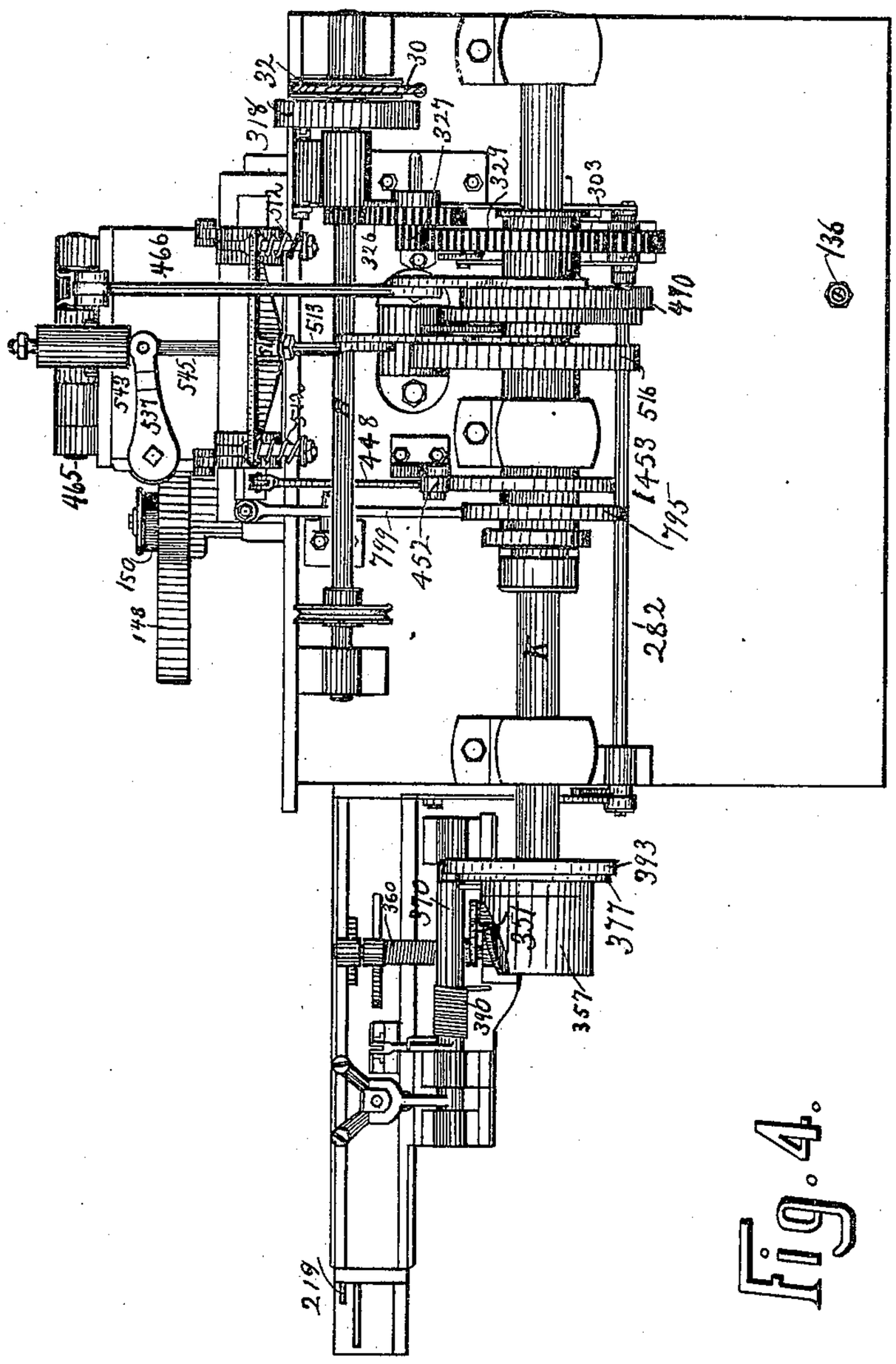


Fig. 4.

WITNESSES:
Henry V. Brown.
Reuben Wetzel.

INVENTOR
William Berri
BY
D. Walter Brown
HIS ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 5.

Fig. 5.

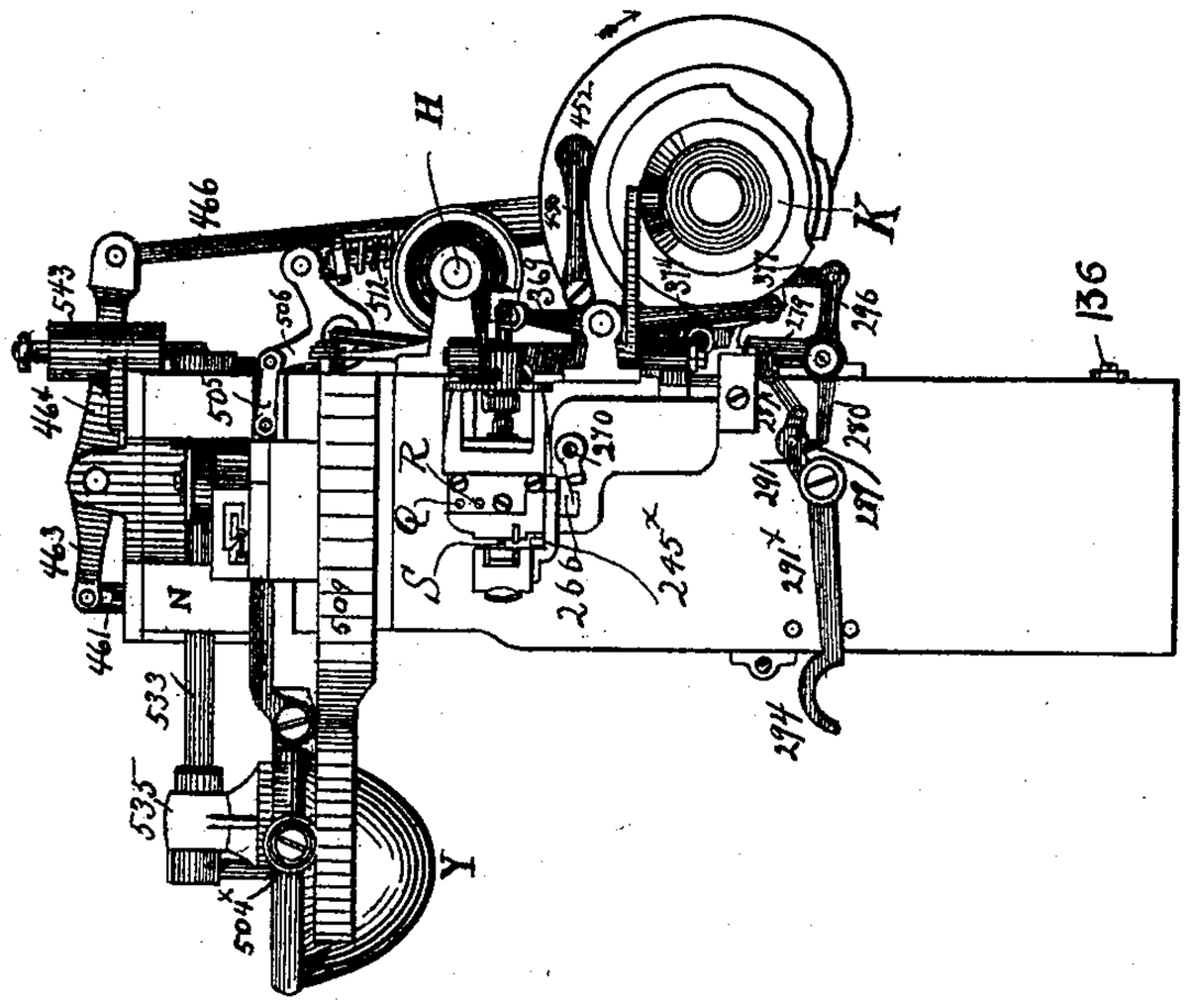
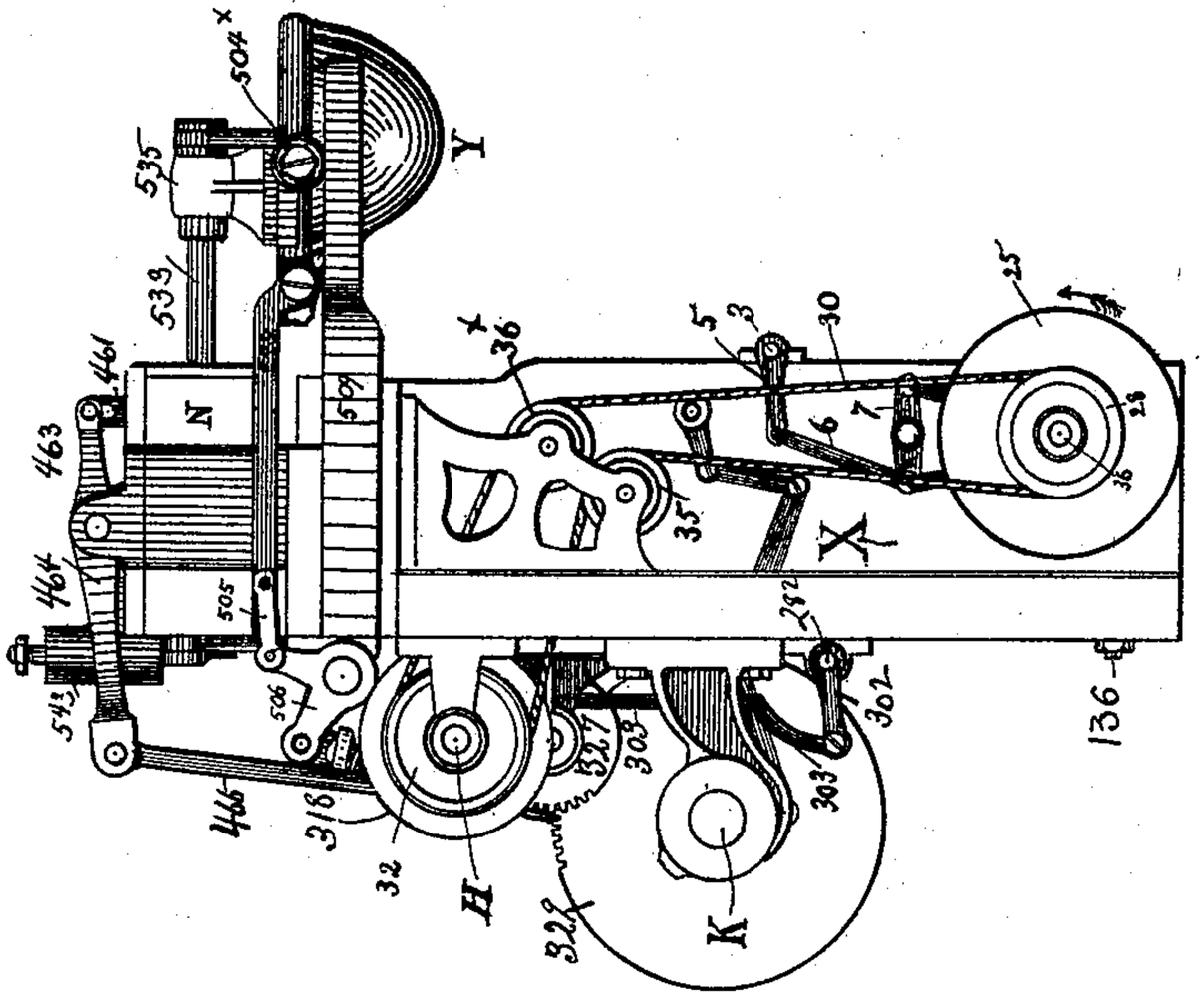


Fig. 6.



WITNESSES:
Henry V. Brown.
Reuben J. Katz.

INVENTOR
William Berri
BY
Walter Brown
His ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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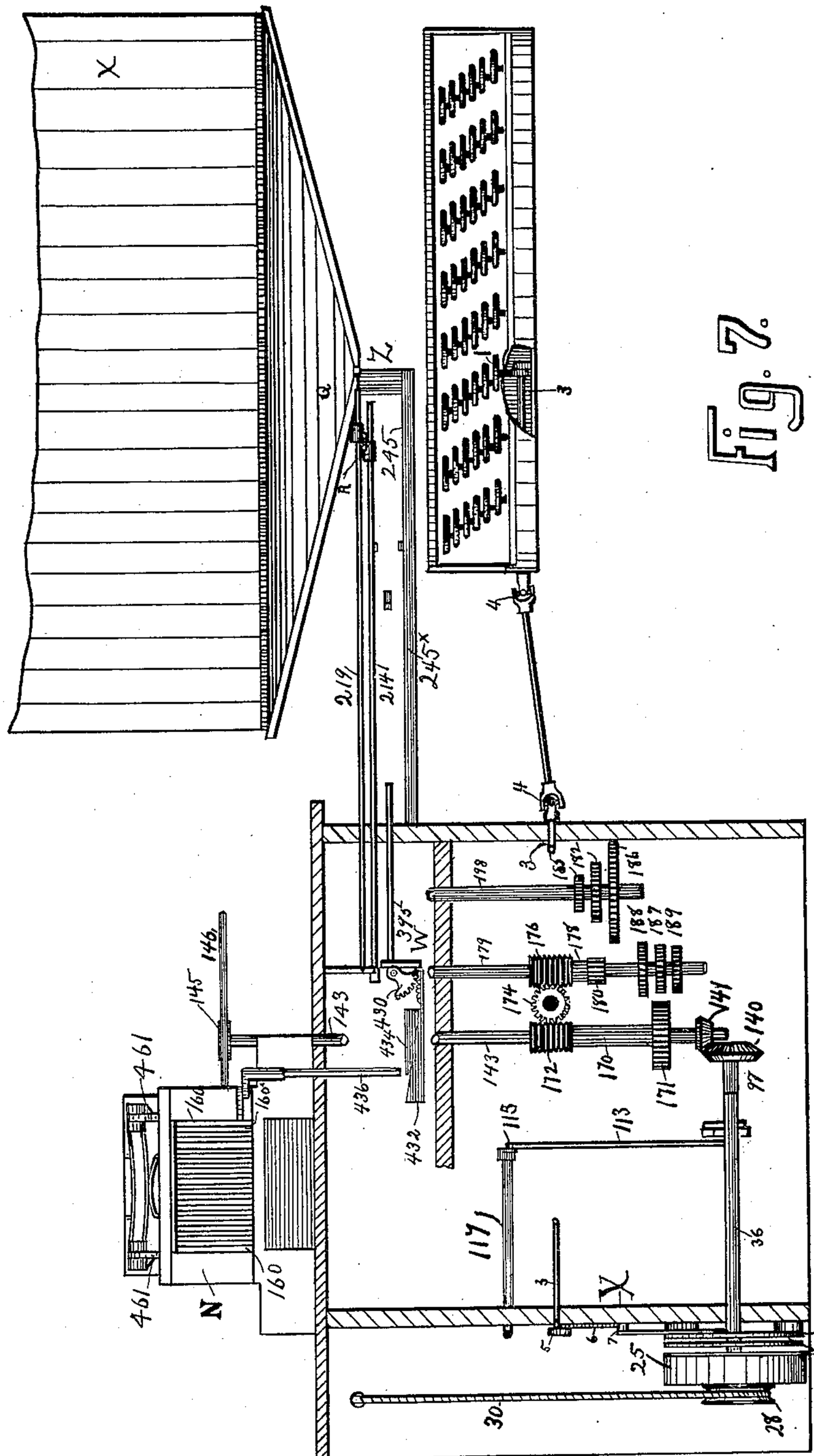

Fig. 7.

WITNESSES:
Henry N. Brown.
Richard A. Katz.

INVENTOR
William Berri
BY
S. Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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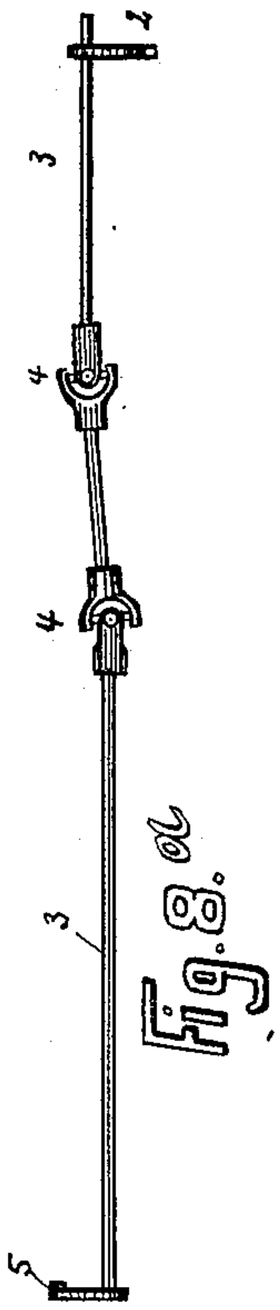

Fig. 8a.

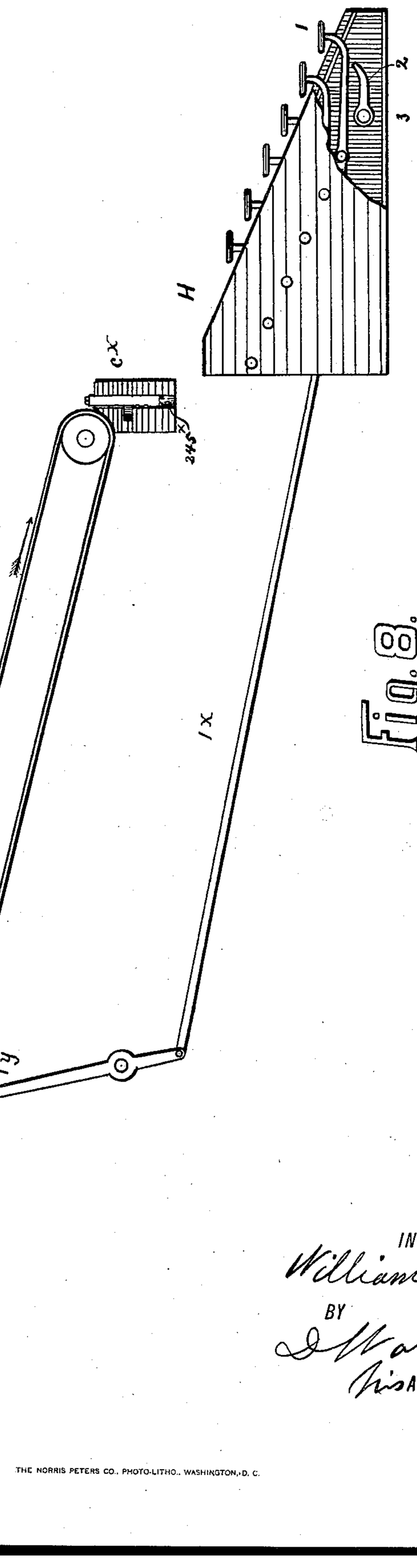

Fig. 8.

WITNESSES:
Henry N. Brown.
Reuben J. Katz.

INVENTOR
William Berri
BY
J. Walter Brown
HIS ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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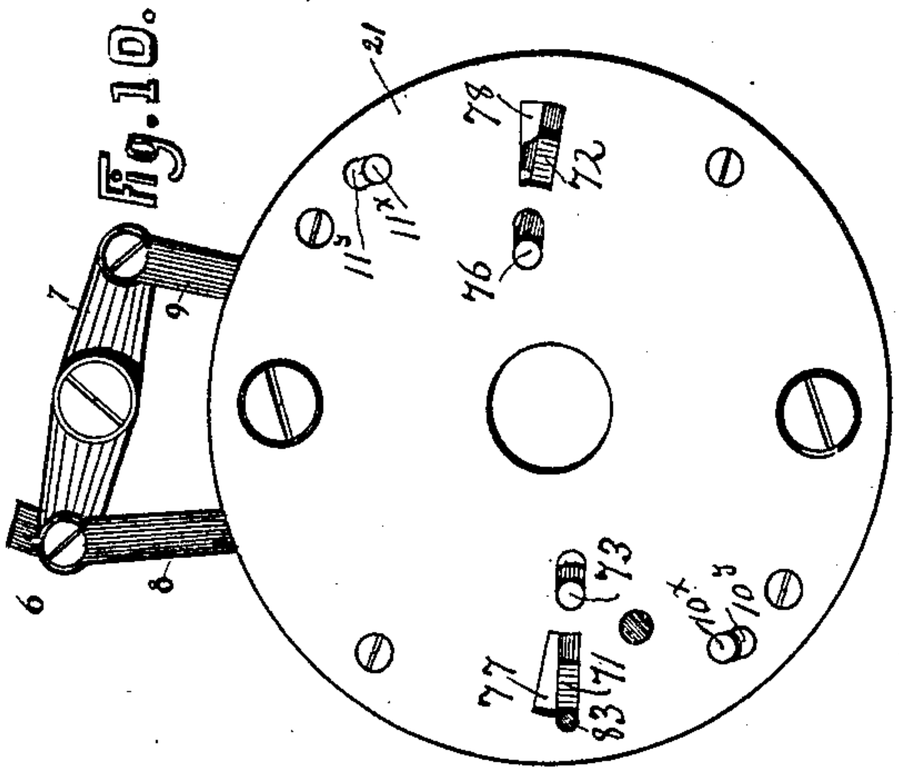
Fig. 10.



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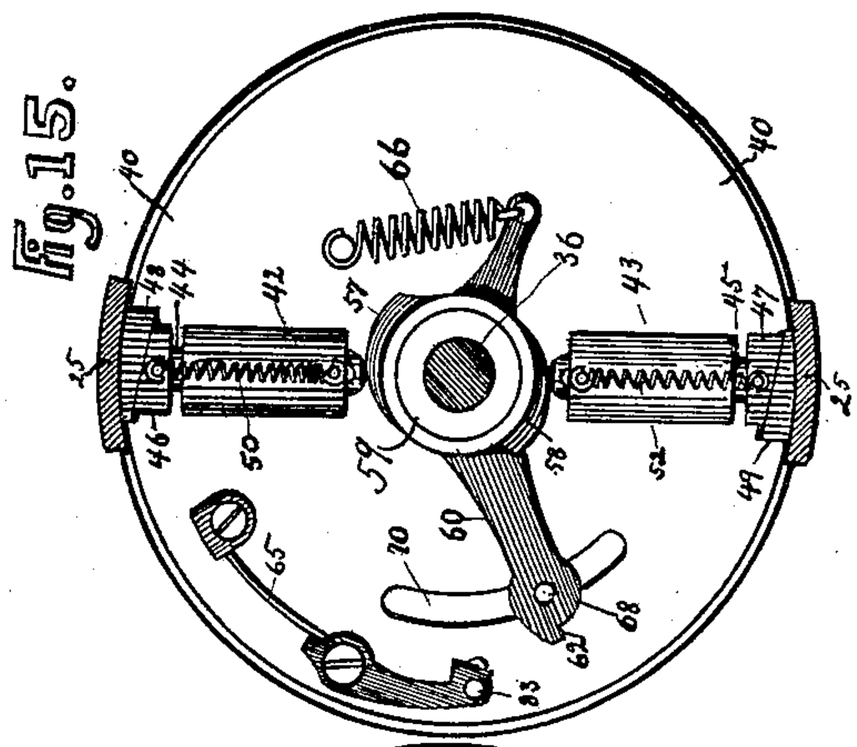

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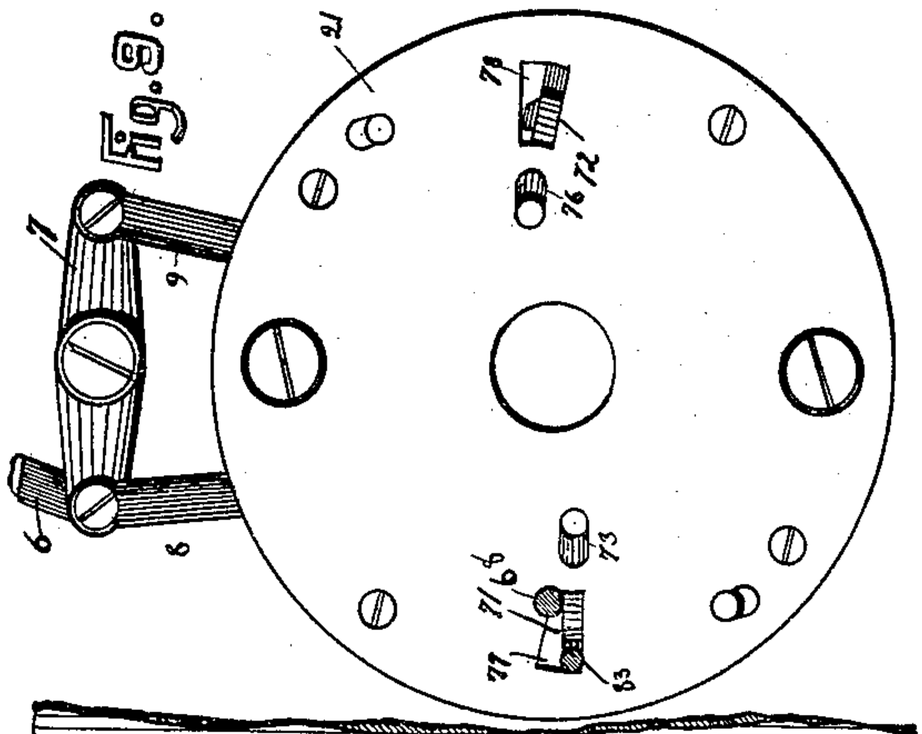


Fig. 14.

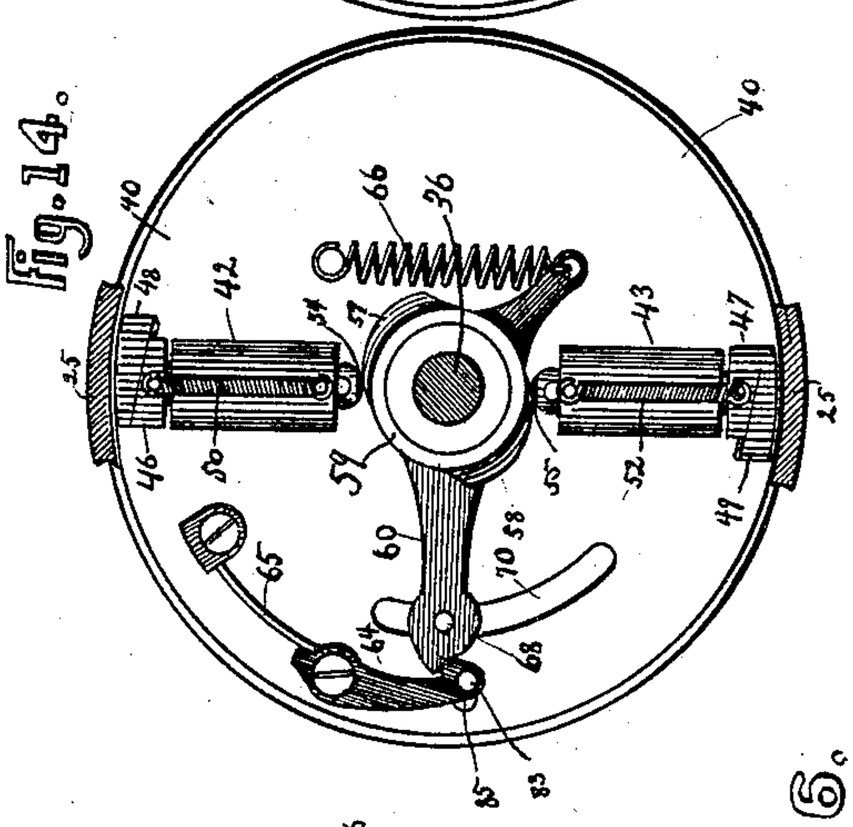


Fig. 11.

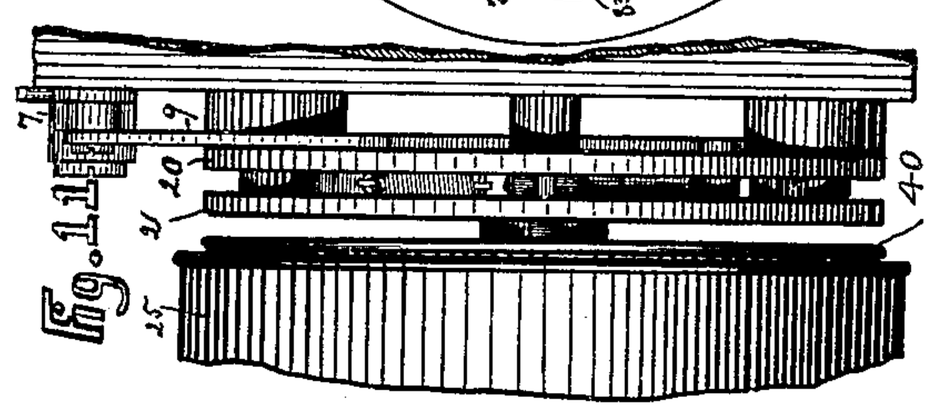


Fig. 16.

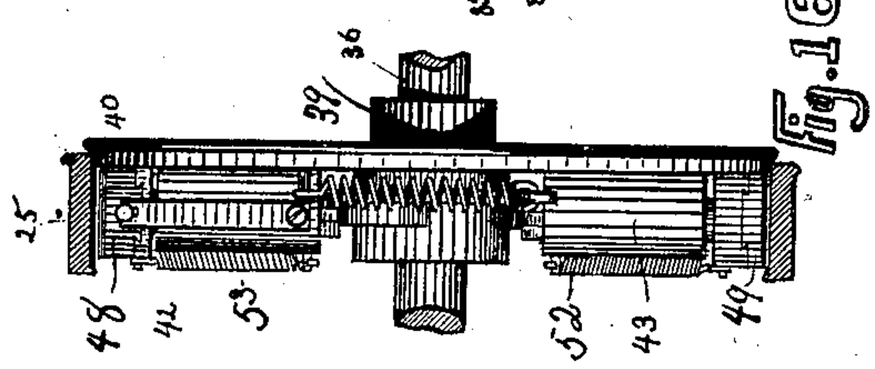
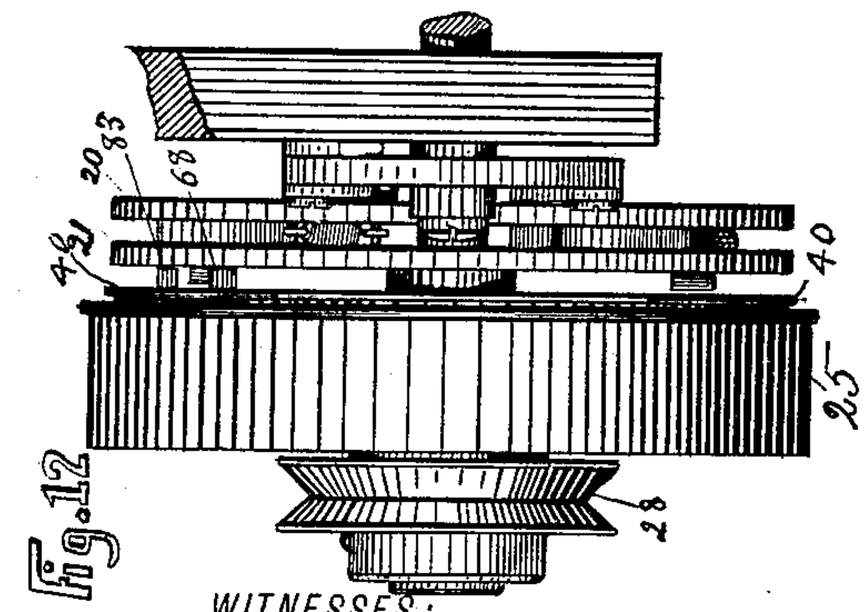


Fig. 12.



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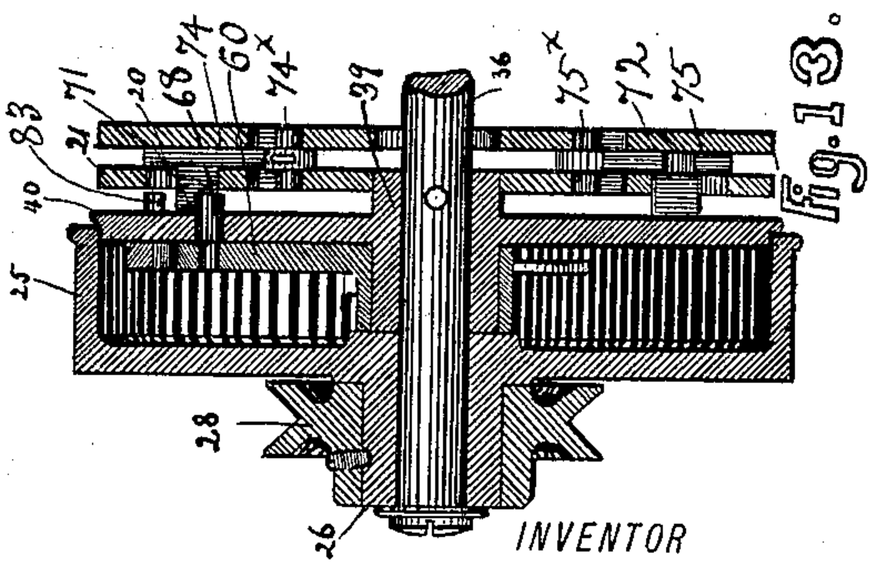

WITNESSES:

Henry N. Brown.

Abraham Hatz.

INVENTOR

William Berri

BY

D. Walter Brown

His ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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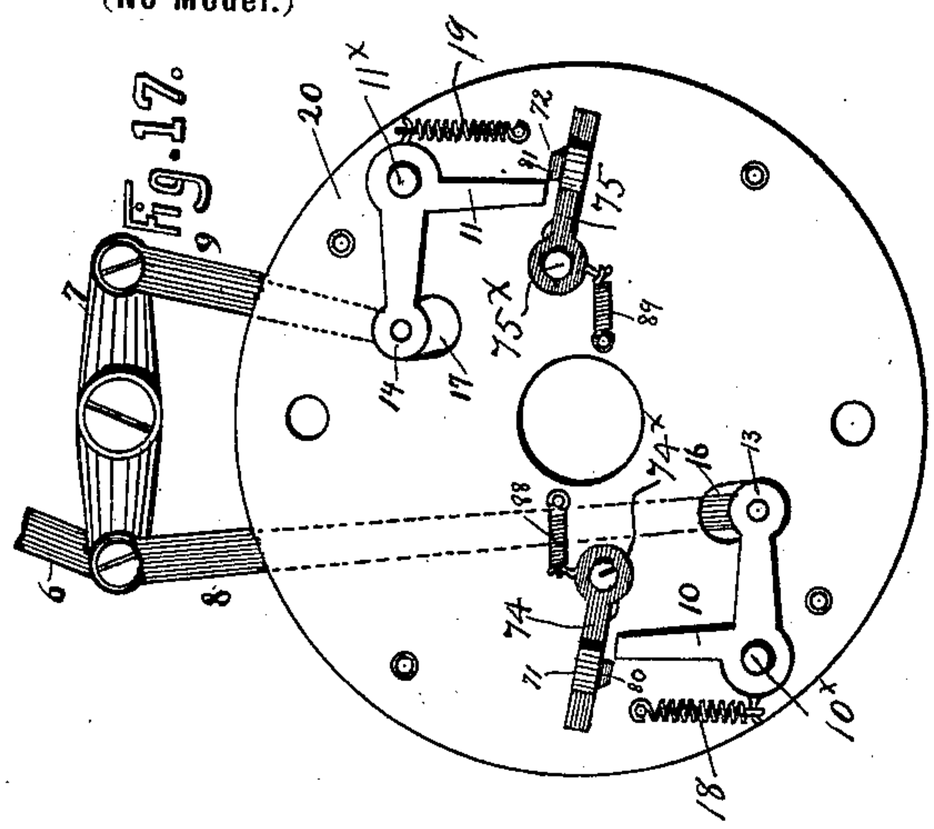
Fig. 17.



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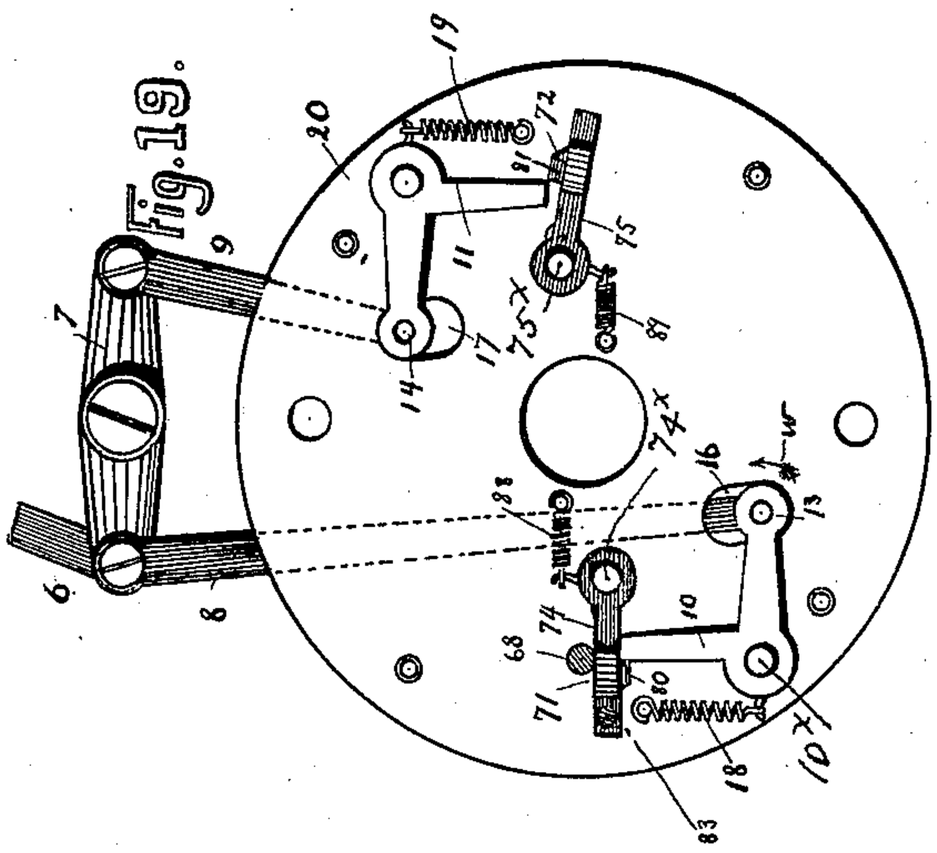

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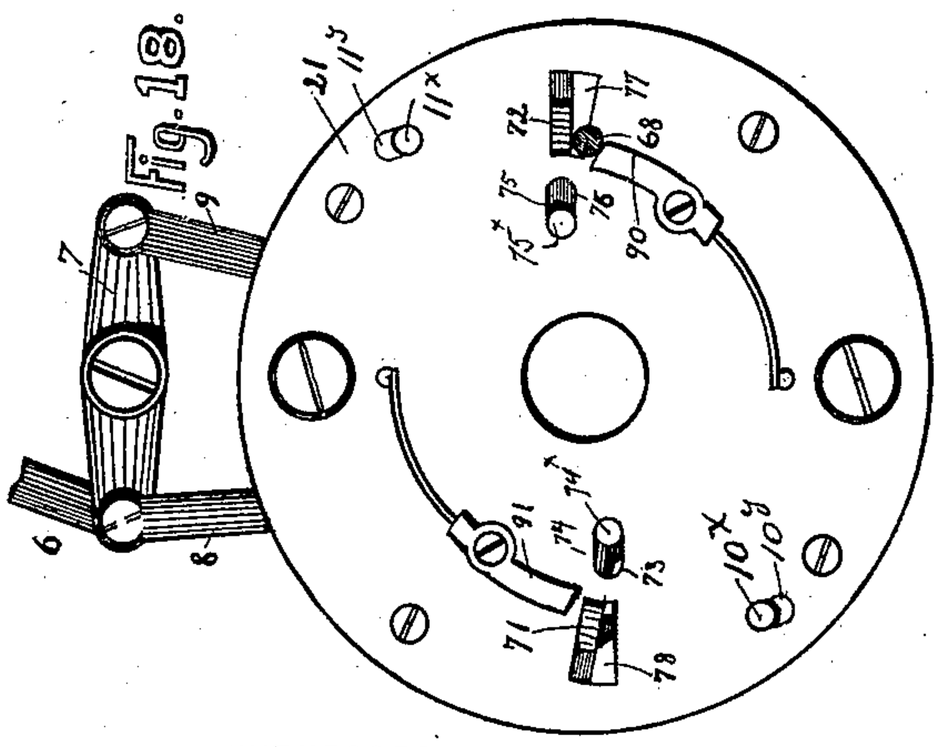


Fig. 21.

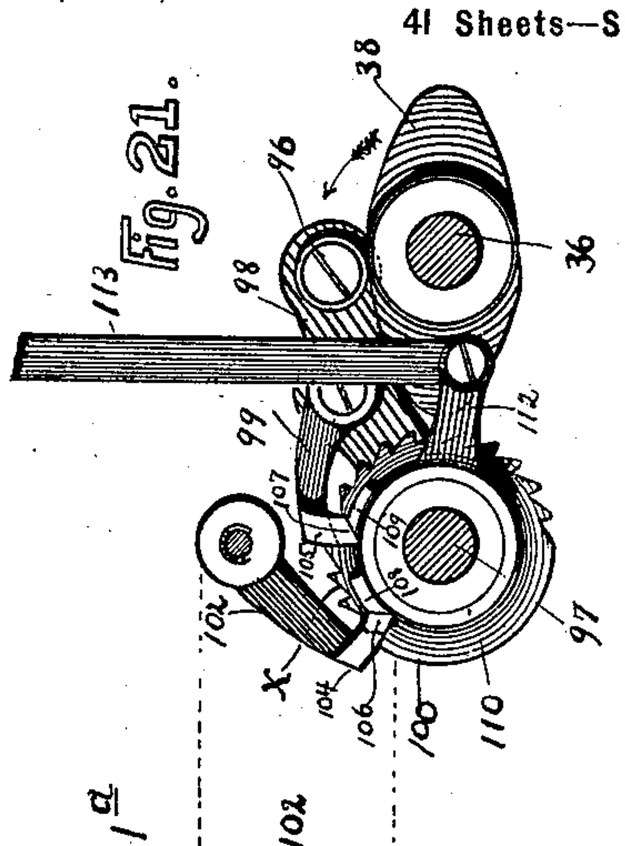


Fig 21a

Fig. 20.

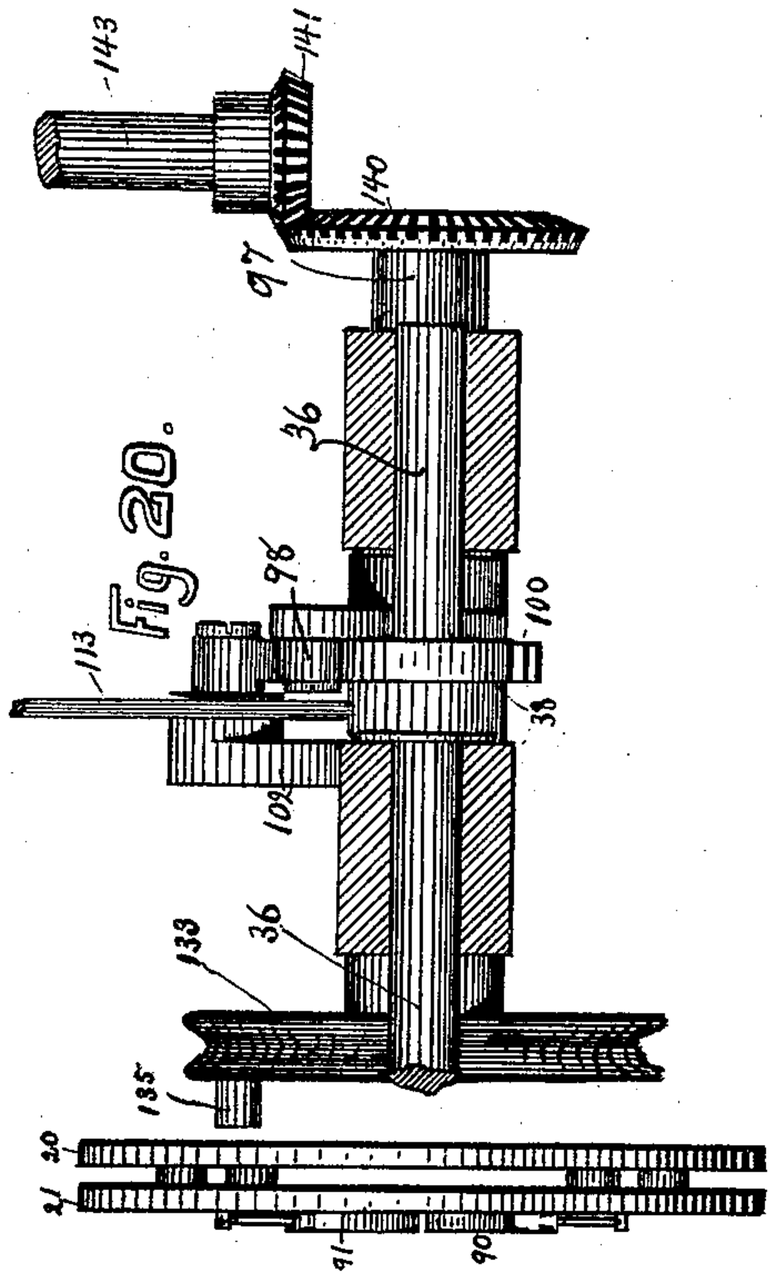


Fig. 18a.

WITNESSES:
Henry V. Brown.
Reuben Kuntz

INVENTOR
William Berri
BY
Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 10.

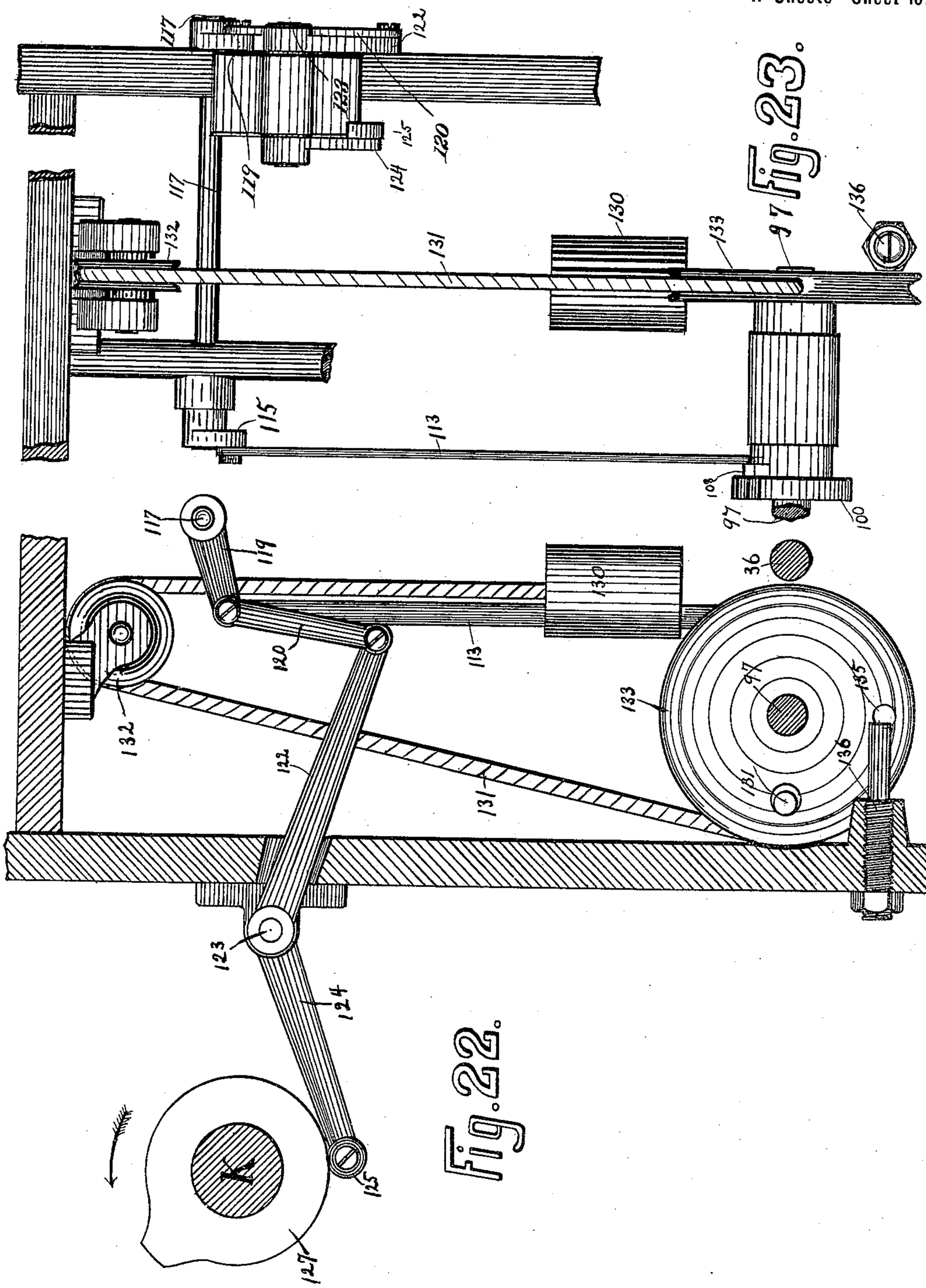


Fig. 23.

Fig. 22.

WITNESSES:
Henry N. Brown.
Reuben Maty.

INVENTOR
William Berri
BY
D. Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 11.

Fig. 24.

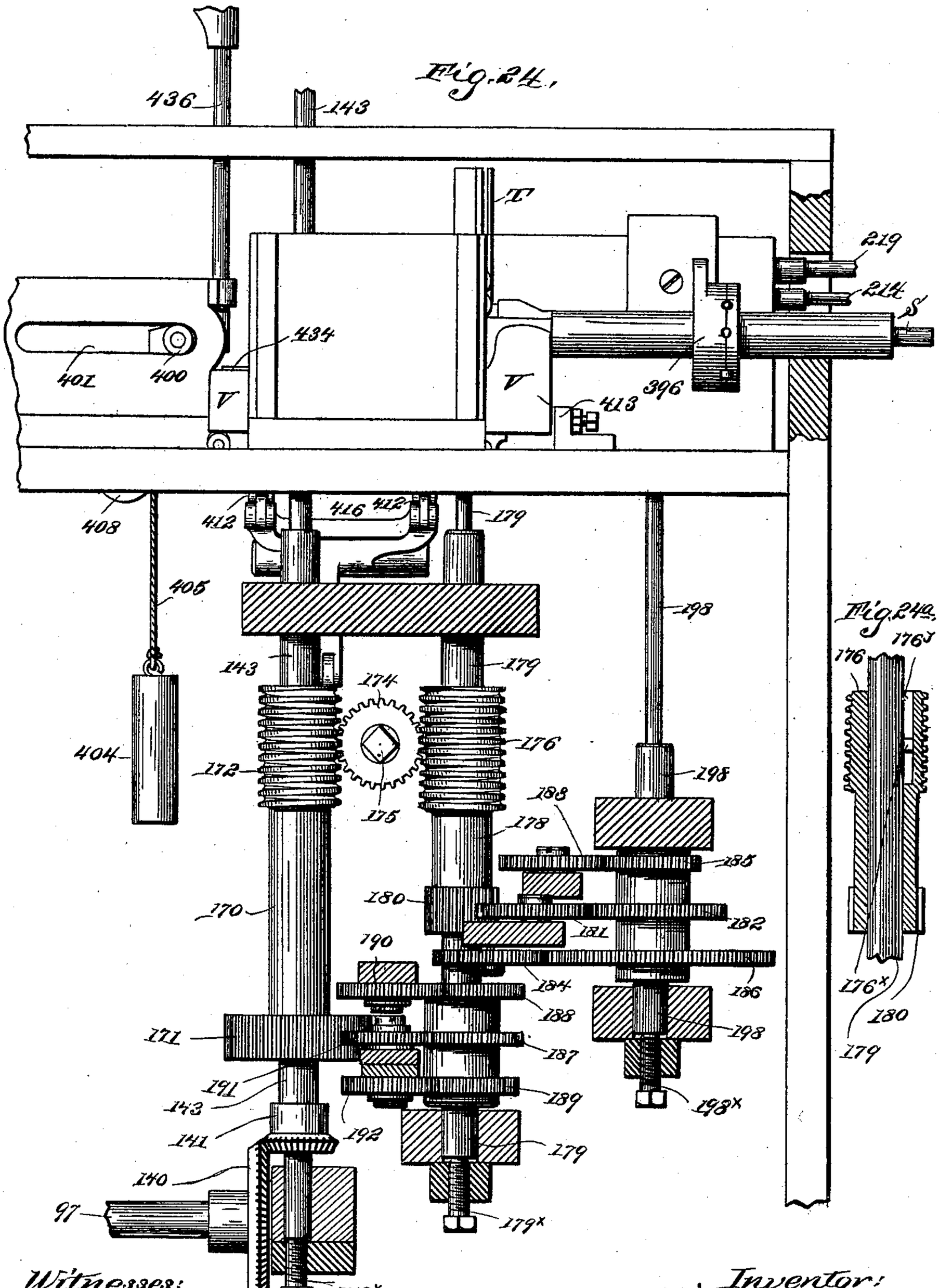


Fig. 24a.

Witnesses:
Kenny H. Brown
Bernard J. Becker.

Inventor:
William Berri
by Walter Brown
his attorney

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 12.

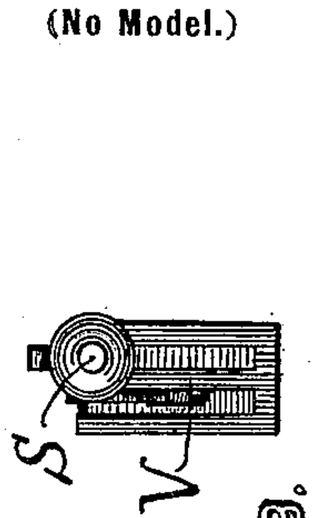


Fig. 29.

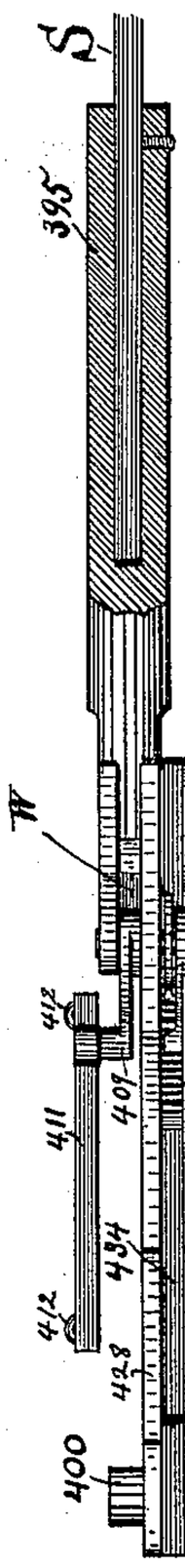
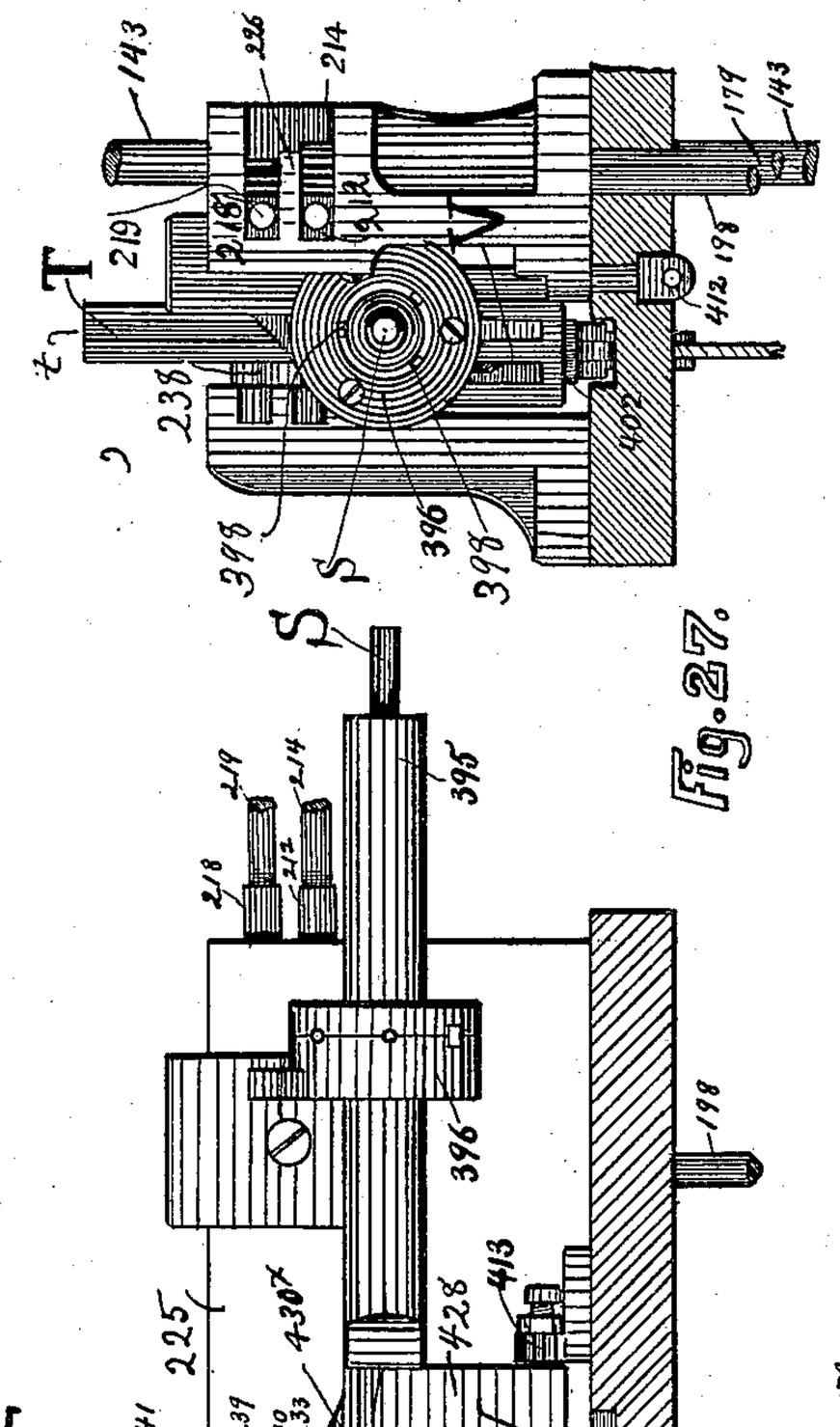


Fig. 28.



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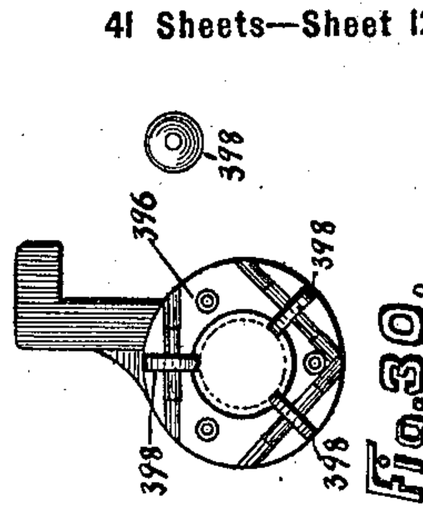


Fig. 30.

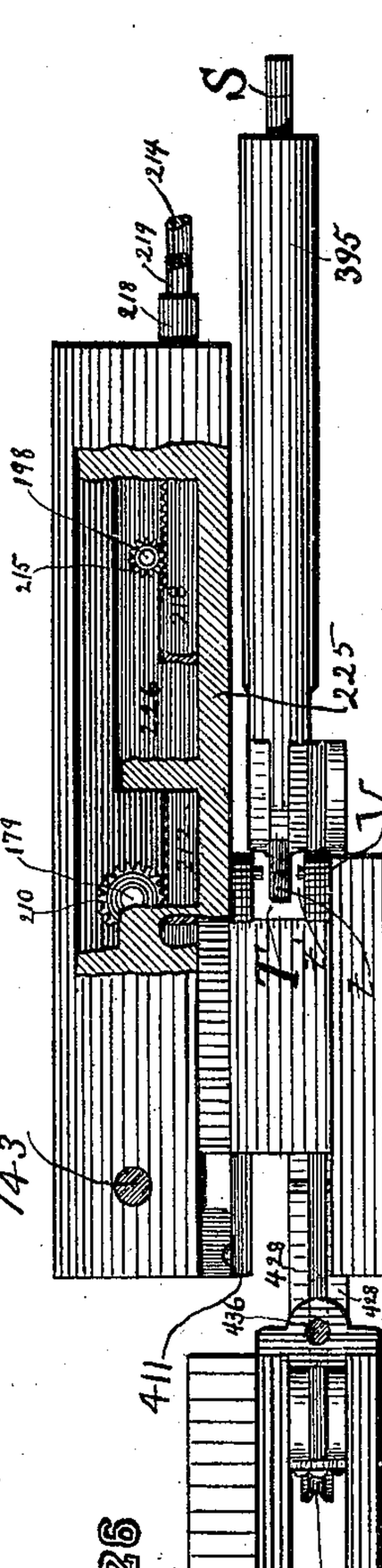


Fig. 26

WITNESSES:

Henry N. Brown.

Reuben Hatz.

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

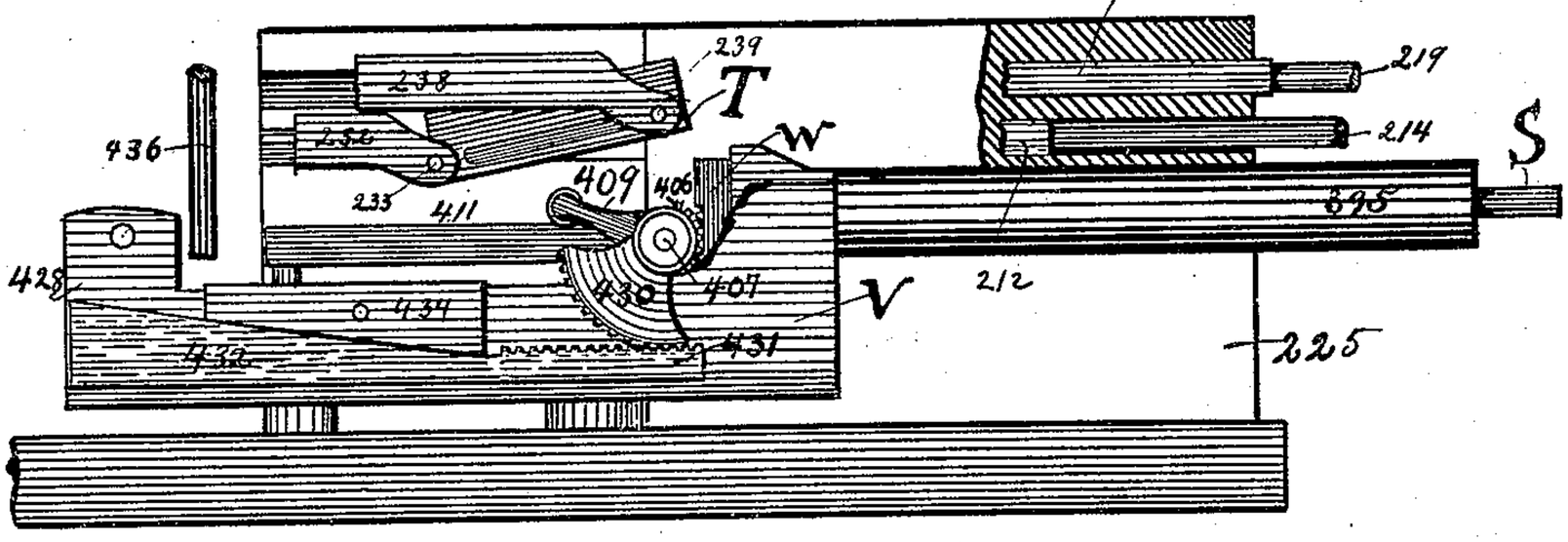
W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 13.

Fig. 32



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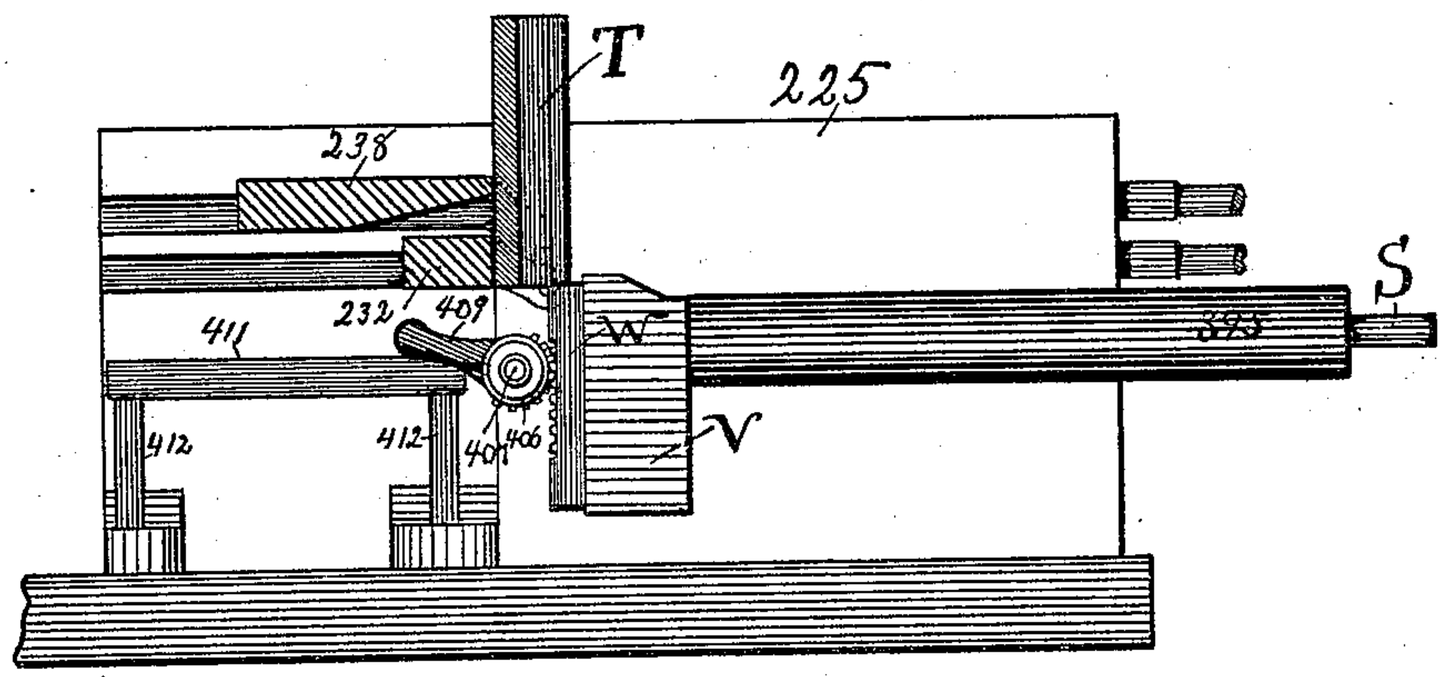

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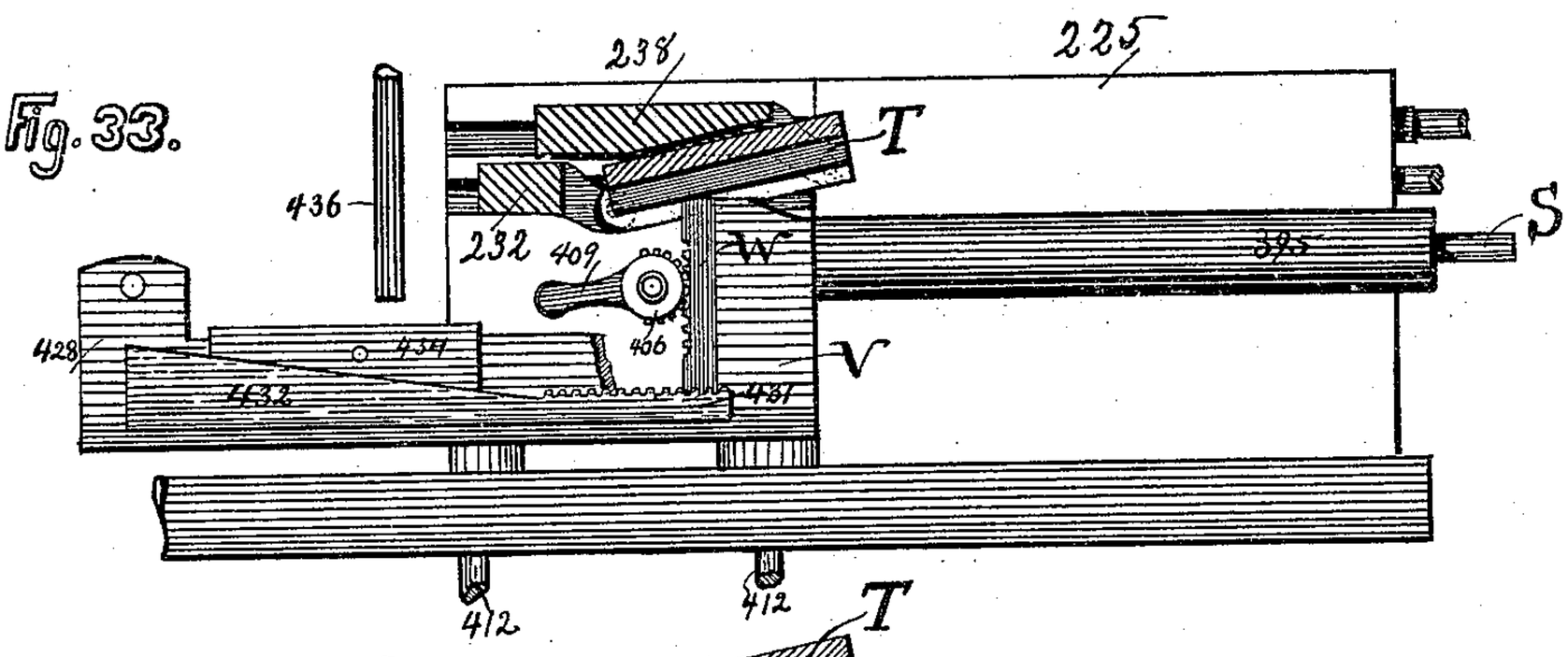
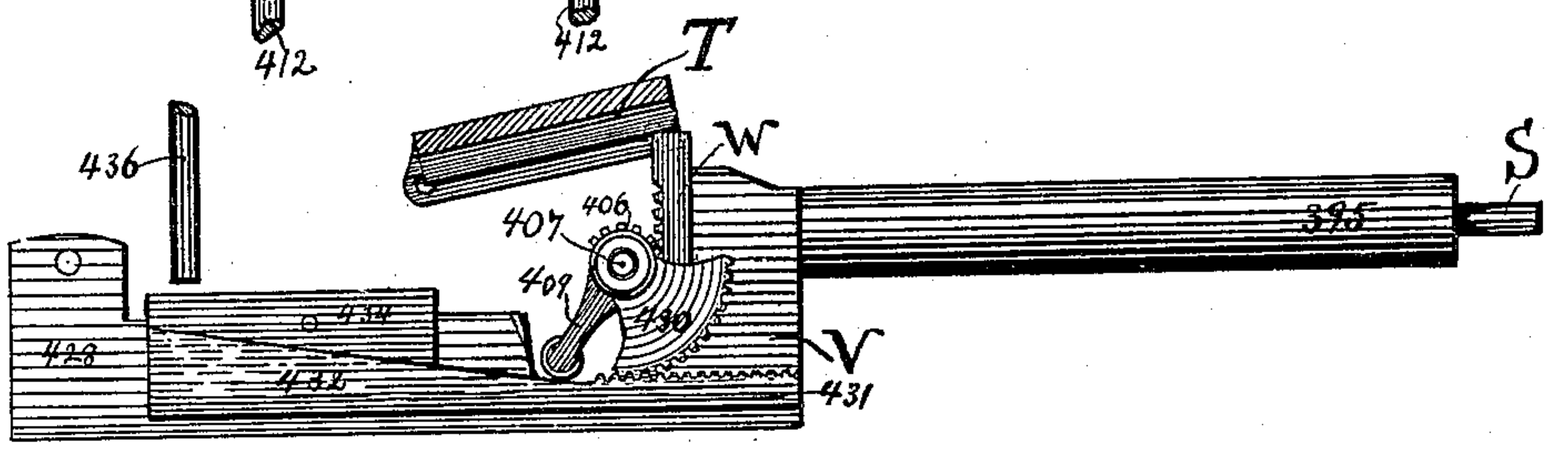


Fig. 34.



WITNESSES:
Henry V. Brown.
Charles F. Keely

INVENTOR
William Berri
BY
D. Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

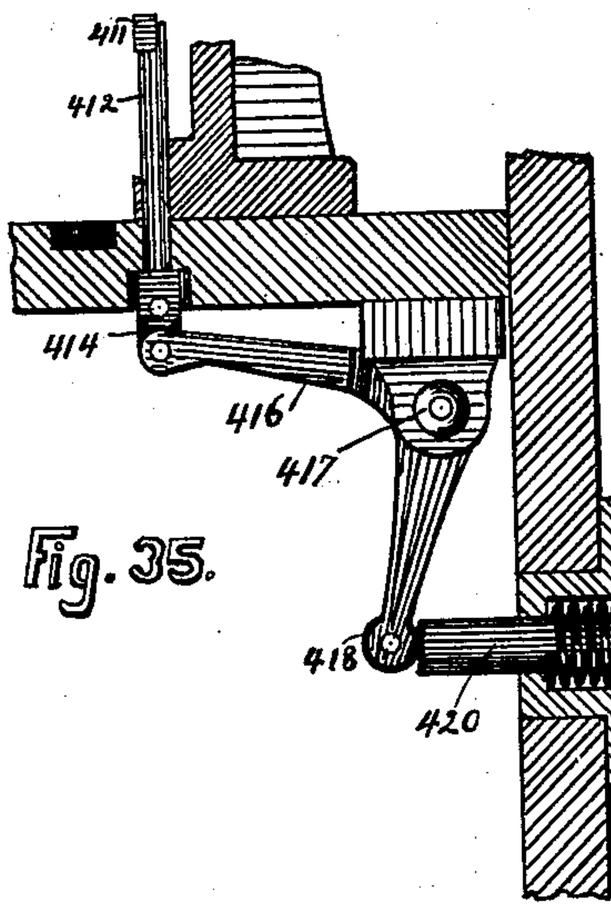
W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

41 Sheets—Sheet 14.

(No Model.)



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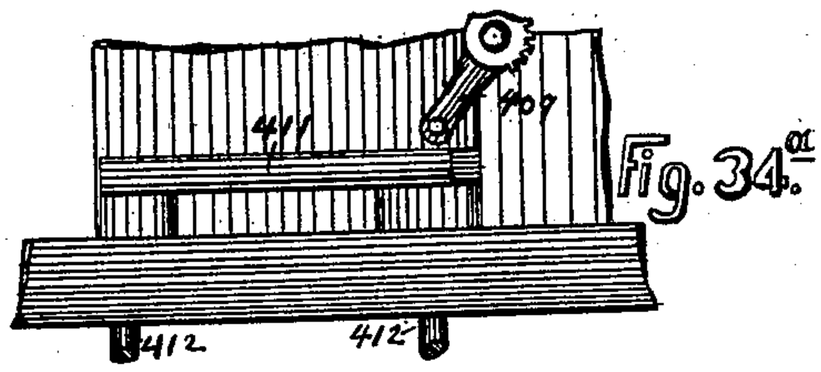


Fig. 34a.

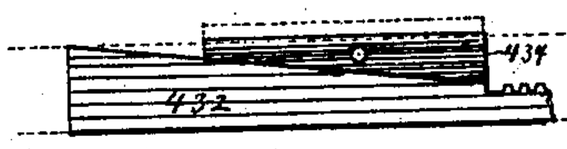
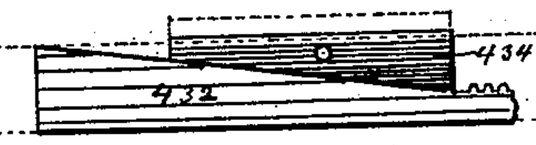


Fig. 36.



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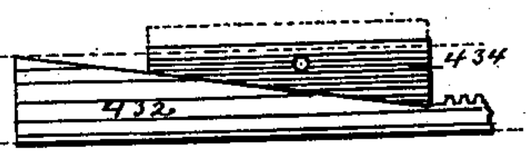


Fig. 38.

Fig. 46.

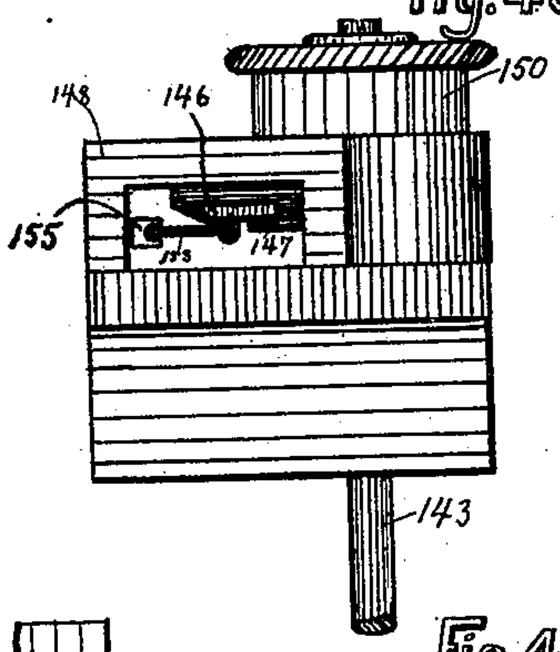
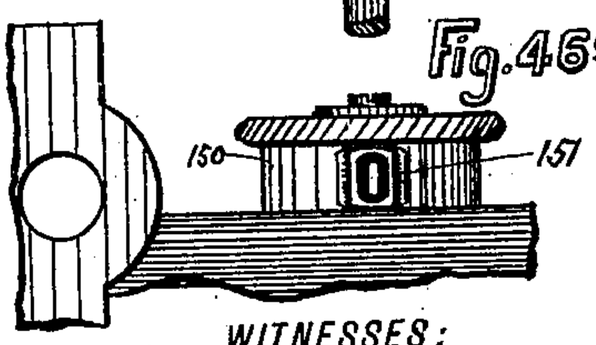


Fig. 46a.



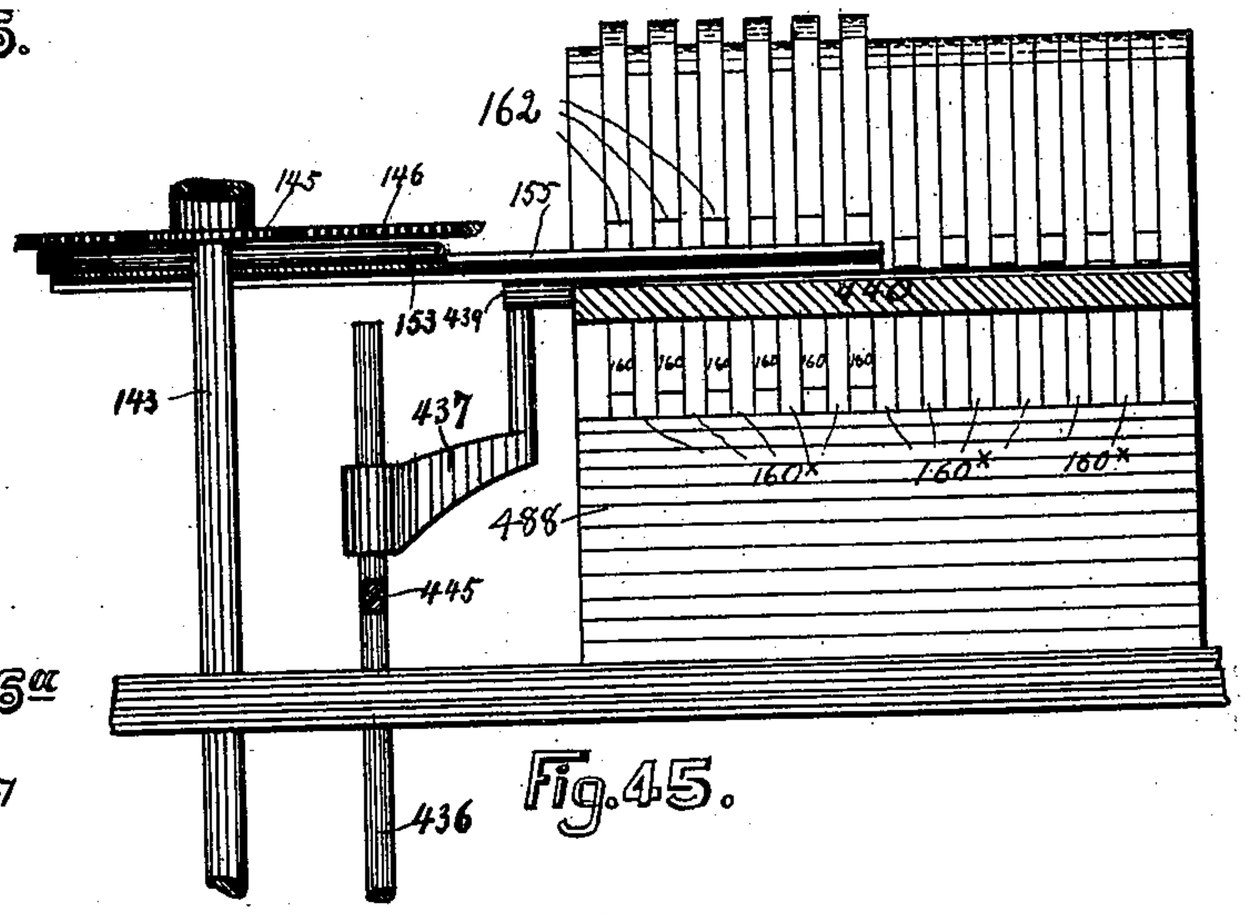


Fig. 45.

WITNESSES:

Henry V. Brown.

Charles Katz.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 15.

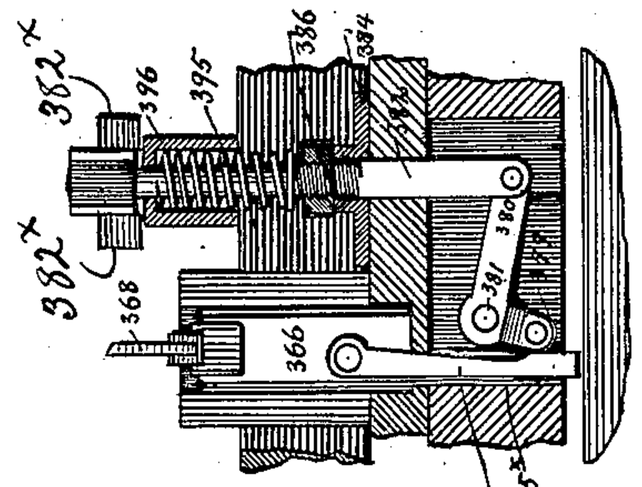


Fig. 55.

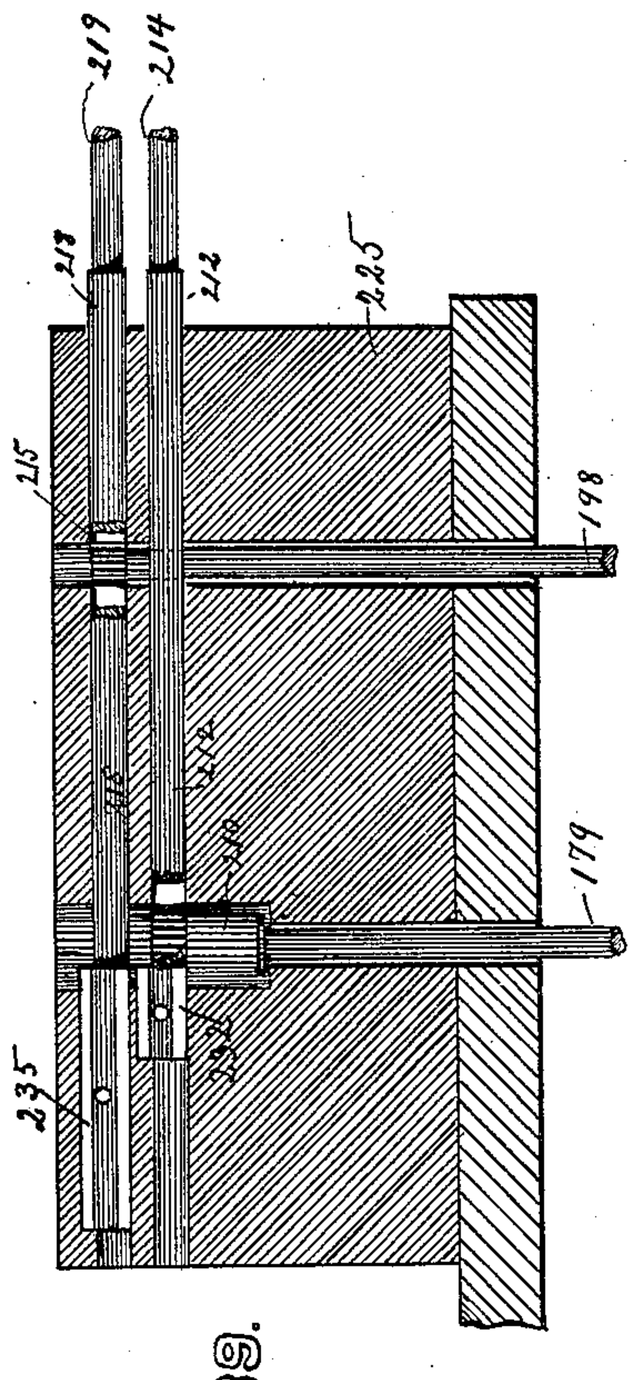


Fig. 39.

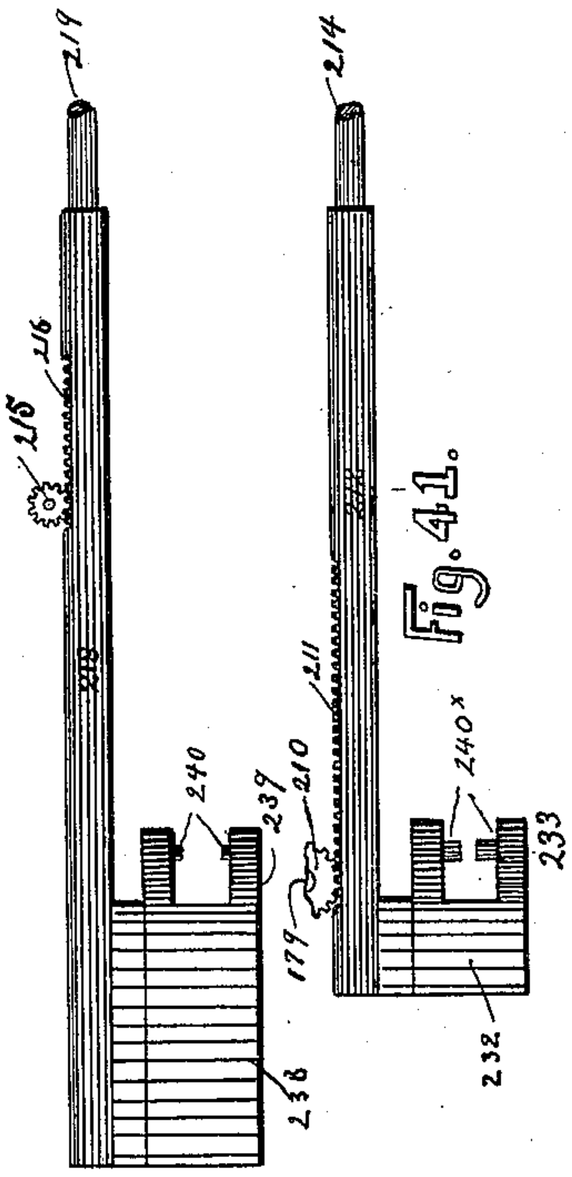


Fig. 40. Fig. 41.

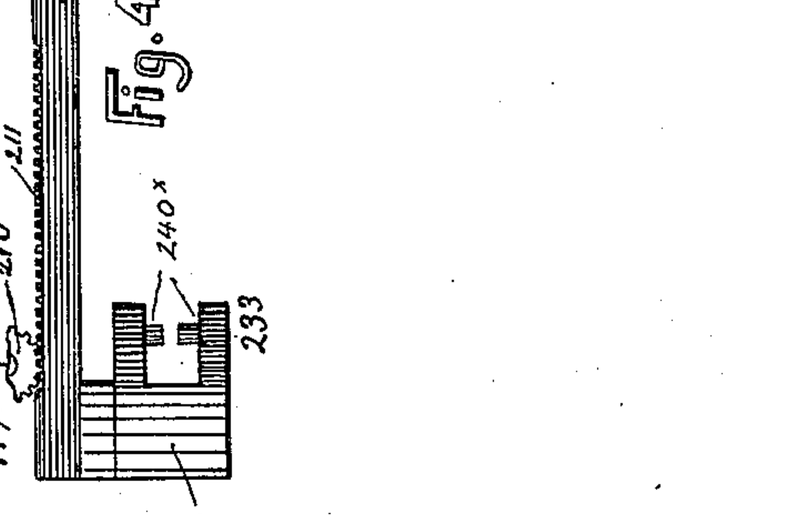


Fig. 41a. Fig. 54.

WITNESSES:

Henry V. Brown.

Charles Hartz

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 16.

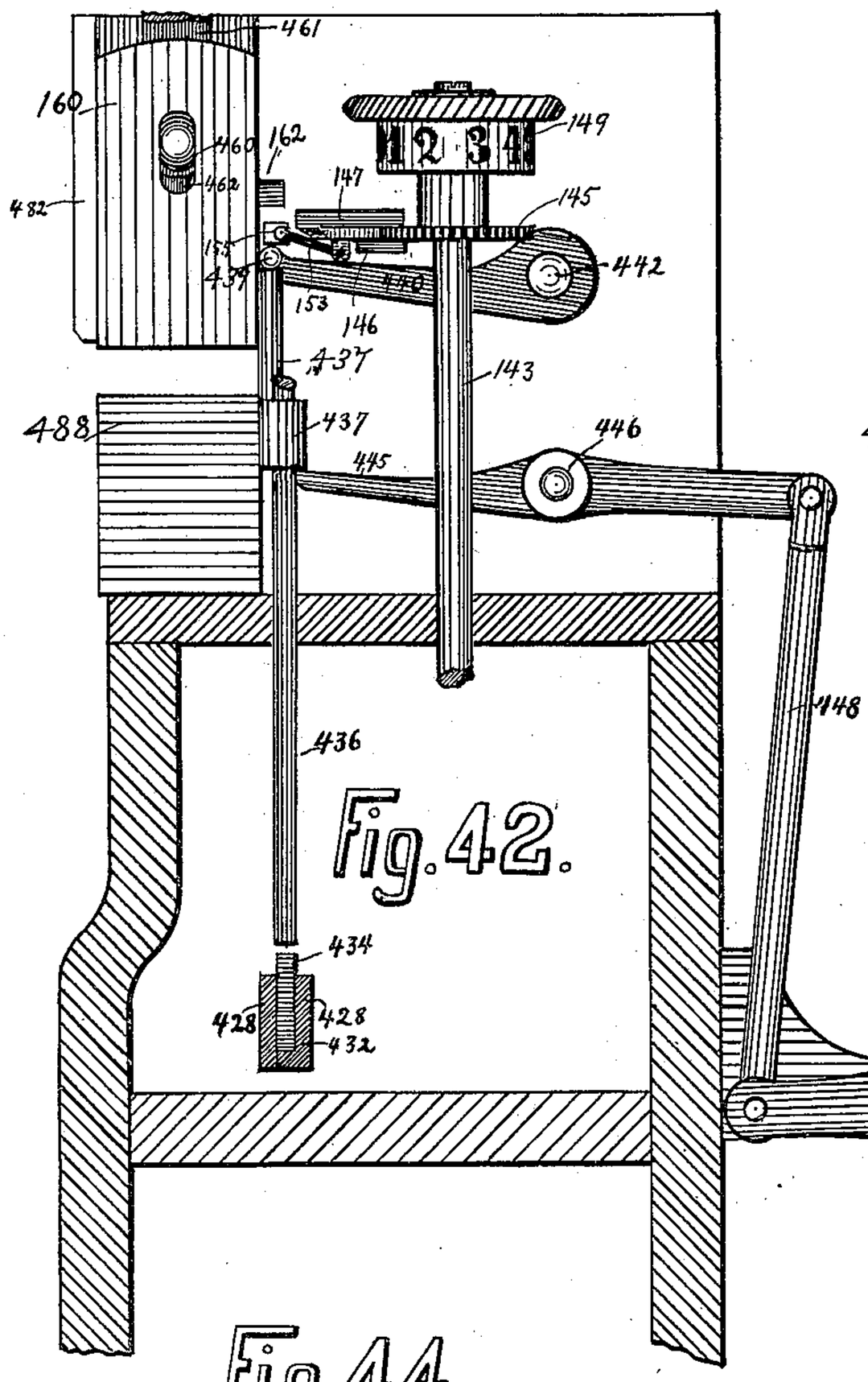


Fig. 42.

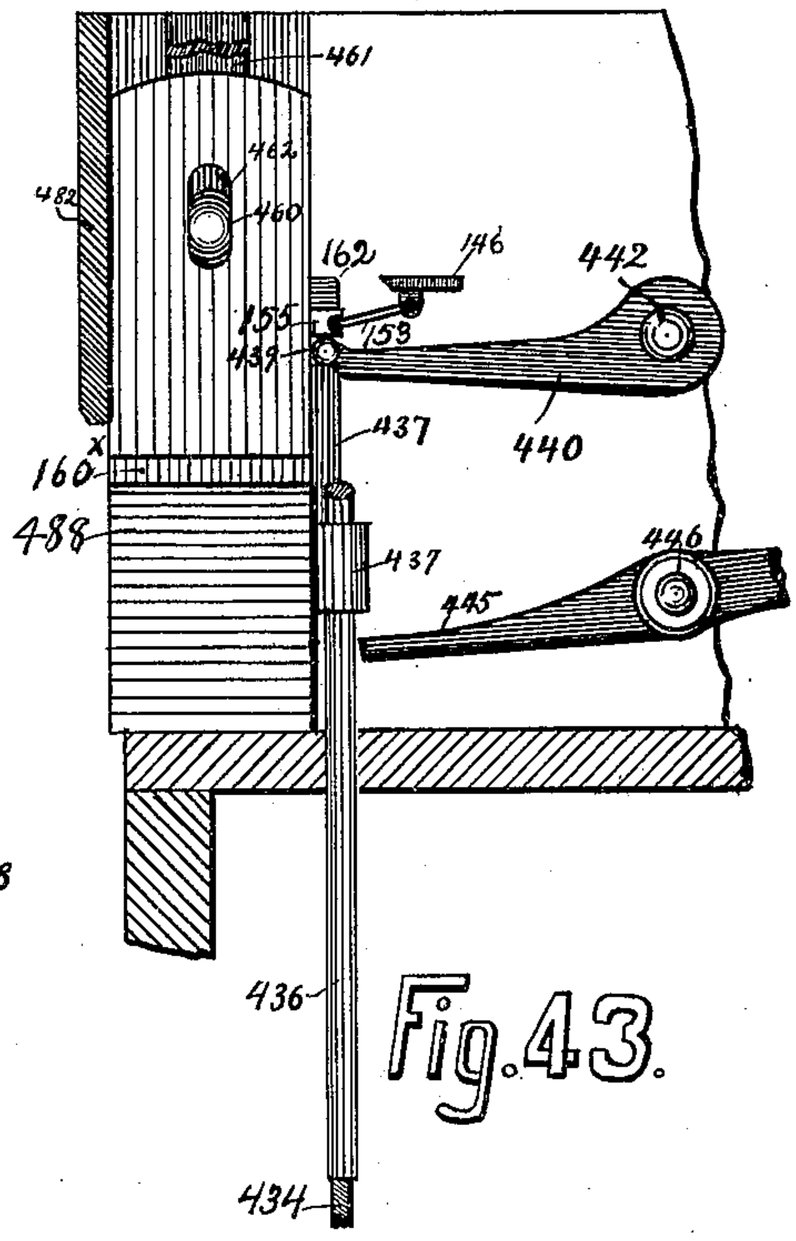


Fig. 43.

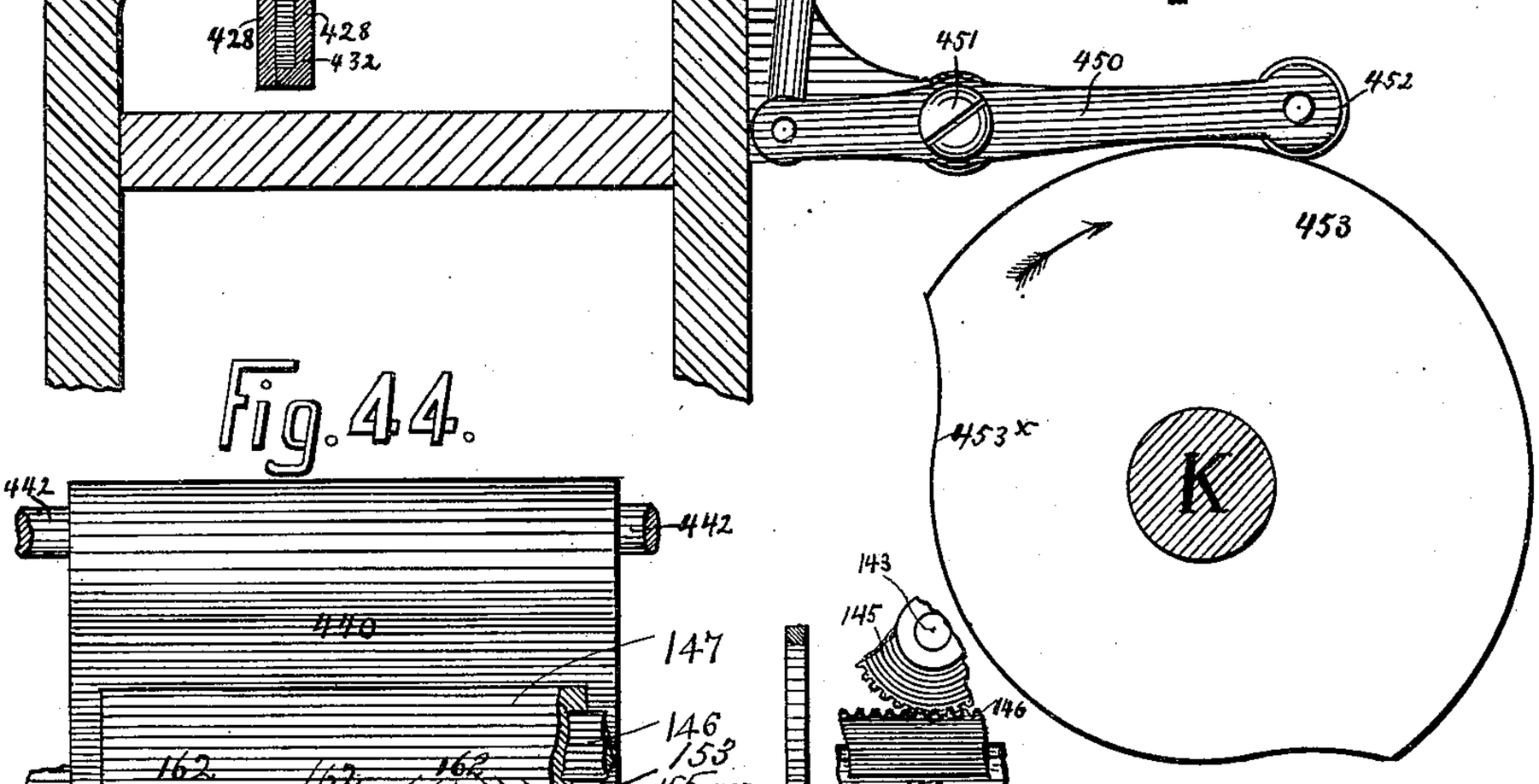


Fig. 44.

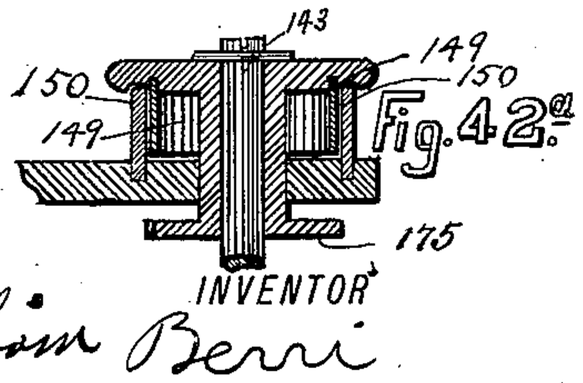


Fig. 42a.

WITNESSES:

Henry V. Brown.

Rudolph Katz.

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 17.

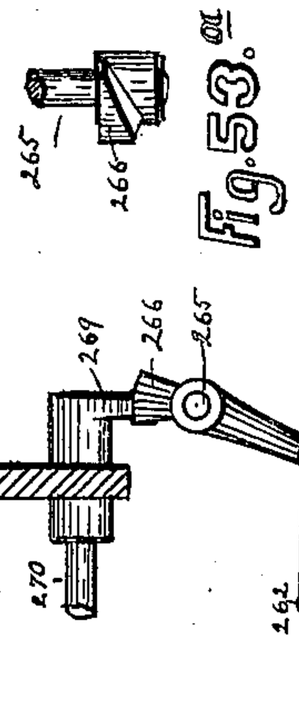


Fig. 53.

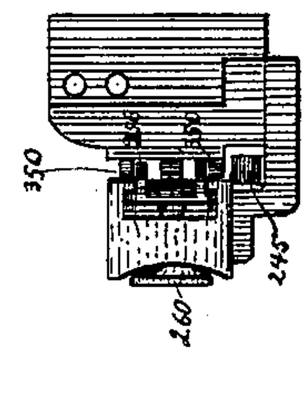


Fig. 49.

Fig. 47.

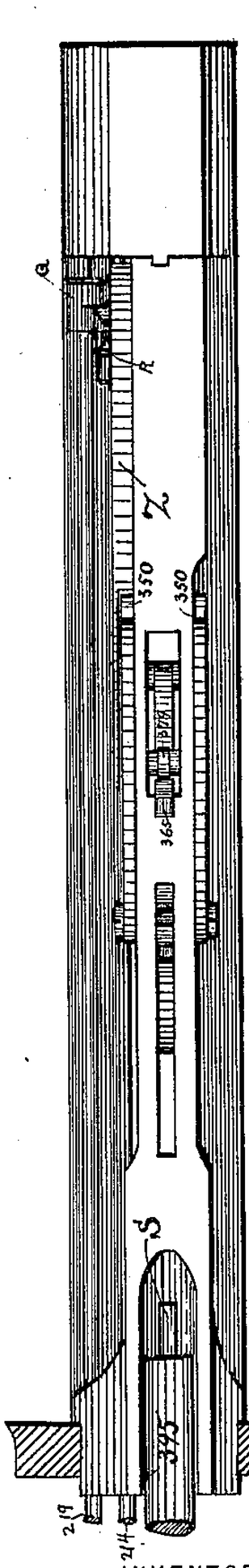


Fig. 48.

WITNESSES:

Henry V. Brown.

Charles F. Perry

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(No Model.) (Application filed Mar. 10, 1897.)

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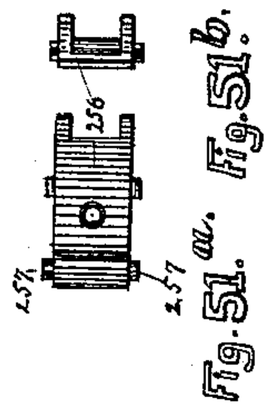

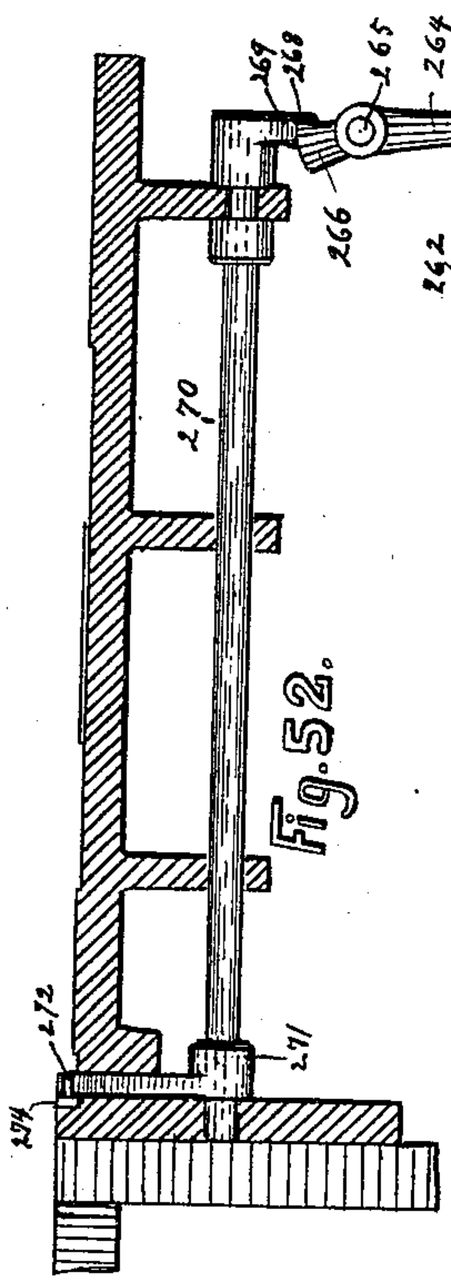

Fig. 52.

Fig. 50.

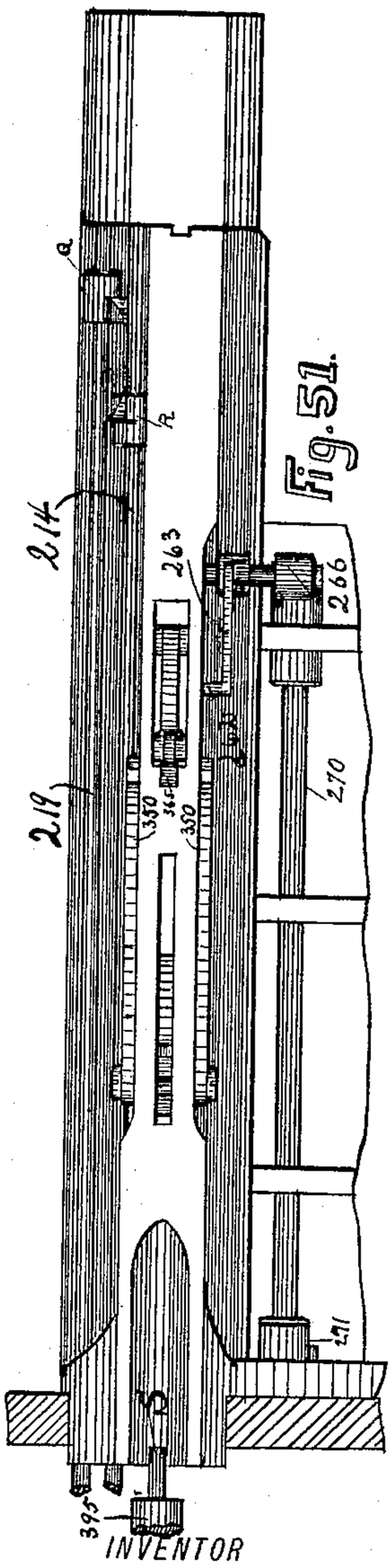

Fig. 51.

WITNESSES:
Kenneth V. Brown.
Herbert Kent

INVENTOR
William Berri
BY
Walter Binns
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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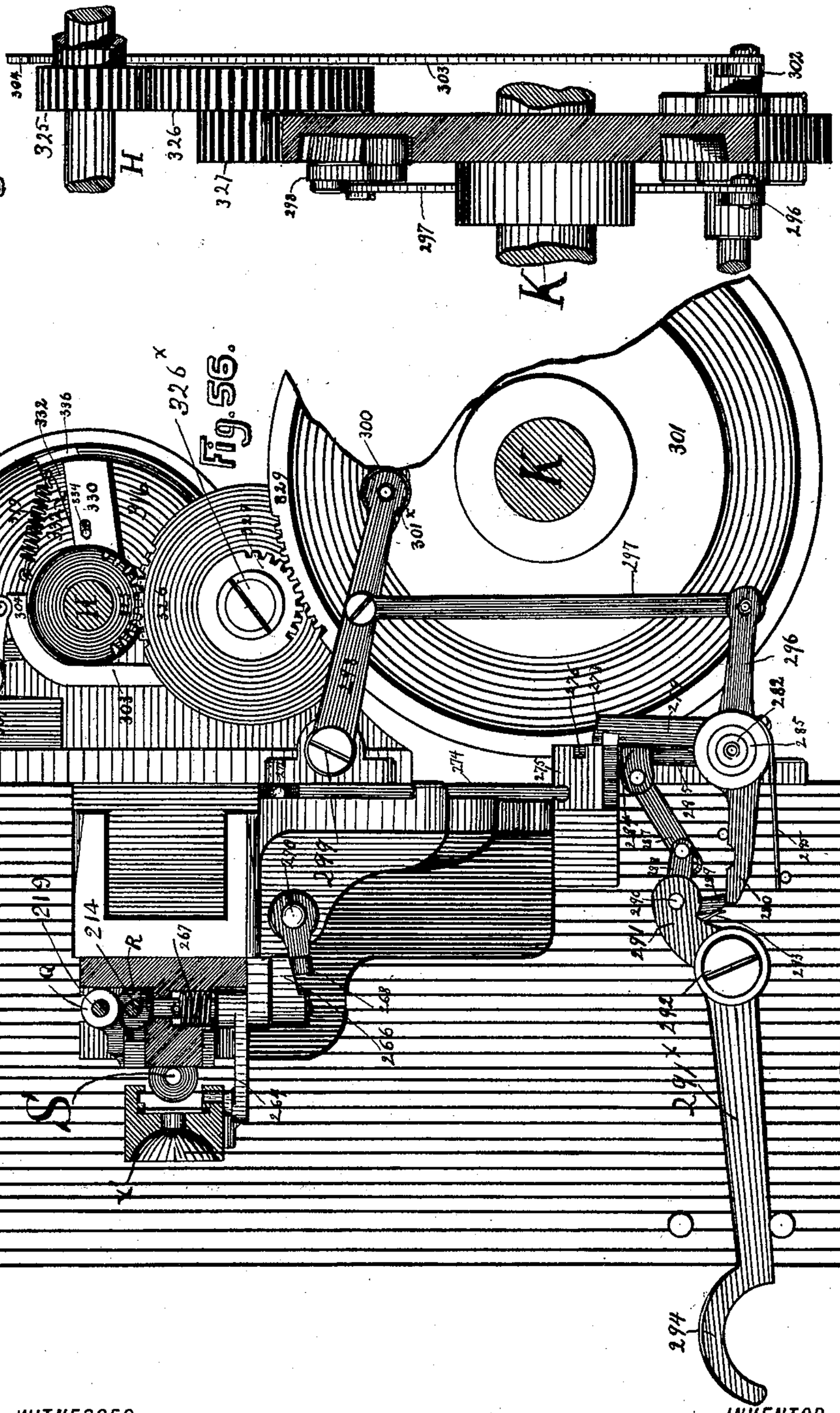
Fig. 57.



WITNESSES:

Henry N. Brown.

Reuben A. Kelly

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 20.

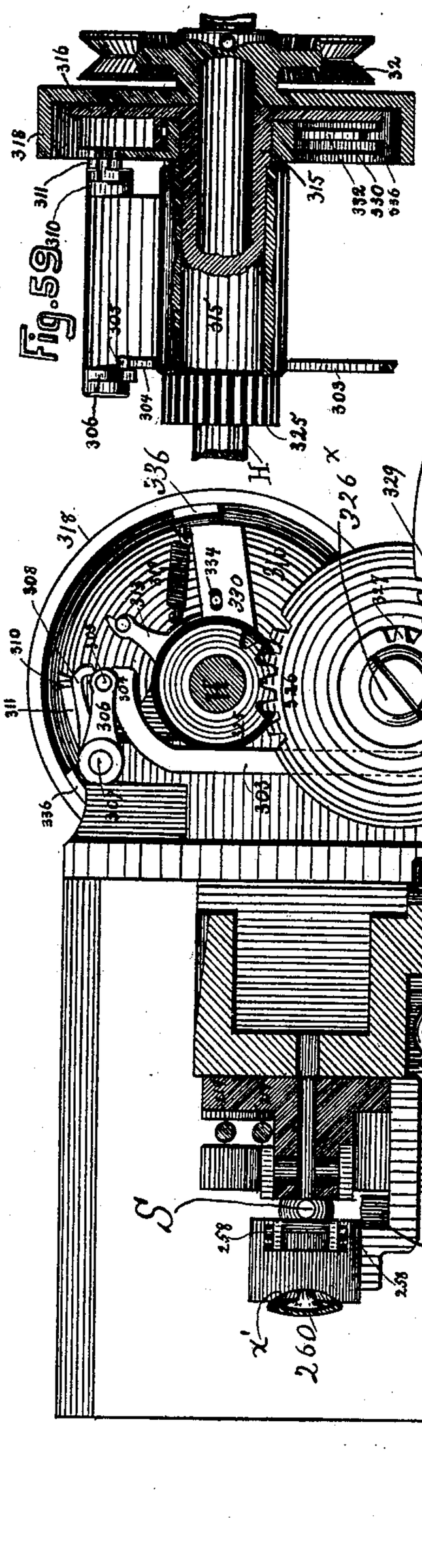


Fig. 58.

Fig. 58a.

WITNESSES:

Henry N. Brown.

Charles F. Hatz.

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 21.

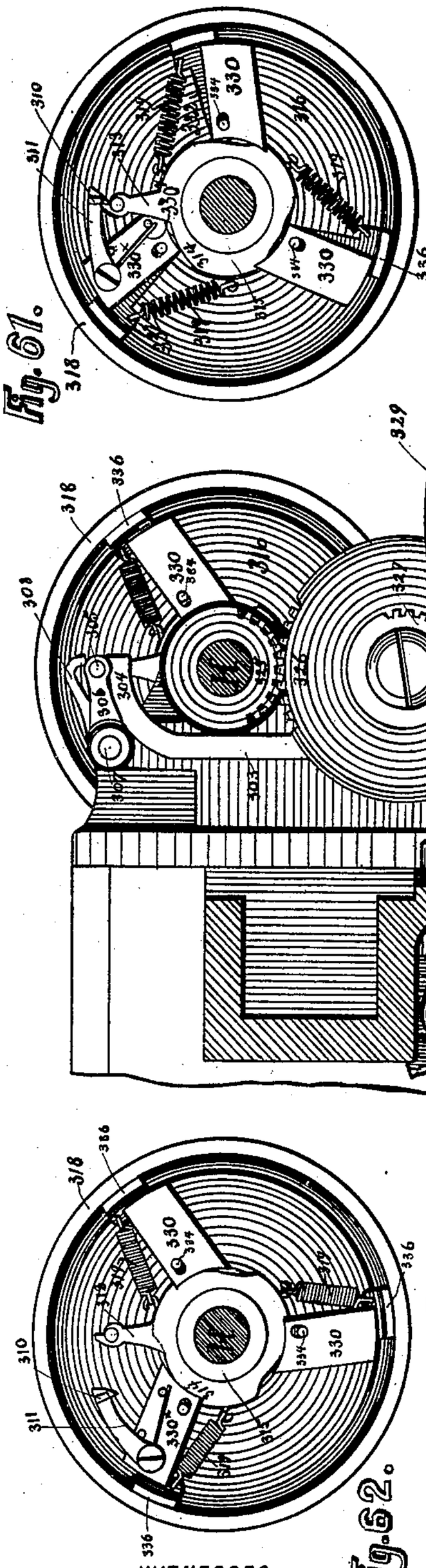


Fig. 61.

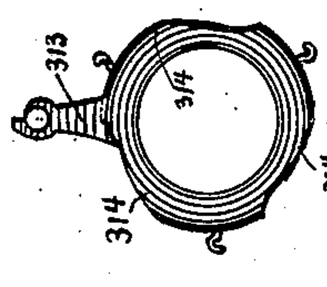


Fig. 61a.

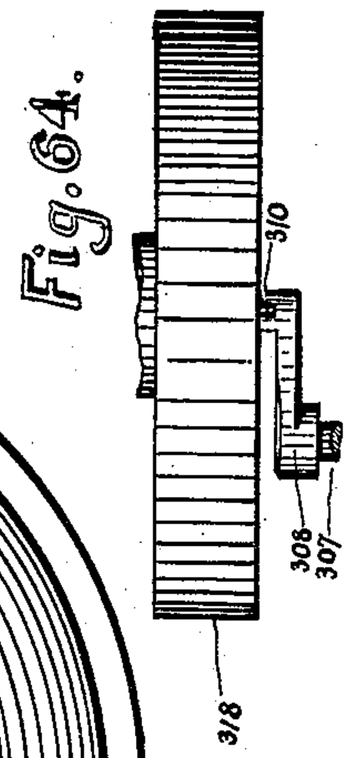


Fig. 64.

Fig. 60.

Fig. 62.

Fig. 63.

WITNESSES:

Henry N. Brown.

Reuben Hatt.

INVENTOR

William Berri

BY

D. Walter Brown

ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 22.

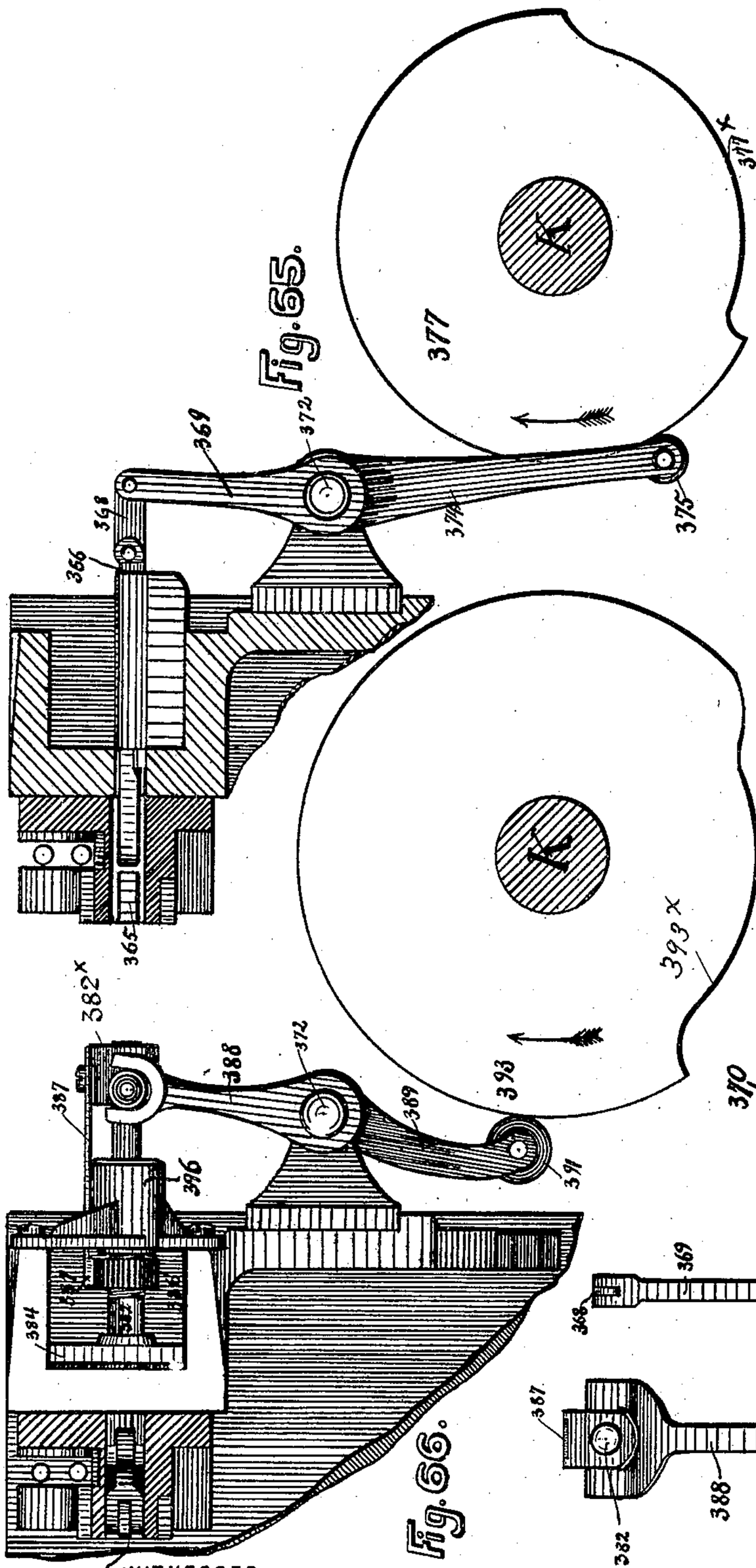


Fig. 65.

Fig. 66.

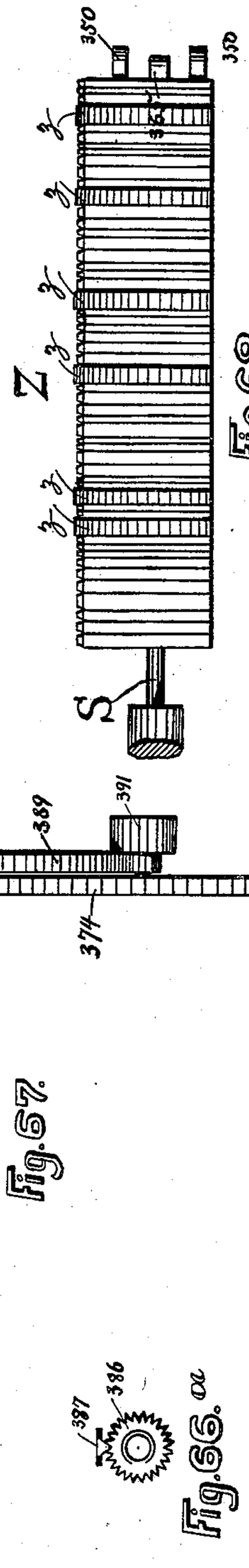


Fig. 68.

Fig. 67.

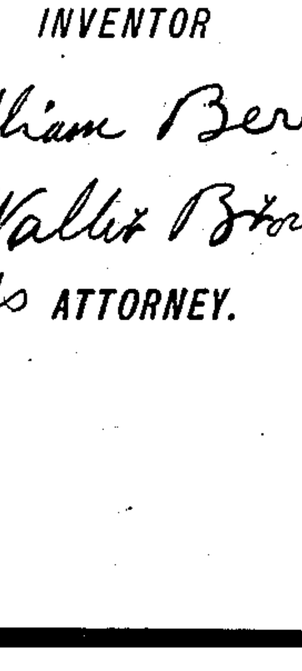


Fig. 66a.

WITNESSES:

Henry N. Brown.

Reuben Katz.

INVENTOR

William Berri

BY

J. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(No Model.) (Application filed Mar. 10, 1897.)

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Fig. 69.

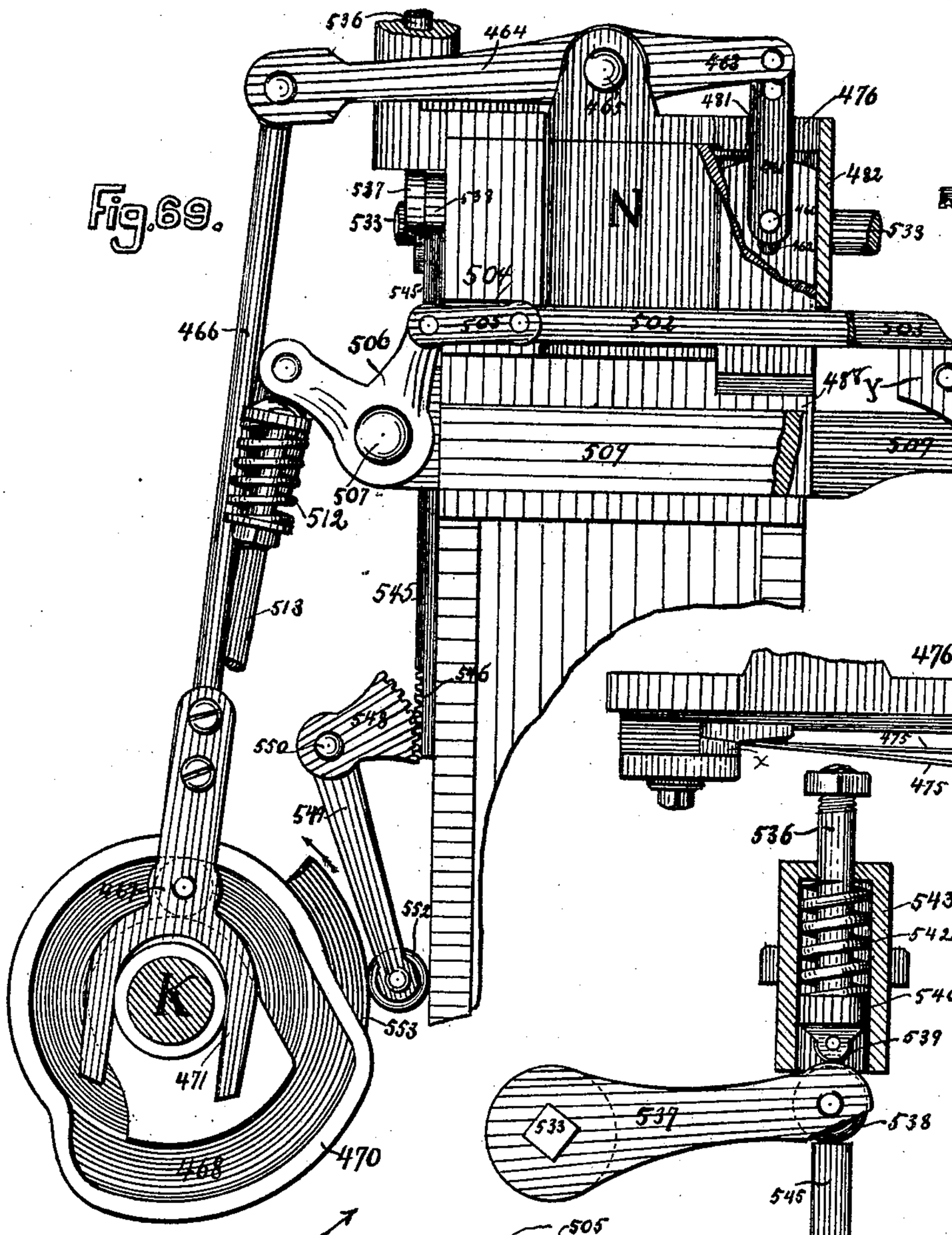


Fig. 70

Fig. 71a.

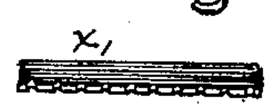
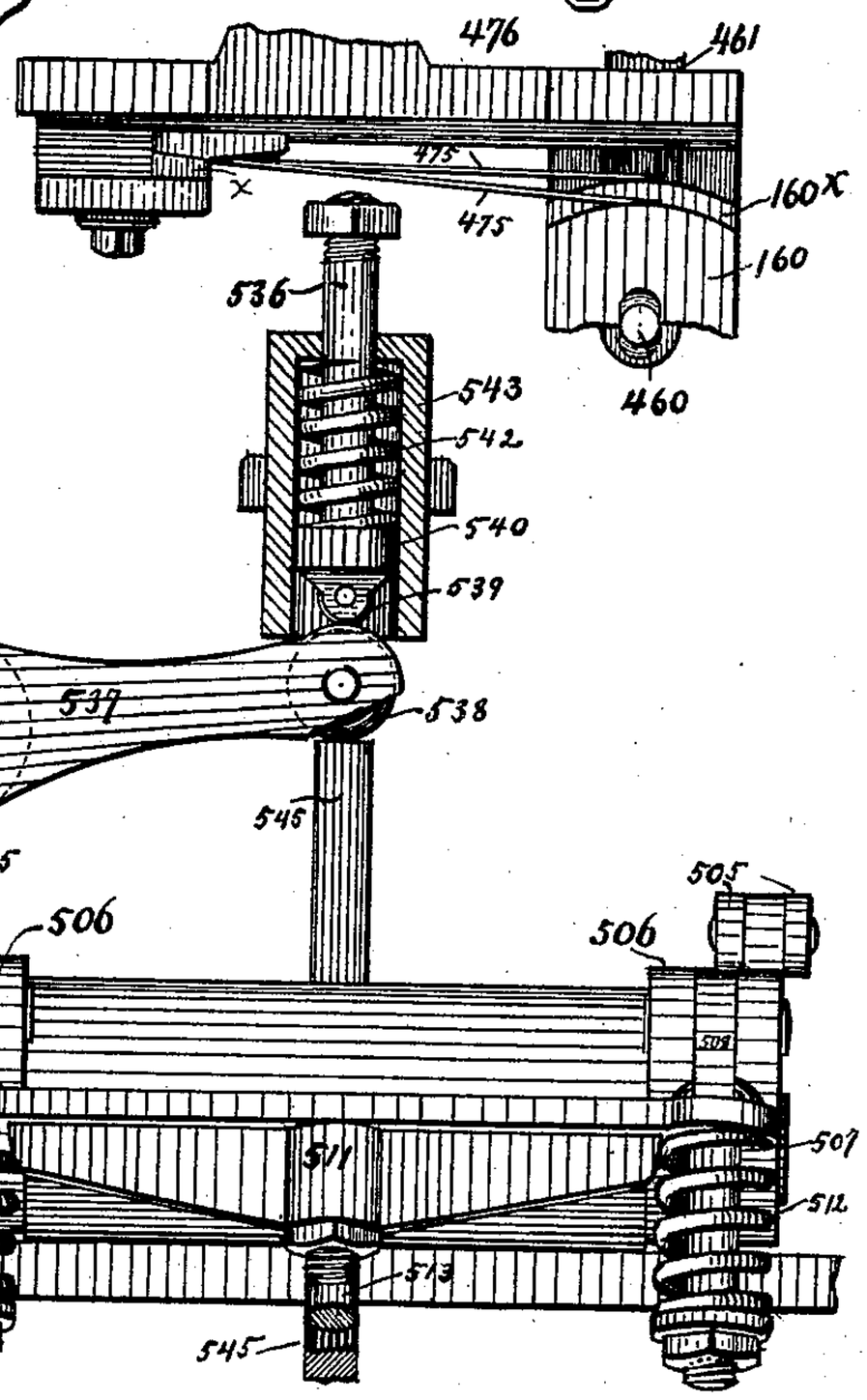


Fig. 71.



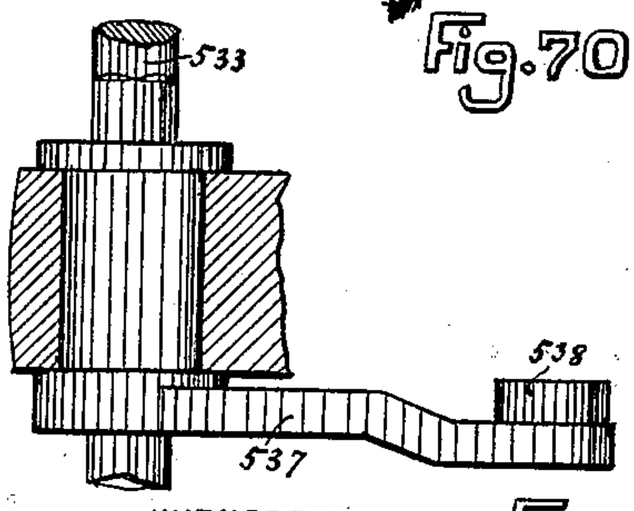


Fig. 70a.

WITNESSES:

Henry N. Brown.

Reuben Katz.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(No Model.) (Application filed Mar. 10, 1897.)

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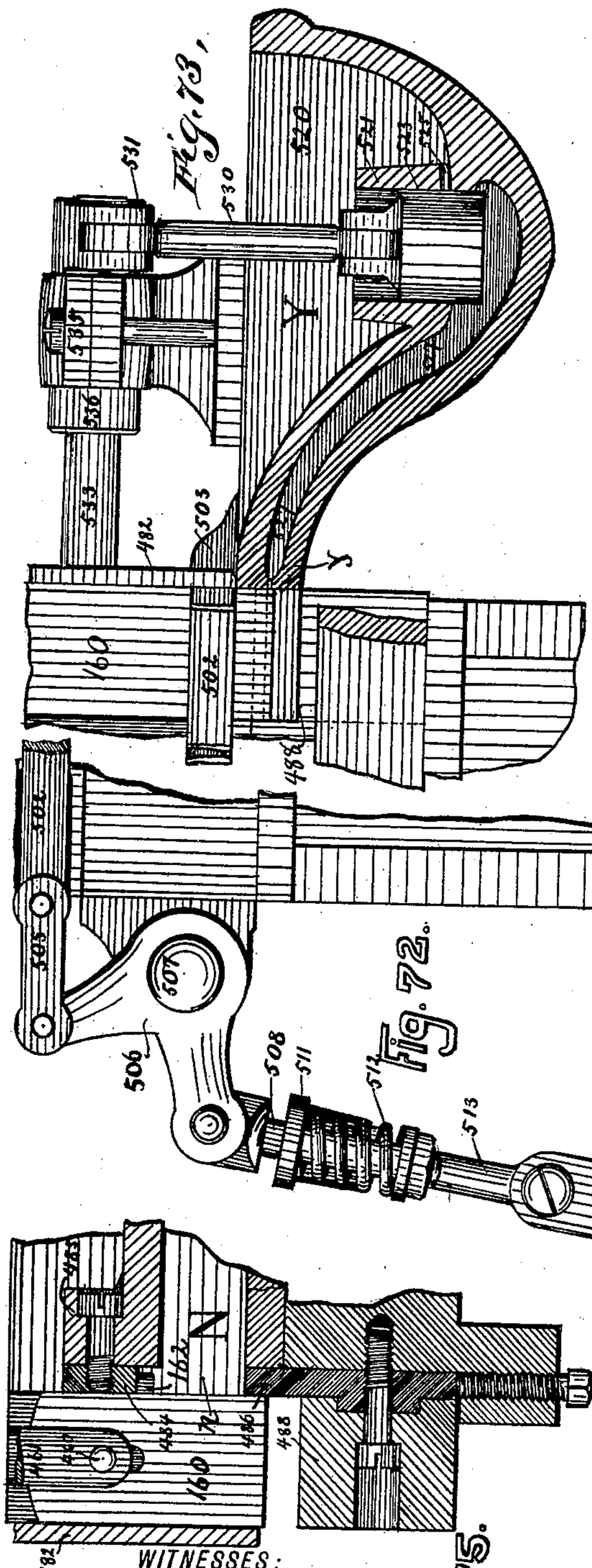

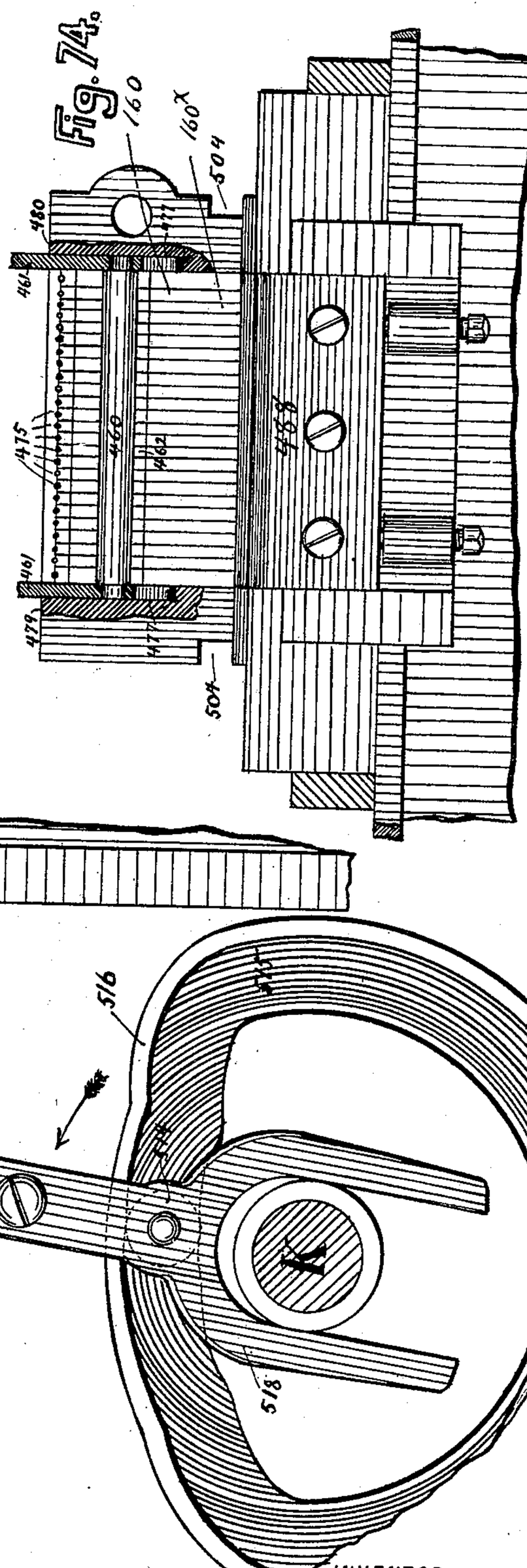

WITNESSES:

Henry N. Brown.

Reuben Wolf.

INVENTOR

William Berri

BY

D. Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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Fig. 100.

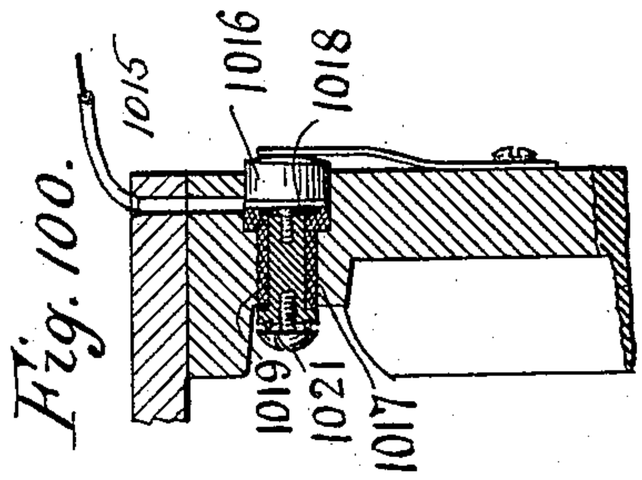

Fig. 99.

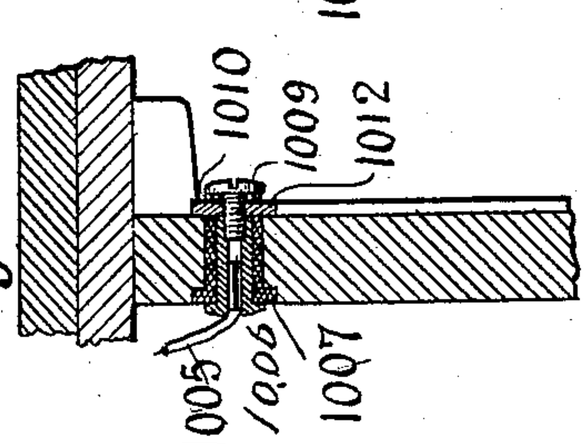

Fig. 76.

WITNESSES:
Henry V. Brown.
Reuben Hall

INVENTOR
William Berri
BY
D. Walter Brown
his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 26.

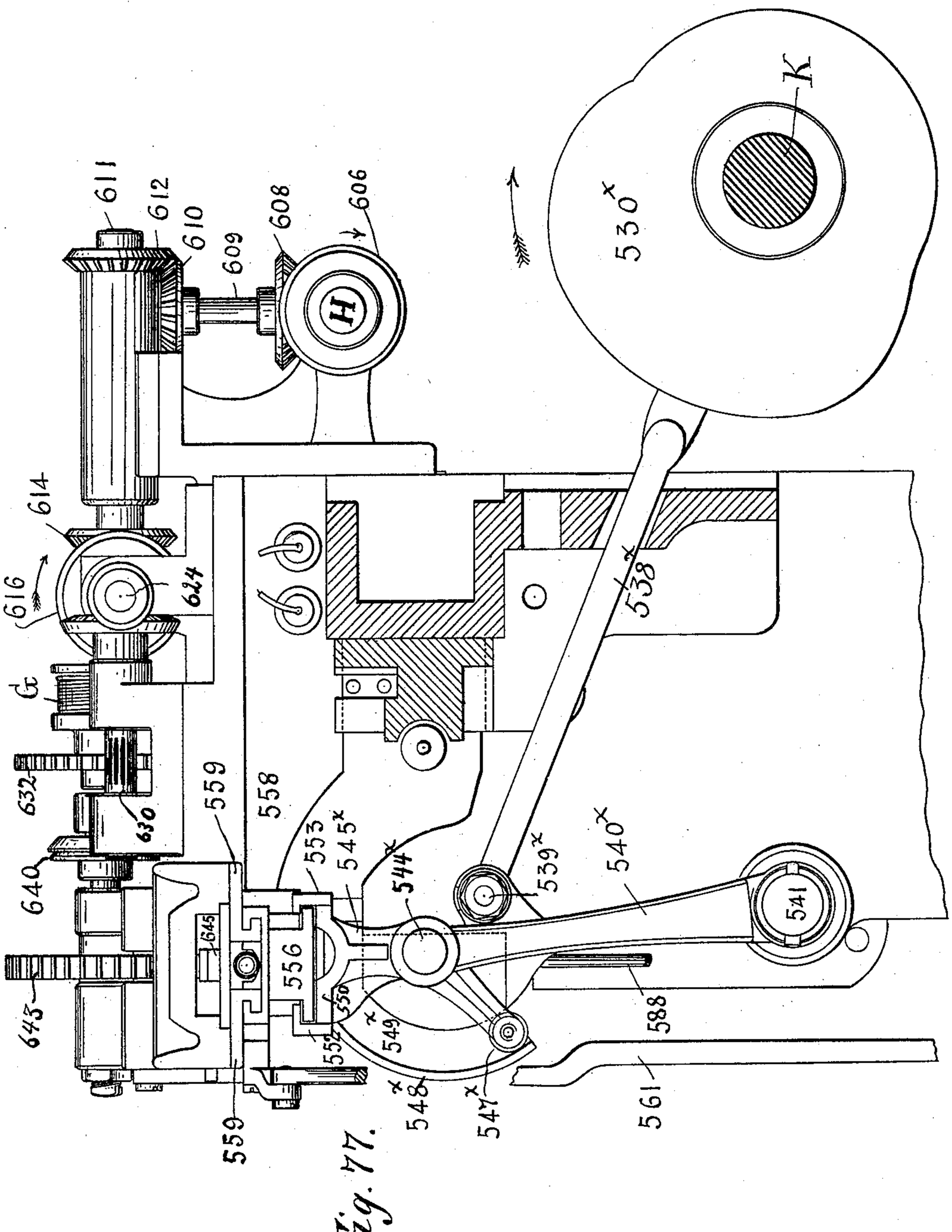

Fig. 77.

WITNESSES:
Henry V. Brown.
Reuben G. Katz

INVENTOR
William Berri
BY
D. Walter Brown
His ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(No Model.) (Application filed Mar. 10, 1897.)

41 Sheets—Sheet 27.

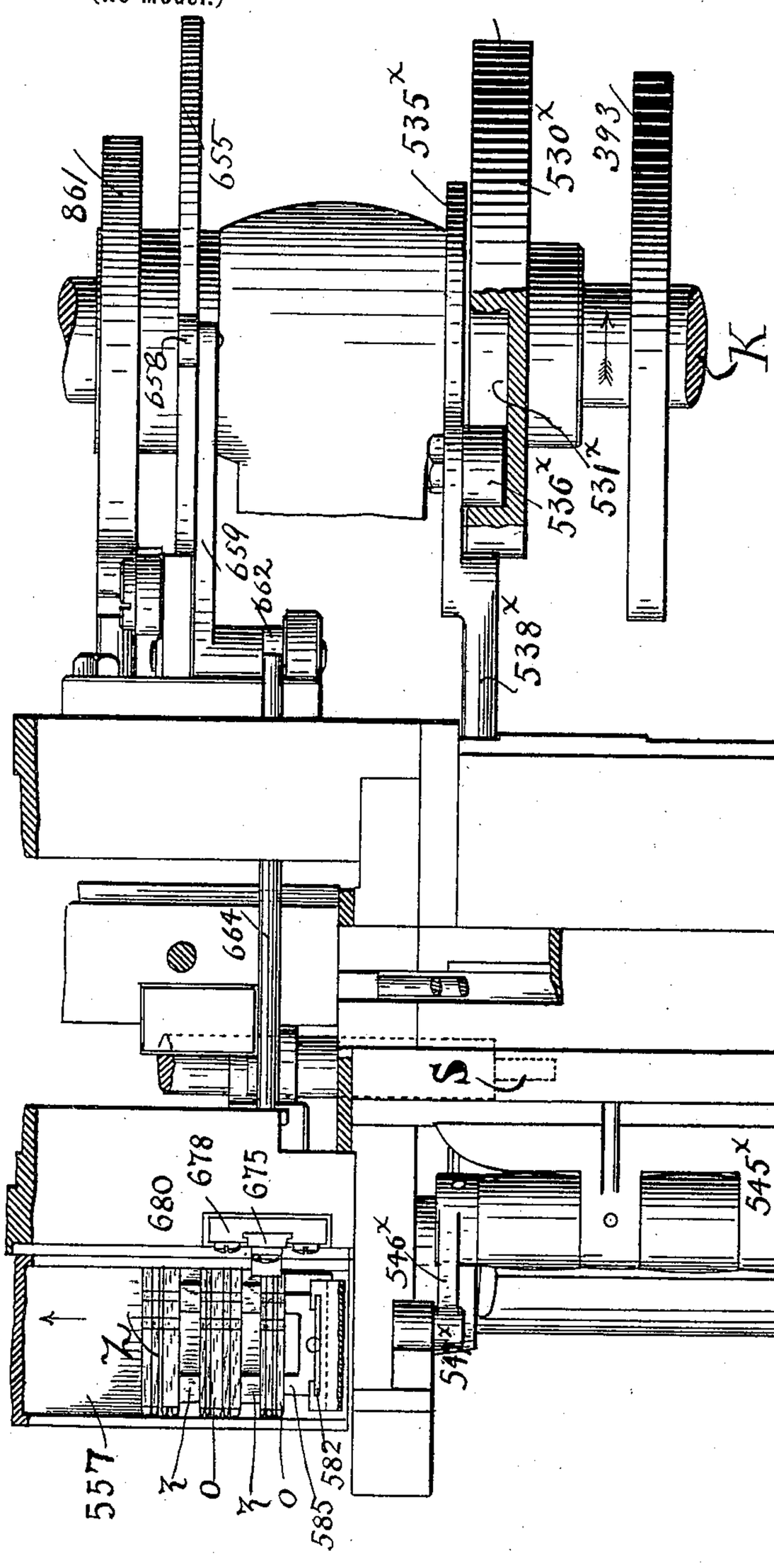

Fig. 78.

WITNESSES:
Henry V. Brown.
Albert H. Katz.

INVENTOR
William Berri
BY
D. Walter Brown
His ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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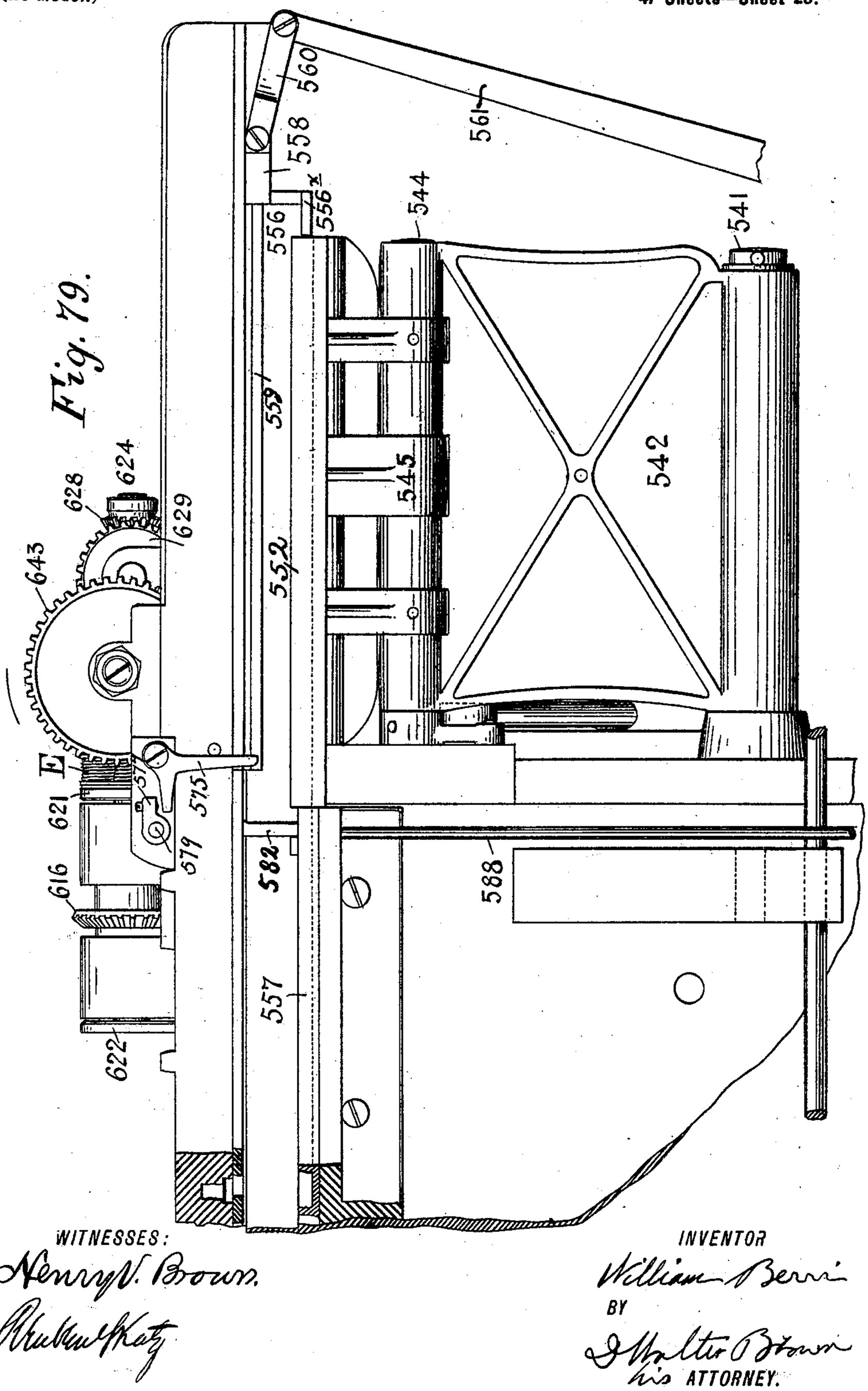
Fig. 79.



WITNESSES:

Henry V. Brown.

Reuben Katz

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.)

41 Sheets—Sheet 29.

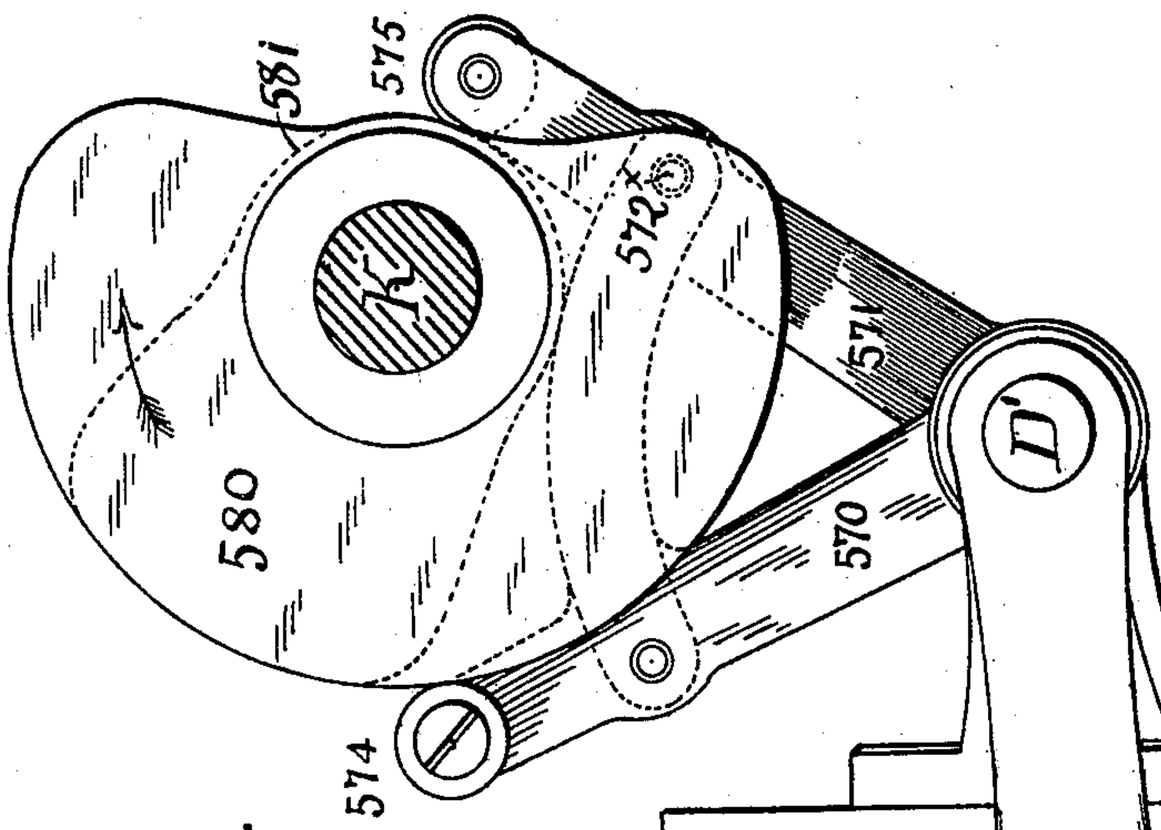


Fig. 104.

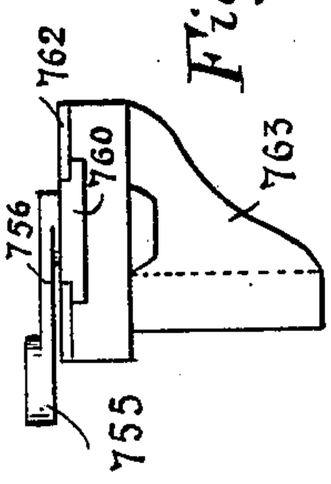


Fig. 80.

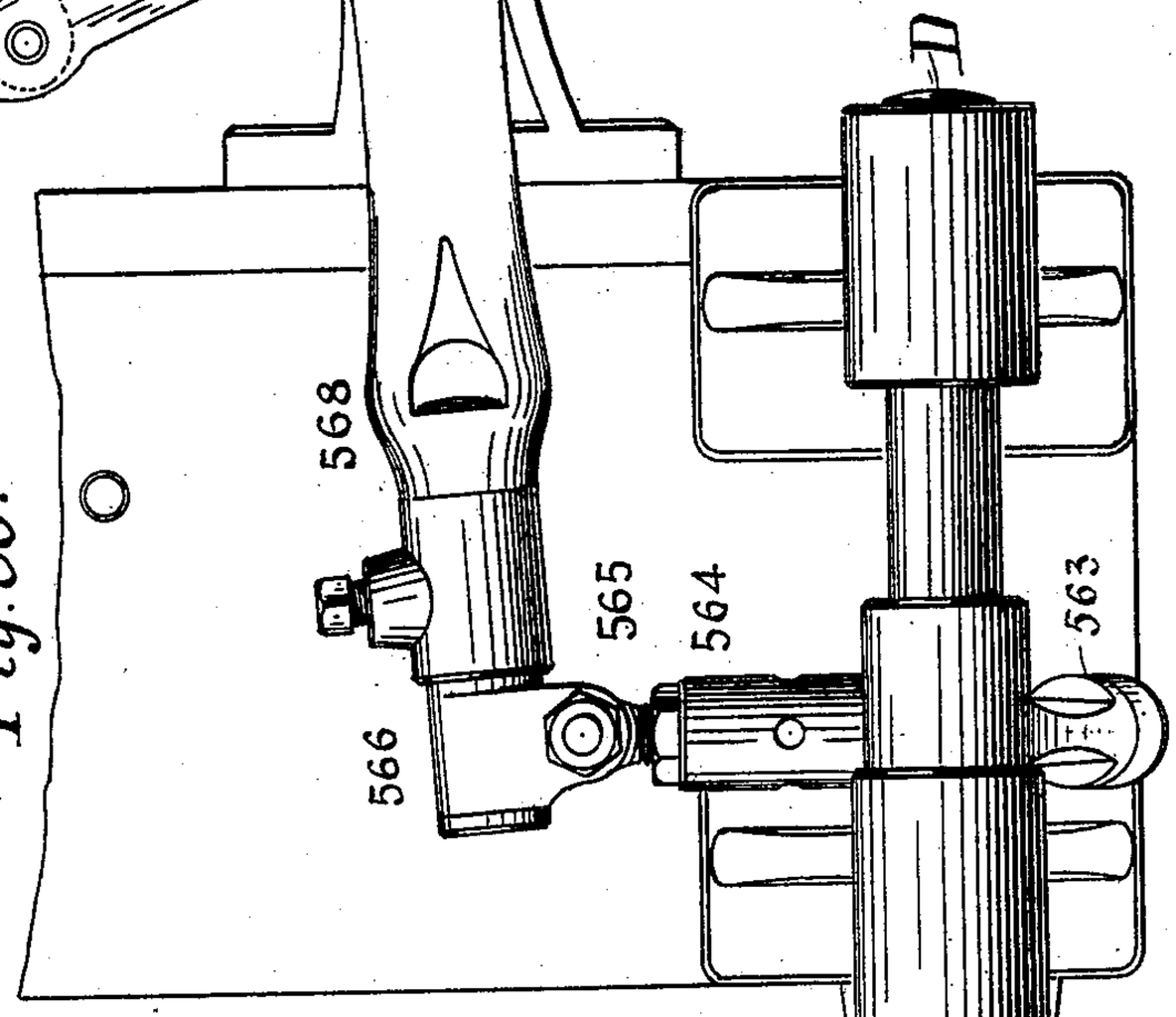
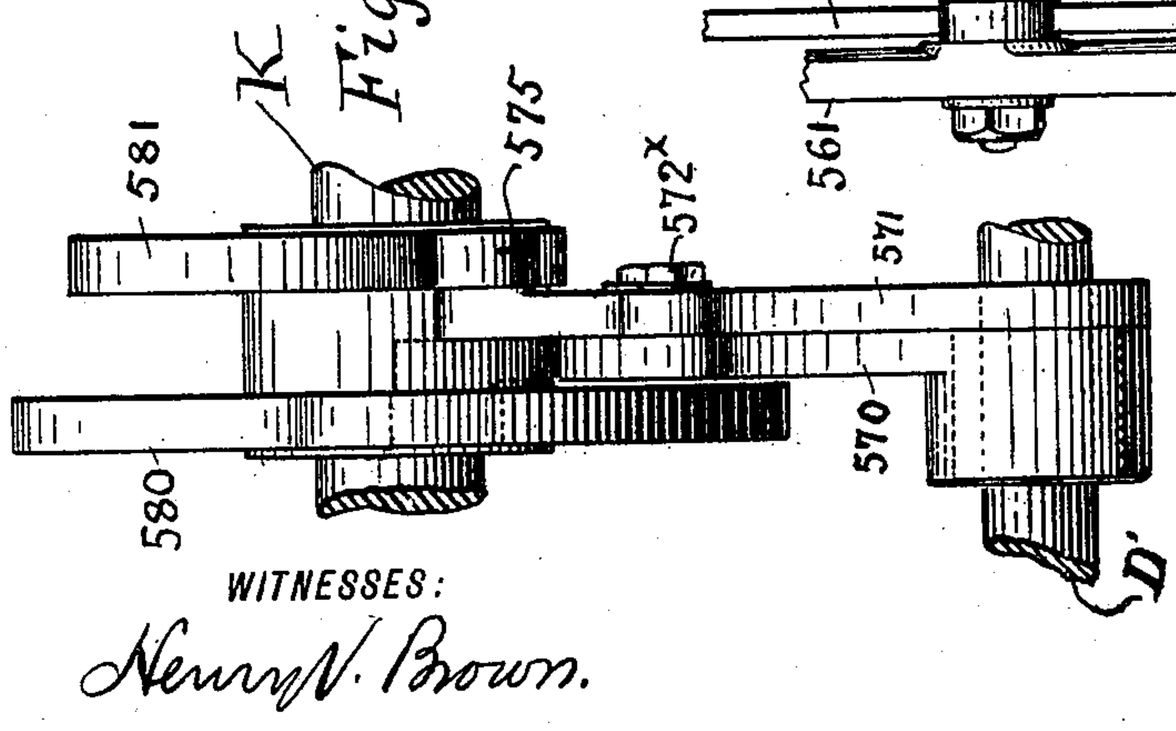


Fig 81



WITNESSES:

Henry V. Brown.

Richard Katz.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

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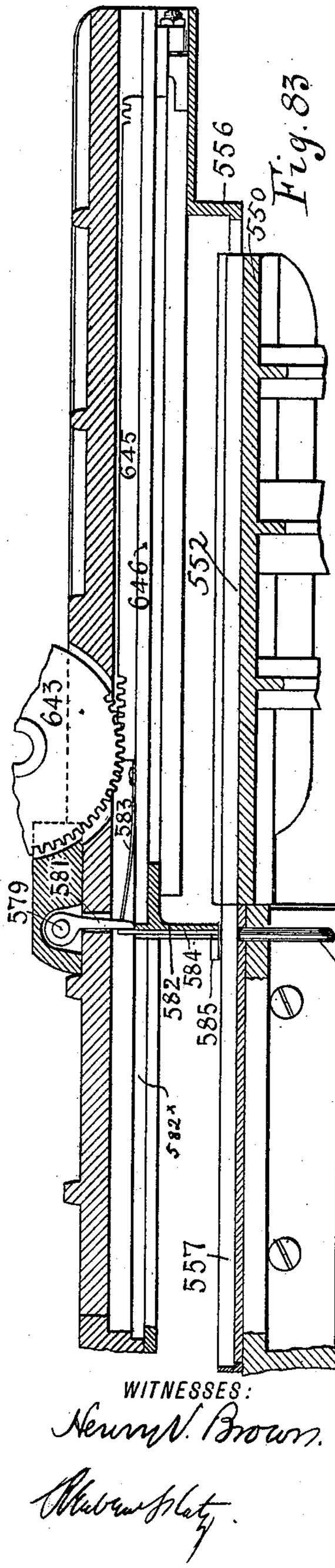

Fig. 83.

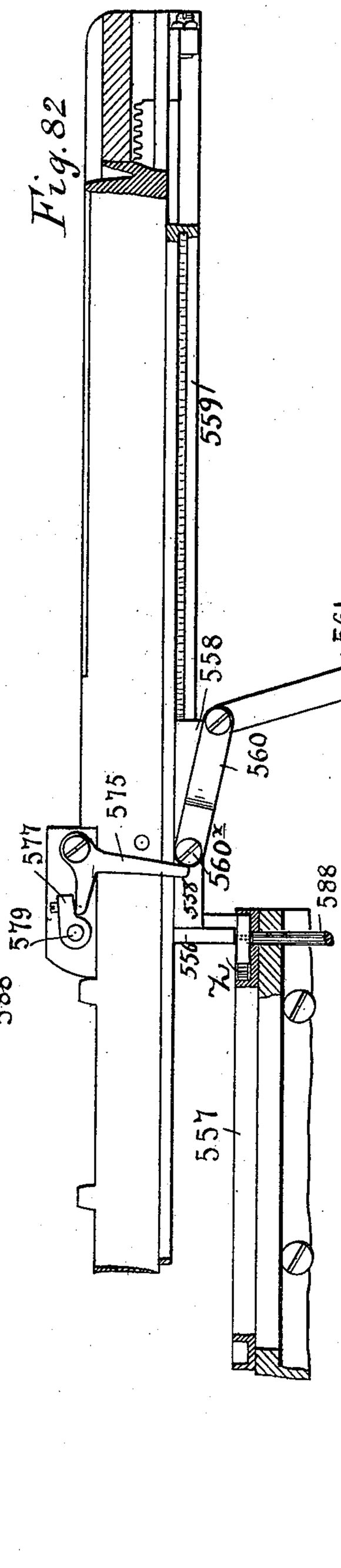

Fig. 82.

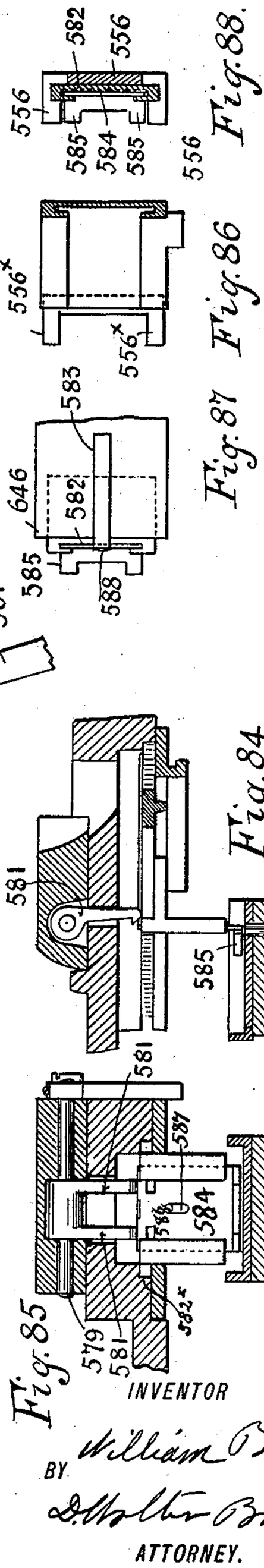

Fig. 88. Fig. 86. Fig. 87.

Fig. 84. Fig. 85.

WITNESSES:

Henry V. Brown.

Thos. J. Haley.

INVENTOR

William Berri

BY D. Walter Brown

ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 31.

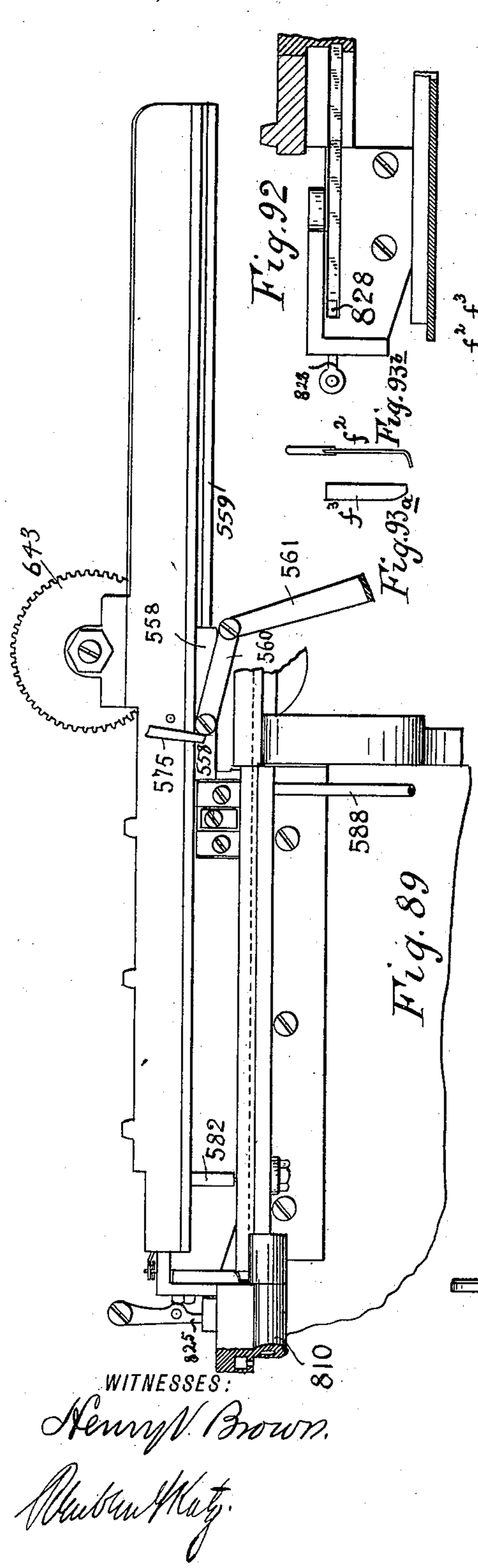

Fig. 89

Fig. 92 Fig. 93a Fig. 93

Fig. 93a

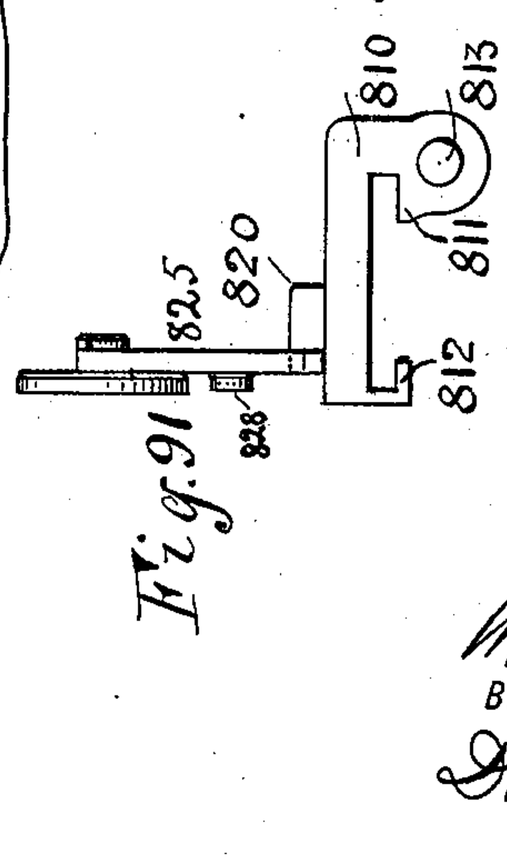

Fig. 91

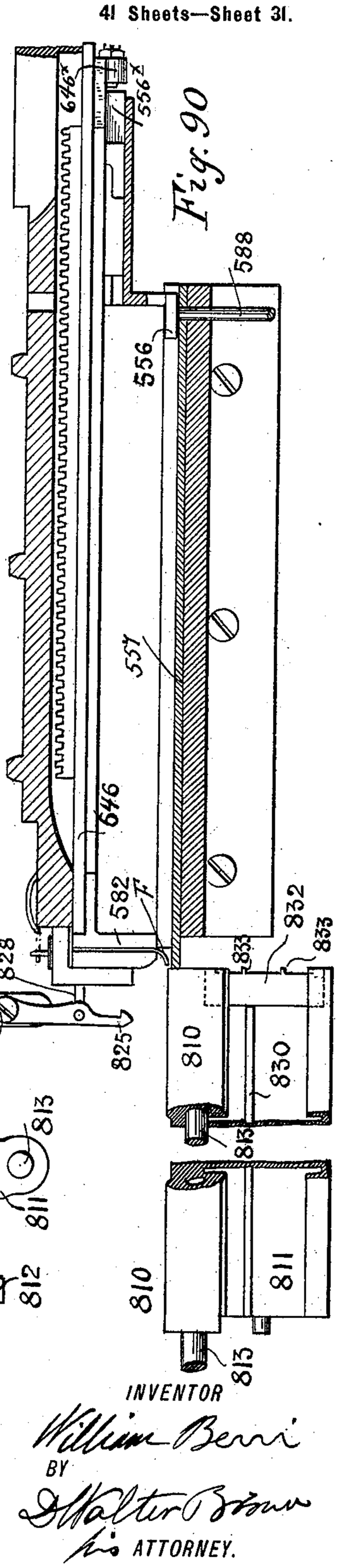

Fig. 90

WITNESSES:

Henry V. Brown.

Reuben Katz.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.)

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Fig. 94a

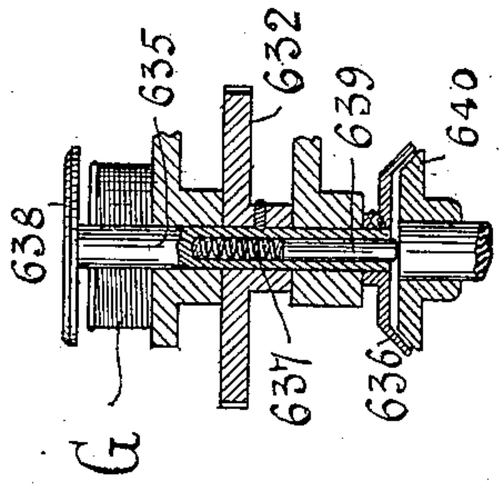
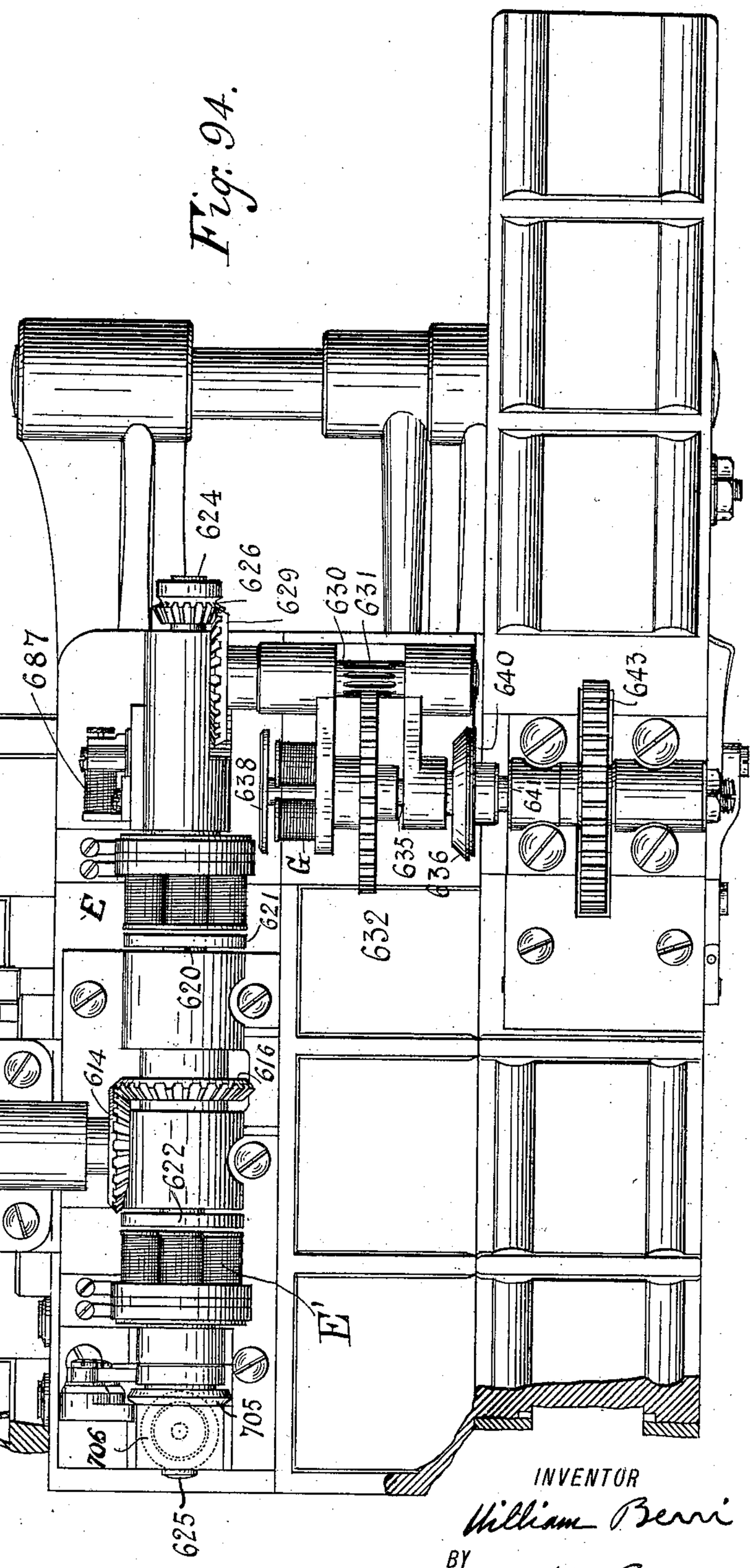


Fig. 94.



WITNESSES:

Henry N. Brown.

Charles F. Katz.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 33.

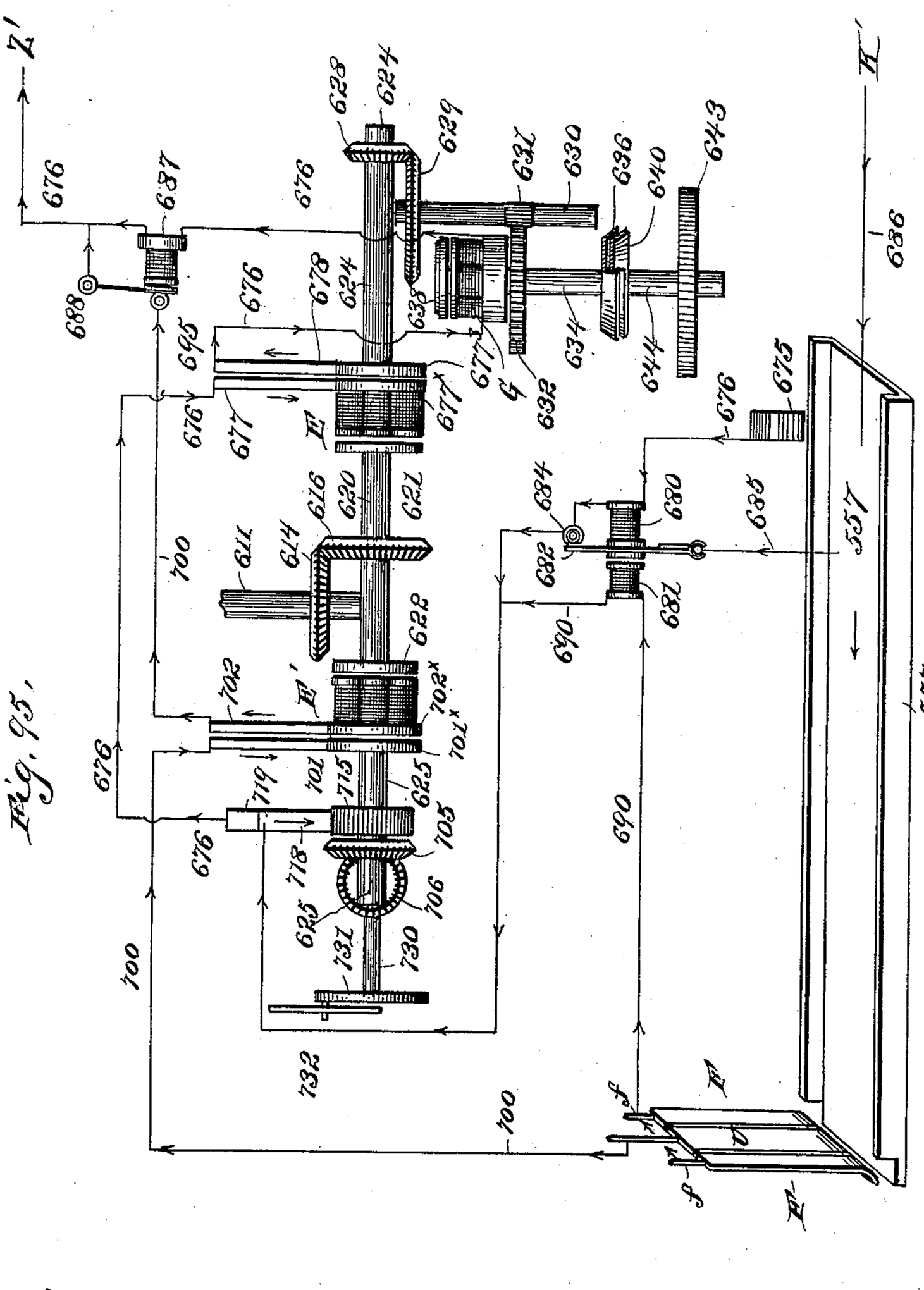


Fig. 95.

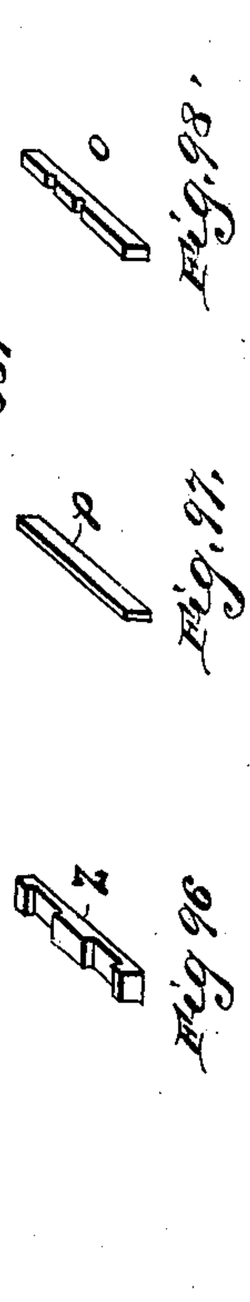


Fig. 98.

Fig. 97.

Fig. 96

Witnesses:
Henry V. Brown.
Bernard L. Recke

Inventor:
William Berri
by Dodger Brown
his attorney

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 34.

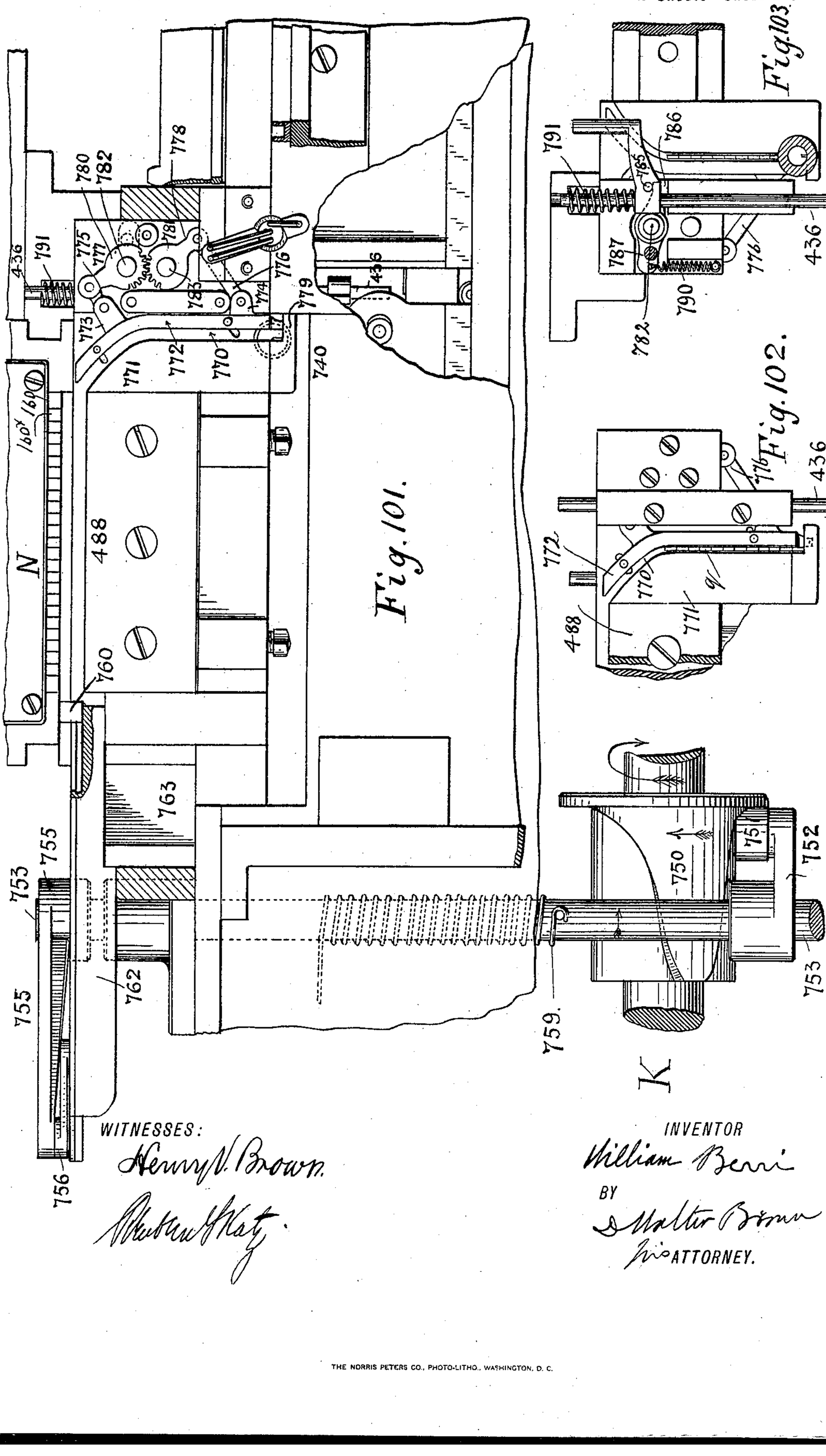


Fig. 101.

Fig. 103.

Fig. 102.

WITNESSES:

Henry N. Brown.

Robert F. Kay.

INVENTOR

William Berri

BY

Walter Brown

his ATTORNEY.

No. 612,010. Patented Oct. 11, 1898.

W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 35.

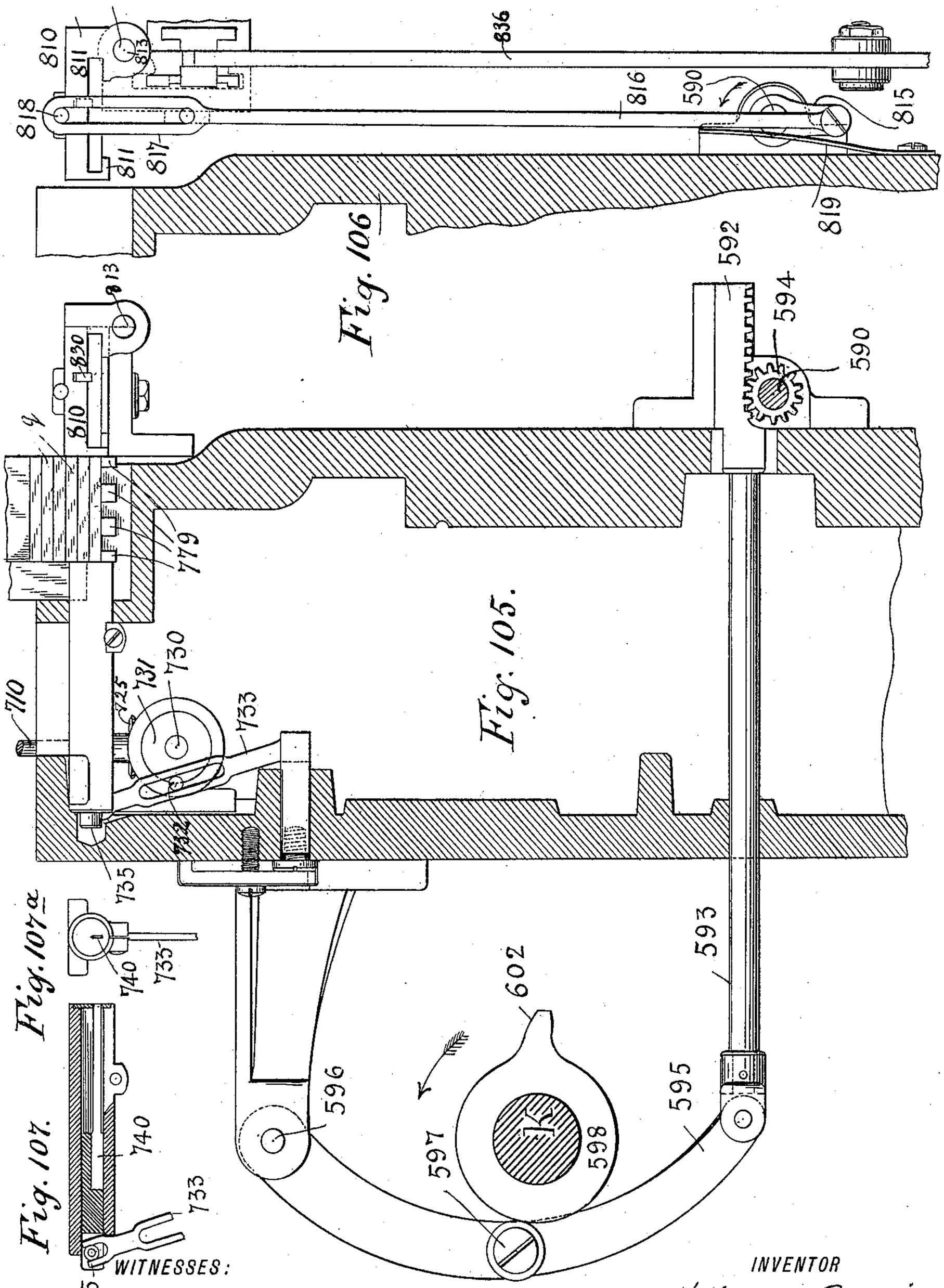


Fig. 105.

Fig. 106.

Fig. 107.

Fig. 107a.

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No. 612,010. Patented Oct. 11, 1898.

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(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 36.

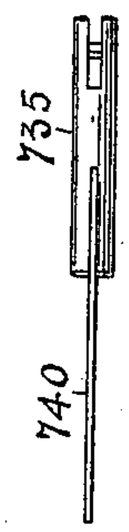

Fig. 108a

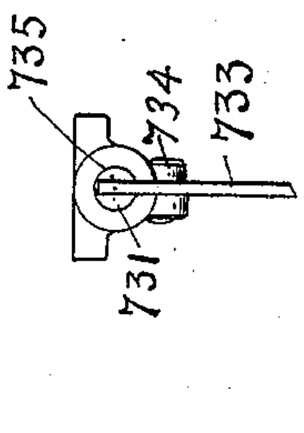

Fig. 108b

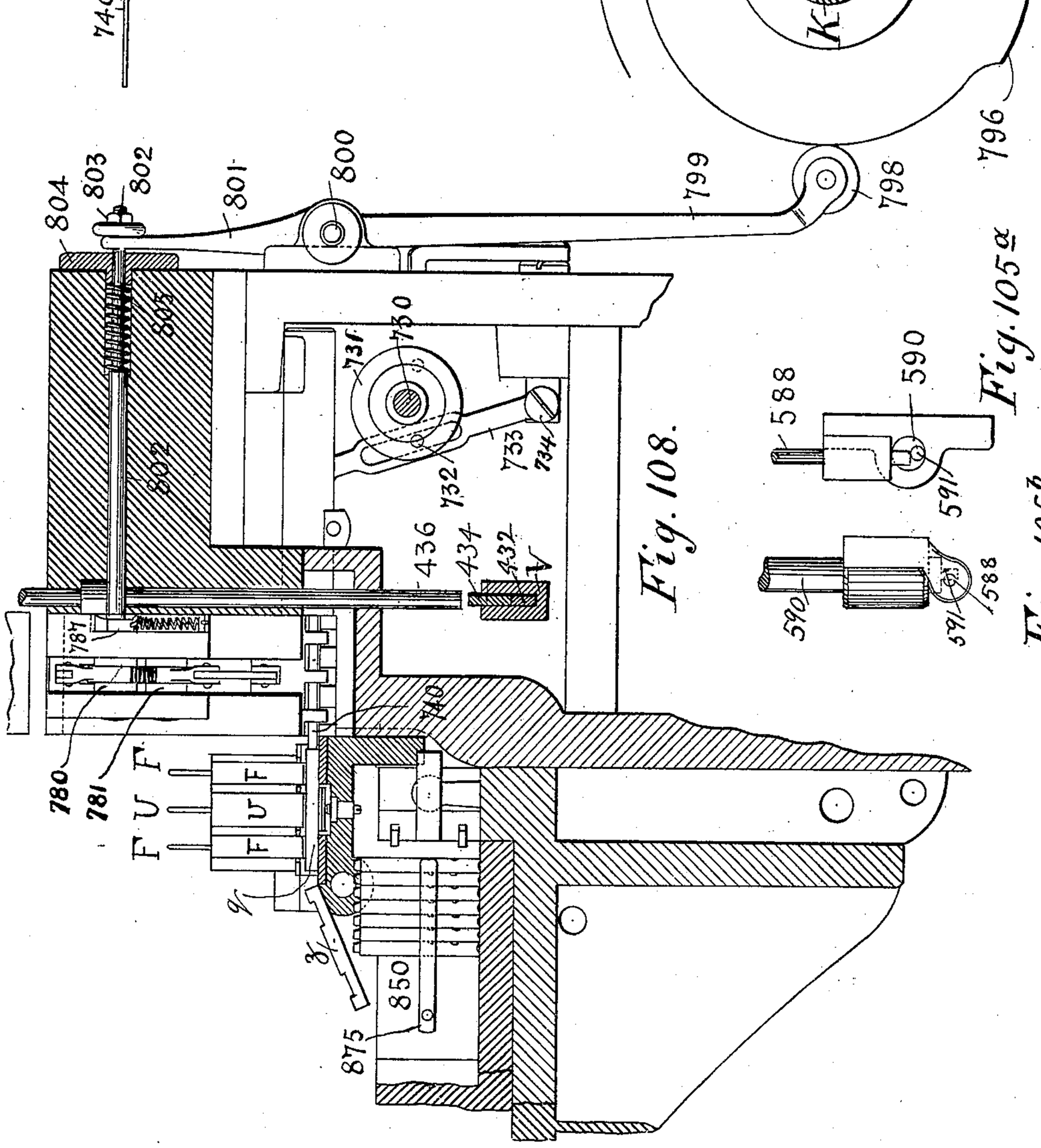

Fig. 108.

Fig. 105a

Fig. 105b

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(Application filed Mar. 10, 1897.)

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41 Sheets—Sheet 37.

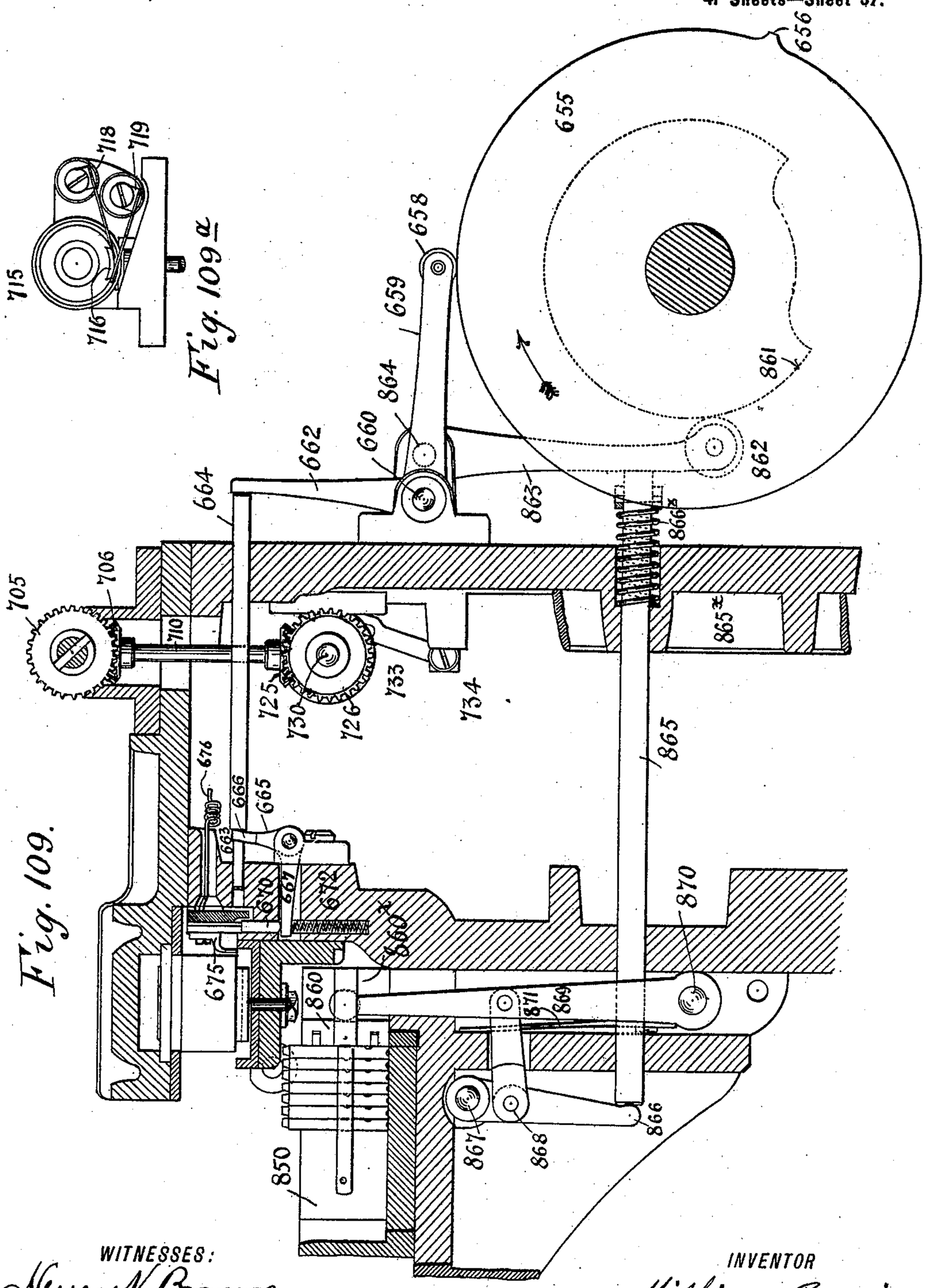

Fig. 109a.

Fig. 109.

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(No Model.) (Application filed Mar. 10, 1897.)

41 Sheets—Sheet 38.

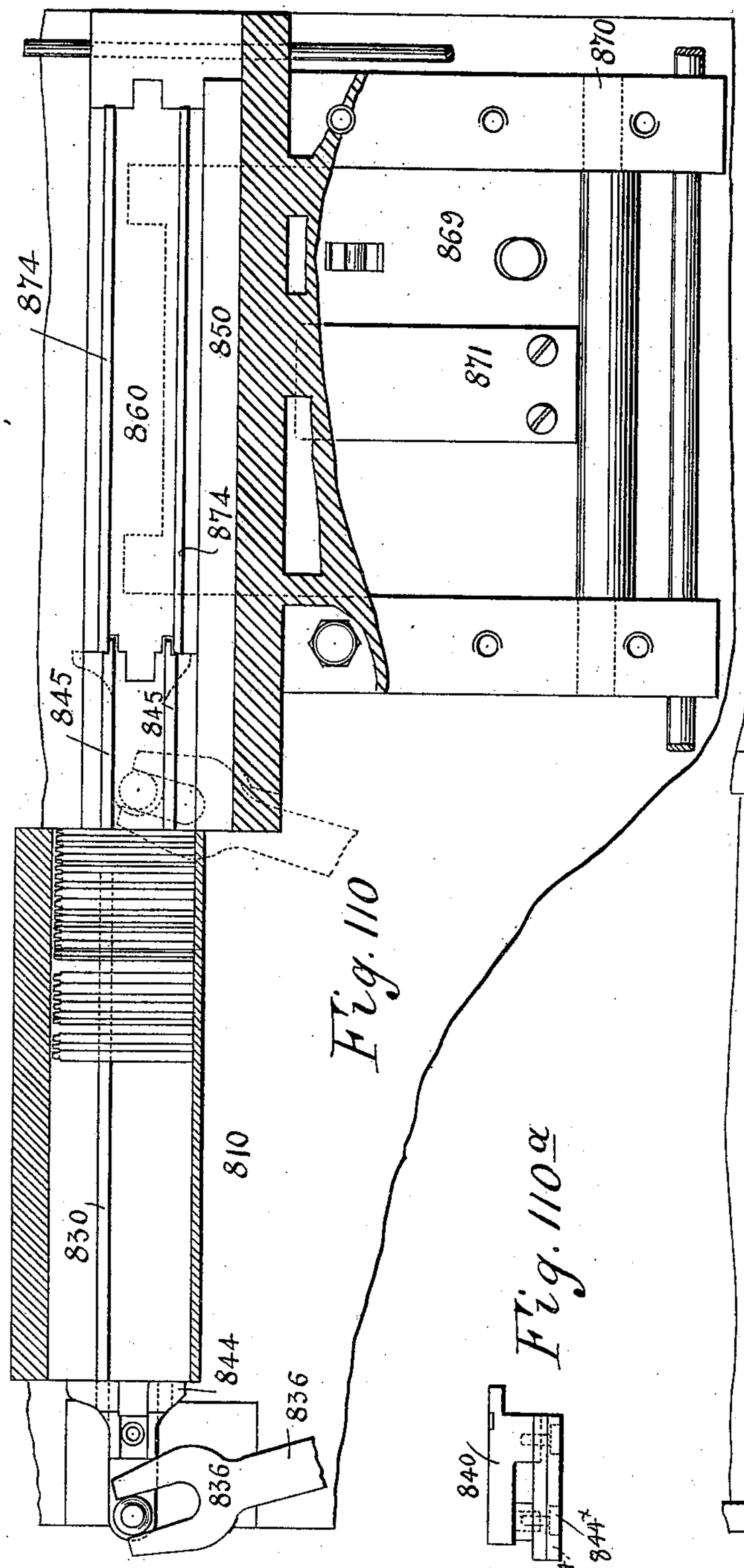

Fig. 110

Fig. 110a

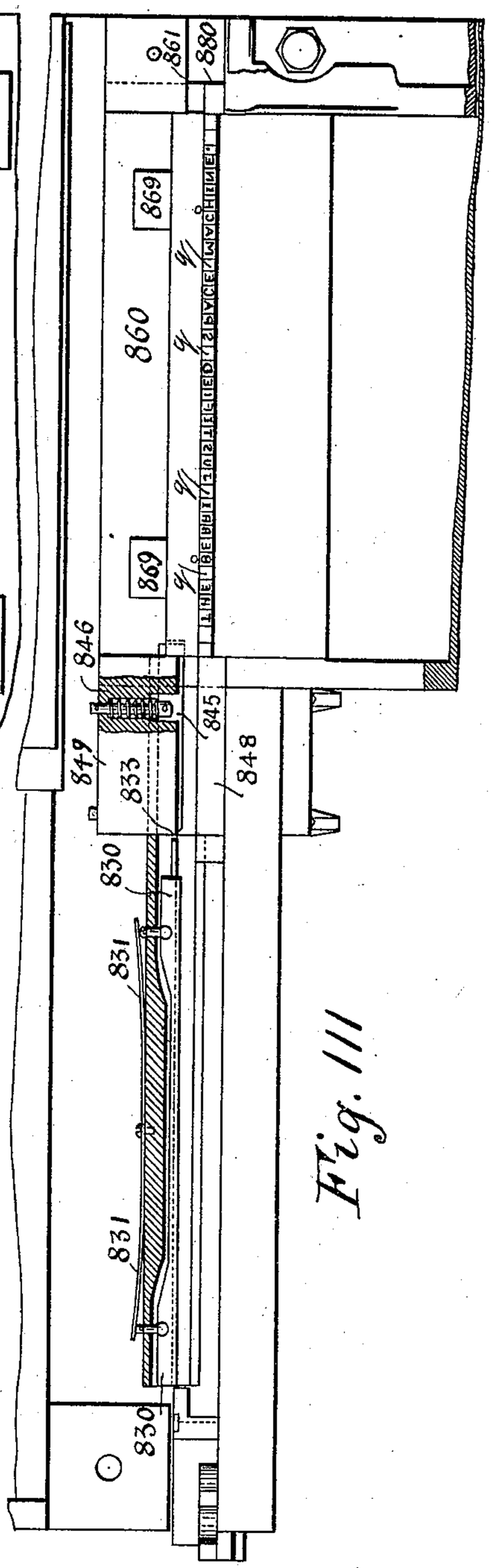

Fig. 111

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(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 39.

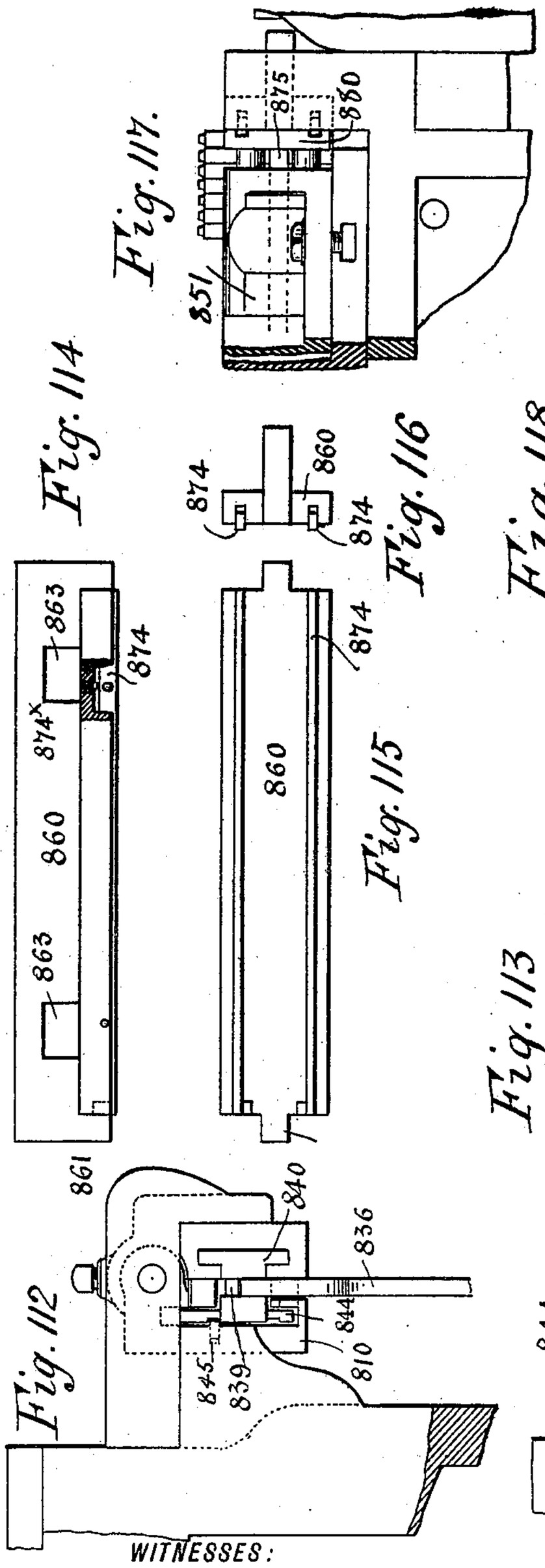

Fig. 112

Fig. 115

Fig. 116

Fig. 117.

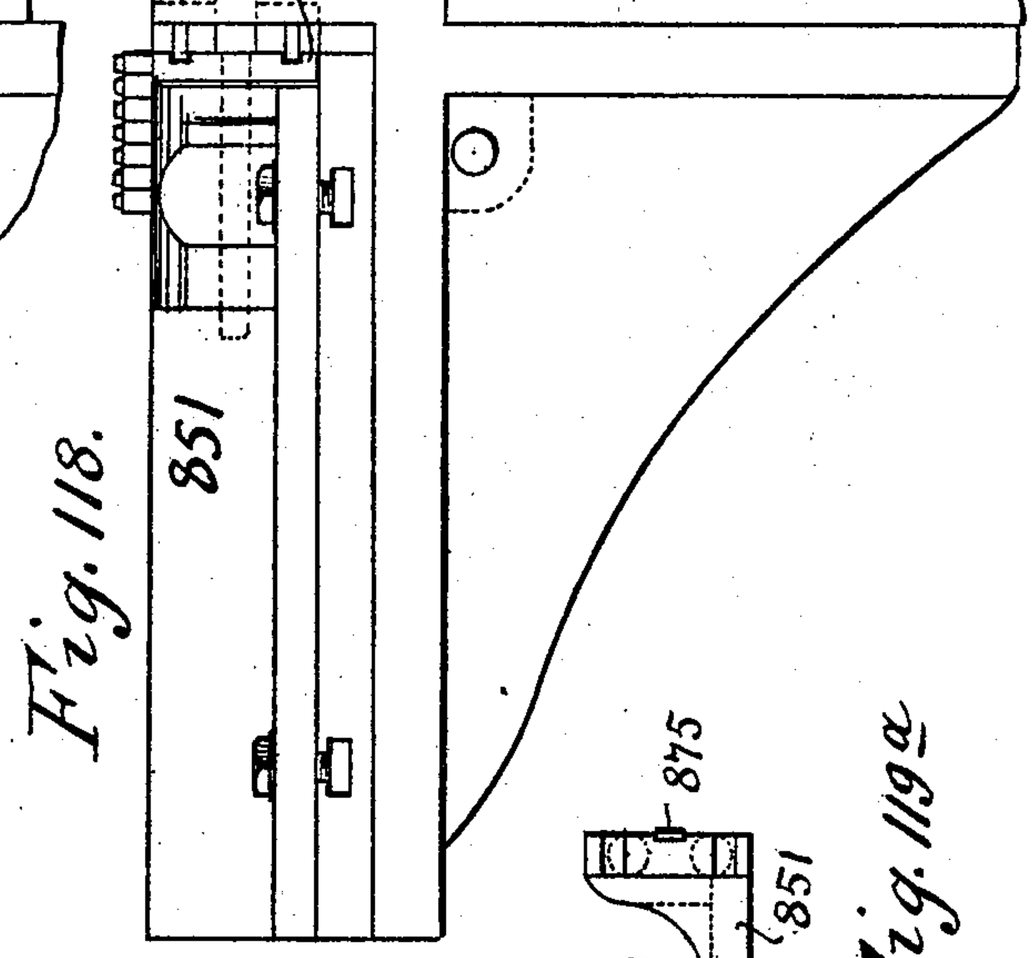

Fig. 118.

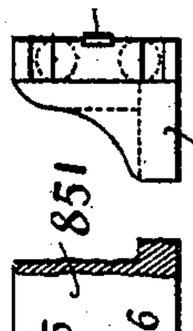

Fig. 119a.

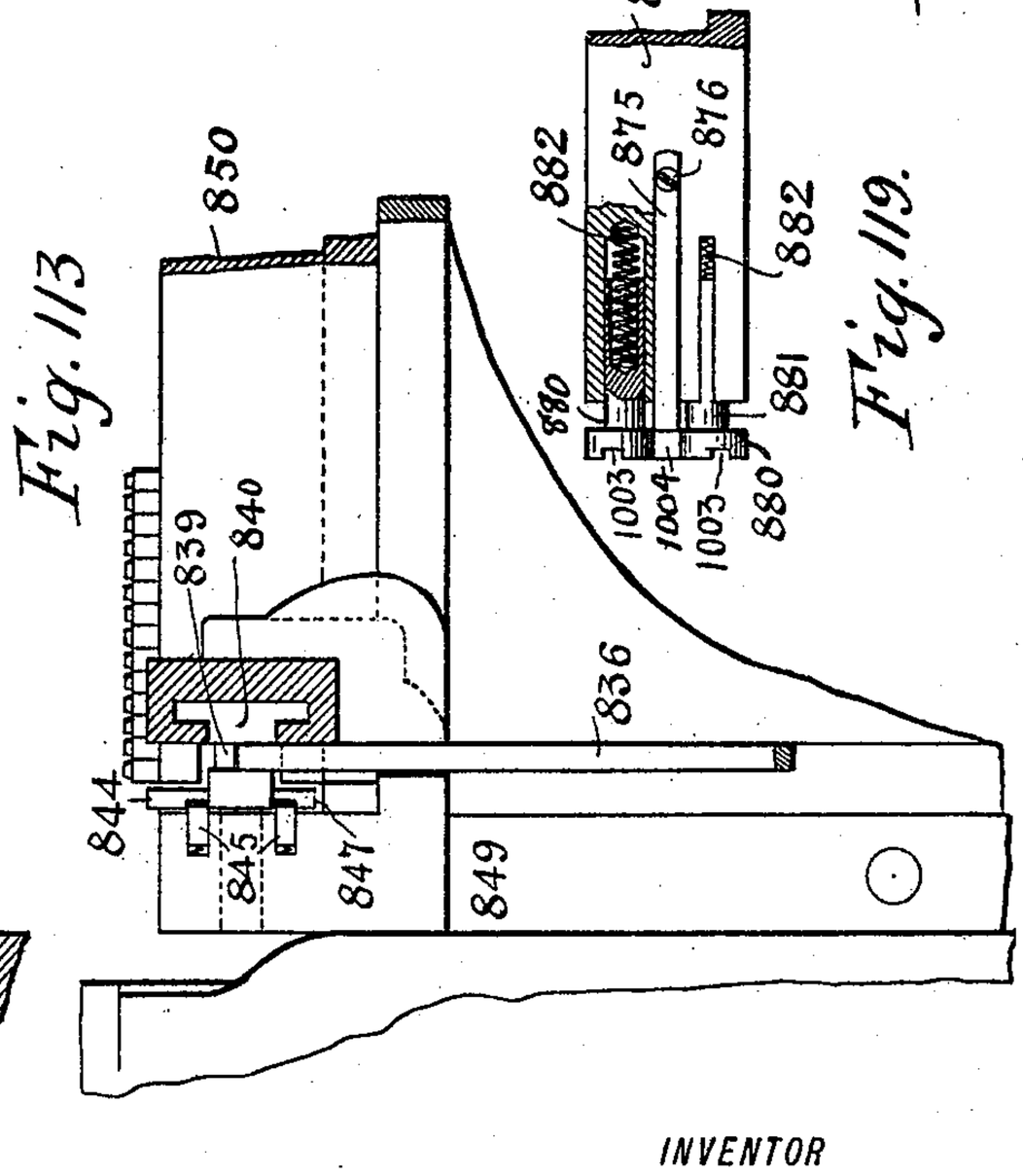

Fig. 113

Fig. 119.

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No. 612,010. Patented Oct. 11, 1898.

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MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 40.

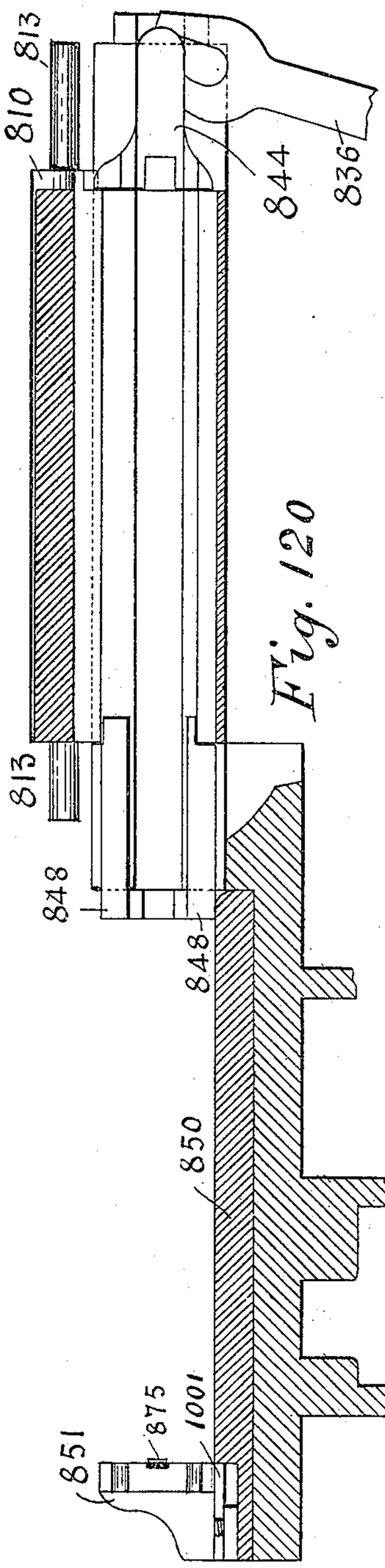

Fig. 120

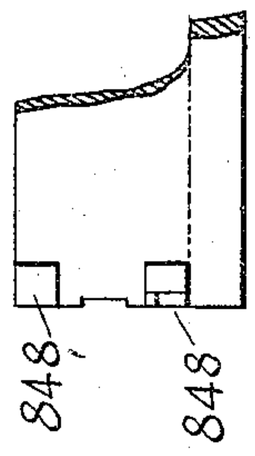

Fig. 122.

Fig. 121.

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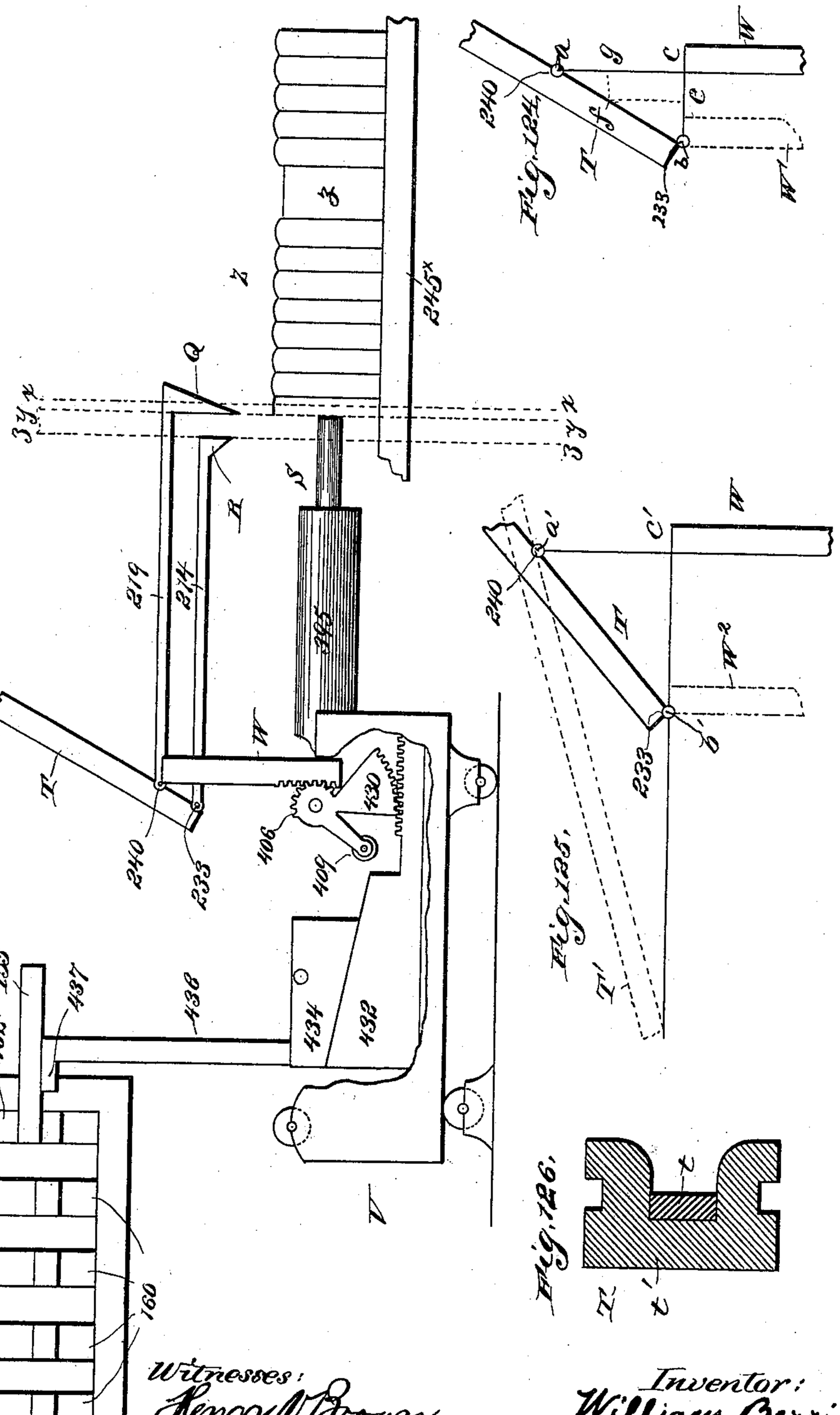
W. BERRI.

MACHINE FOR CASTING JUSTIFYING SPACES AND JUSTIFYING LINES OF TYPE.

(Application filed Mar. 10, 1897.)

(No Model.) 41 Sheets—Sheet 41.



Witnesses:
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Bernard Boecke

Inventor:
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his attorney

UNITED STATES PATENT OFFICE.

WILLIAM BERRI, OF NEW YORK, N. Y.

MACHINE FOR CASTING JUSTIFYING-SPACES AND JUSTIFYING LINES OF TYPE.

SPECIFICATION forming part of Letters Patent No. 612,010, dated October 11, 1898.

Application filed March 10, 1897. Serial No. 626,774. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BERRI, a citizen of the United States, and a resident of the city of New York, (Brooklyn,) county of Kings, and State of New York, have invented certain new and useful Improvements in Machines for Setting and Justifying Type, of which the following is a specification.

My invention relates to improvements in machines for casting justifying-spaces and justifying lines of type.

Especially the invention consists, in the first place, in the operative combination of means for assembling the type and means for casting justifying or "justified" spaces, which when inserted into the assembled line of type will justify the same; and in this respect the invention also consists in the combination of a magazine for space-slugs, forming a part of the means for assembling the lines of type, a key for controlling the feed of the space-slugs from said magazine, and devices operatively connecting said key with the means for casting the justified spaces, so that said key and devices constitute the operative connection between the means for assembling the type-line and the means for casting the justified spaces, and the whole constitutes, in effect, one coöperative machine. The space-slugs are fed into the line wherever in general an ordinary space would be inserted in type-setting by hand, and thus the number of space-slugs in the assembled line determines the number of justified spaces which shall be cast, and the operating of the key of the space-slug machine sets in motion the means for casting that number of justified spaces, and at the same time for regulating the size of the opening of the molds, so that the spaces when cast and inserted in the line (and which spaces I term "justified spaces") shall exactly justify the line.

The invention also consists in means for casting all the justified spaces, be they few or many, at one operation, thereby saving a large amount of time over casting spaces singly.

The invention consists, further, in the combination, with the means for assembling the line of type and for casting the justified spaces of a line at a single operation, of means so operatively connected with these as to automatically remove the space-slugs from the line and insert the justified spaces in their places.

Referring to the drawings which accompany the specification to aid the description, Figure 1 is a front and Fig. 2 a rear elevation of the apparatus for casting the spaces and inserting same into the line of type. The keyboard of the devices for assembling the lines is omitted. Fig. 3 is a front and Fig. 4 a rear elevation of the devices for casting the justified spaces, the devices for inserting same into the line being removed. Fig. 5 is a right end and Fig. 6 a left end elevation of the same parts as are shown in Figs. 3 and 4. Fig. 7 is a front elevation, partly broken and with certain of the front parts removed and showing the pointers and certain shafts, gear-trains, and wedges operated through the movement of the key which releases the space-slugs from their magazine. Fig. 8 is an end elevation of certain parts, partly broken and showing the space-slug magazine, carrier-belt, keyboard, and connecting-rods and lever. Fig. 8ª is a detail of the universal link-shaft which connects the key of the space-slug magazine with the spacing apparatus. Fig. 9 is an elevation, on a large scale and as seen from the left of Fig. 11, of the escapement mechanism connected with the clutch, which, in connection with the key of the space-slug magazine, brings into operation the mechanism for registering the number of spaces to be cast and for opening the desired number of molds. This figure shows the escapement in the position assumed when the clutch has completed a half-revolution and forced the hook of the escapement over the end of the left-hand bell-crank. The dogs shown in Fig. 18 are omitted in this figure. Fig. 10 shows the same parts as Fig. 9, but in position to cause the clutch to operate the mechanism. Fig. 11 is a broken end elevation showing the relation of the escapement to the clutch. Fig. 12 is a top view of the same parts as are shown in Fig. 11, and Fig. 13 is a horizontal section through the same. Fig. 14 is an elevation as seen from the left of Fig. 13 of certain parts of the clutch in the position of rest, and the shell being broken away to show the interior. Fig. 15 is a face view of the same parts as are shown in Fig. 14, but in operative position. Fig. 16 is an edge view of the parts shown in Fig. 14 and

in the same position, part of the shell being removed to show the interior. Fig. 17 is an internal view of the escapement, the parts being in the position assumed when the clutch is revolving and before its pin 68 has come into contact with either of the escapements. Fig. 18 is an elevation of the escapement mechanism looking from the left of Fig. 11 and showing the pin of the clutch and the dogs on plate 21 in the position assumed when the clutch is at rest and its pin is bearing against the projection of escapement 75. Fig. 18ª is an edge view of plates 20 and 21 and the dogs which prevent the reverse motion of the cam detached from the other parts of the clutch. Fig. 19 is an elevation of the escapement mechanism as seen from the left of Fig. 11, plate 21 being removed and showing the hook of escapement 74 engaging bell-crank 10 and the parts at rest. Fig. 20 is a side view, partly sectioned, showing short shaft 36, its cam and ratchet devices, and the gearing through which shaft 36 operates the mechanism which determines how many space-molds will be opened; and Fig. 21 is an end view of the parts shown in Fig. 20. Fig. 21ª is a view of a pawl. Fig. 22 is a side view, and Fig. 23 a front view, on large scale, of the devices which return the mechanism which determines the number of space-molds to be opened to its normal position. The parts are in normal position. Fig. 24 is a front view, on large scale, showing the shafts, gear-trains, and tilting bar which aid in determining the degree to which the space-molds shall be opened and also the bar which determines the number of molds to be opened. Fig. 24ª is a section of the shell 176. Fig. 25 is a side view, on large scale, of the wedge-carriage and tilting-bar mechanism for determining the degree of opening of the space-molds and in normal position. Fig. 26 is a top view, partly broken, of the said wedge-carriage and tilting-bar mechanism and showing the gears and racks for moving the pointers which actuate the tilting bar. Fig. 27 is an end elevation, partly sectioned, of the same parts as are shown in Fig. 25. Fig. 28 is a top view, partly broken, of the wedge-carriage and the feeler which operates the wedges; and Fig. 29 is an end view of the same parts. Fig. 30 is a detail of the carriage-bracket and anti-friction-rollers for the feeler S. Fig. 31 is a side view, partly sectioned, of the tilting bar in its normal position, the vertically-reciprocating bar W against the lower end of the tilting bar, and the rack, gear, and horizontal bar which raise bar W and set the wedge which determines the degree of opening of the molds. The carriage and wedges are removed. Fig. 32 is a broken side view of the wedge-carriage, tilting bar, vertically-reciprocating bar, pointers, and feeler. The tilting bar is shown at its greatest inclination and the vertically-reciprocating bar has not yet risen. Fig. 33 shows substantially the same parts as Fig. 32, and the tilting bar is in the same position, but the vertically-reciprocating bar has now risen against the tilting bar. Fig. 34 shows substantially the same parts as Fig. 33 and the tilting bar in the same position, but the wedge-carriage is assumed to be in a different position, and the vertically-reciprocating bar has now risen against the other end of the tilting bar. In this figure the wedge 434 is at its highest position corresponding to the widest opening of the molds. Fig. 34ª is a broken side view of the horizontal bar 411 and the arm 409, which cause the rise of the vertically-reciprocating bar W, which bar W is shown in Figs. 31 to 34, inclusive. The arm 409 is shown in Fig. 34ª in its lowest position, which corresponds to the highest position of said bar W. Fig. 35 is a side view, partly sectioned, showing the cam mechanism for raising and lowering said horizontal bar. The position corresponds to that of Fig. 31. Figs. 36, 37, and 38 are representations of wedges for three different fonts of type. Fig. 39 is a side view, partly sectioned, showing the rods of the pointers and the racks, pinions, and vertical shafts for moving same. The lower portions of the vertical shafts are shown on larger scale in Fig. 24. Fig. 40 is a plan view of the rod of pointer Q with its rack and pinion and the yoke which is pivotally connected with the tilting bar; and Fig. 41 is a corresponding view of the rod of pointer R and similar parts, Fig. 41ª being an end view of Fig. 41. Figs. 40 and 41 should be compared with Figs. 25 and 26. Fig. 42 is a vertical sectional elevation, on large scale, of the cam mechanism for raising the mold-plates and showing the end of the wedges and the vertical rod which determines the degree of opening of the molds. All said mold-plates are shown in the highest position. The plane of this figure is parallel to that of Fig. 5. Fig. 42ª is a sectional detail of the indicator. Fig. 43 is a broken view showing the mold-plates and several other of the parts seen in Fig. 42. The vertical rod has now descended upon the wedge and the mold-plates are set to cast some certain spaces. Fig. 44 is a broken top view, on large scale, of the mold-plates and means for raising and lowering the same. Fig. 45 is a rear view, on large scale, of the mold-plates and means for raising and lowering same. This figure corresponds to Fig. 44 and shows six molds adjusted for casting certain spaces. Fig. 46 is an end elevation of the rack and plate for determining the number of molds which are to be opened, and Fig. 46ª is an elevation of the front of the indicator. Fig. 47 is a top view showing the cam mechanism for actuating the hooks which move the line preparatory to gaging it and the feeler and pointers and their rods in the normal position before any space-slugs are fed into the line, Fig. 48 being a front elevation, and Fig. 49 a right end view, of the same parts. Fig. 50 is a top view of substantially the same parts as are shown

in Fig. 47, but in the position assumed when certain space-slugs have been fed into the line and the aforesaid hooks have moved to the left. In this figure the top plate near the front of the apparatus has been removed to show the hand-hook which is concealed in Fig. 47. Fig. 51 is a front elevation but with part of the frame cut away and the hook 256 removed. The parts are in the position of Fig. 50. This figure also shows the rock-shaft and cam for locking the apparatus until the line has been brought to the proper position by the hand-hook. Figs. 51ª and 51ᵇ are respectively front and right end views of the hand-hook. Fig. 52 is a detail in plan of said rock-shaft and cam and their connections with the pin which is acutated when the hand-hook moves to the extreme left of Fig. 50. Fig. 53 is a broken elevation of said rock-shaft and cam in the position when the line has been moved to the left, and Fig. 53ª is a detail of the cam. Figs. 54 and 55 are horizontal sectional details of the devices for bringing the line to its exact position to be gaged by the said feeler, Fig. 54 showing the parts in normal position, and Fig. 55 is the position when the line has been moved up. Figs. 54 and 55 should be compared with Figs. 65, 66, and 67. Fig. 56 is an elevation of the clutch mechanism for controlling the connection of the main cam-shaft K with the constant-motion shaft H and of the hook by which the operator controls the clutch. The parts are in the normal position. This figure also shows the rods of the pointers in section and the arm, cam, and rock-shaft of the device for locking the apparatus until the line is in proper position. Fig. 57 is an edge view, partly sectioned, of certain of the parts shown in Fig. 56, but the shell of the clutch and certain of its parts are removed. Fig. 58 is a similar view and of the same parts shown in Fig. 56, but the parts are now in the position assumed when the operator has raised the hand-hook to start the main cam-shaft K. Fig. 59 is a broken vertical section through the center of the clutch, the parts being in the position of Fig. 56. Fig. 58ª is a broken elevation of the lower part of the rod which effects the release of the clutch mechanism. Fig. 60 is a similar view and of the same parts as Fig. 56, but the parts are shown in the position they assume just after the cam-shaft K has begun to turn and the dog on the end of the hand-hook has been pushed off the arm of the bell-crank 280, so as to insure the stopping of the said cam-shaft when it has made one revolution. Figs. 61 and 62 are face views of the clutch mechanism, the front of the shell being removed, and respecively showing the parts in the position of rest and just before the cam-shaft has completed one revolution, Fig. 61ª being a detail of the cam which throws the clutch into operation. Fig. 63 is an edge view of the clutch, the shell being removed and in the position of Fig. 61. Fig. 64 is a plan of the shell of the clutch and showing the hook which engages the cam resting on the arm which operates the said hook. Fig. 65 is a view from the right end of Fig. 47 of the cam mechanism for operating the arm 365, Figs. 54 and 55, which comes behind and pushes the line when it is gaged. The position of the parts is the same as in Fig. 54. Fig. 66 is a view from the right of Fig. 47 of the cam mechanism for operating the bell-crank which vibrates arm 365, Figs. 54 and 55, and pushes the line exactly up to its gaging position. The position of the parts is the same as in Fig. 54. Fig. 66ª is a detail of the nut and locking device for regulating the play of said bell-crank. Fig. 67 is a detail of the shaft, sleeve, arms, and rollers which, in connection with cams 393 377, Figs. 65 and 66, operate said bell-crank and arm 365. Fig. 68 is a side elevation of the assembled line with its space-slugs in position for being gaged. Fig. 69 is an end view, partly broken, of the molds, the cam mechanism for operating same, and parts of the mechanism for bringing the casting-pot up against the molds. The parts are in normal position, all the mold-plates being in their highest position. Fig. 70 is a front elevation of the cross-heads and springs for bringing the nozzle of the casting-pot hard up against the face of the molds, and Fig. 70ª is a broken detail of the arm and shaft for operating the piston of the pump of the casting-pot. Fig. 71 is a broken elevation of the mold-plates and springs for depressing same. Fig. 71ª is a broken edge view of the block in which the ends of the springs are held. Fig. 72 is a broken elevation showing the cam mechanism for reciprocating the casting-pot. The parts are in the position assumed when the casting-pot is up against the face of the mold. Fig. 73 is a sectional elevation showing the casting-pot in position against the face of the mold. The piston is down to force the metal into the mold. Fig. 74 is a front view, partly broken, of the mold, all the plates being in the highest position. This figure shows the rod on which the plates are suspended. Fig. 75 is a broken sectional elevation on a plane parallel to that of Fig. 73 of the molds, showing the plates in highest position. This figure illustrates the construction of the mold-case. Fig. 76 is an elevation, partly sectioned, of the right end of Fig. 1, on a large scale, and showing the cam mechanism for turning the assembled line and raising it to the level of the channel in which the line is moved along during the removal of the space-slugs and the insertion of the justified spaces, the parts being in their normal position. Fig. 77 is an elevation, partly sectioned, of the same parts and on the same scale as are shown in Fig. 76, but said parts are now in the position assumed when the line has been turned and raised to the level of the channel. Fig. 78 is a broken plan view, partly sectioned, of the parts shown in Fig. 76, on the same scale and in the same

position. This figure shows part of a line of type in the channel and the line-feeder in position behind the line for pushing the same along in the channel. Fig. 79 is a broken front elevation of the parts shown in Fig. 76 and on the same scale, but in the position of Fig. 77. This figure also indicates the gears for operating the line-feeder. Fig. 80 is an elevation, on a large scale, of the cam mechanism for operating the means which push the line out of the turning devices into the channel. The parts appear as seen from the right of Fig. 1 and are in the position of rest. Fig. 81 is an edge elevation of the parts shown in Fig. 80 and on the same scale. Fig. 82 is a broken front elevation, partly sectioned and on a large scale, of the guideways, block, and lever for operating the pusher which pushes the line out of the turning devices into the channel. This figure also shows the line-feeder which moves the line along in the channel, the rod which raises the said line-feeder to its normal position after it has moved the line, and indicates a line in the channel. The parts are in the position assumed when the line has been pushed into the channel and the line-feeder has descended behind the line. Fig. 83 is a sectional elevation of most of the parts shown in Fig. 82 and on the same scale, but the pusher is removed. This figure also shows the hook which normally holds up the line-feeder. The parts are in the position assumed before the line-feeder has descended. Fig. 84 is a broken sectional elevation on the scale of Fig. 82 and showing the line-feeder and the hook therefor, but the line-feeder is now released from the hook and is in its lower position. Fig. 85 is an end elevation of the same parts on the same scale and in the same position as seen in Fig. 84. Fig. 86 is a plan of the line-pusher. Fig. 87 is a plan of the line-feeder and its bar 646, and Fig. 88 is a plan and section of the line-feeder in the pusher. Fig. 89 is a front elevation on the same scale as Fig. 82 and showing the line-pusher in the position assumed when the line has been pushed into the channel and the line-feeder has advanced nearly to the end of its movement, nearly all the type-line having entered the tumbler. Fig. 90 is a sectional elevation on a plane parallel with that of Fig. 82 and on the same scale and showing the line-feeder at the extreme end of its stroke. This figure also shows the rack for operating the line-feeder and the hook for retaining the tumbler in the raised position until released. The tumbler is shown down after having been released from said hook. This figure also shows the brushes which control the electric currents that effect the step-by-step movement of the line-feeder. Fig. 91 is an edge view of the hook engaging the tumbler, the latter being in the upper position in line with the channel. Fig. 92 is an elevation of the bracket which carries the brushes F F U and showing the pin which operates the hook to release the tumbler, and Fig. 93 is a plan of the bracket. Figs. 93^a, 93^b, and 93^c are details of the brushes and the insulating-holders of the same. Fig. 94 is a plan, partly broken and on large scale and showing the gear-trains which actuate the line-feeder and the spacing mechanism. This figure shows the magnets G, which operate the clutch which controls the movement of the line-feeder, and also the magnets E′, which control the devices which introduce the justified spaces into the line. Fig. 94^a is a sectional detail of the clutch which controls the operation of the line-feeder. Fig. 95 is a diagrammatical representation of the electrical circuits, magnets, brushes, and gear-trains for operating the line-feeder and the devices for introducing justified spaces into the line. Figs. 96, 97, and 98 are respectively perspective views of a space-slug, an ordinary or a justified space, and a type. Figs. 99 and 100 are sectional details illustrating convenient modes of carrying the electric circuits through the frame, so as to facilitate the removal of parts of the machine. Fig. 101 is a front elevation, partly broken and on large scale, of the mechanism for effecting the adjustment of the justified-space magazine for spaces of different widths, also the cam mechanism for pushing the justified spaces from the base of the mold N to said magazine. This figure shows the magazine wide open in normal position. Fig. 102 is a front elevation of the magazine adjusted for thin spaces, and Fig. 103 is a back elevation of the same and showing parts of the mechanism for adjusting the magazine and locking it after it is adjusted. Fig. 104 is an end elevation of the pusher 760 and its operating-arm 756 for pushing the justified spaces into the magazine. Fig. 105 is an elevation, partly sectioned and on large scale, of the mechanism which pushes the justified spaces into and the space-slugs out of the line. This figure also shows the cam mechanism for rocking shaft 590, which actuates the means for raising the tumbler to a level with the channel in which the line is advancing, so that the tumbler can receive the line. Said shaft 590 also carries the eccentric-pin seen on Fig. 105^a, which operates rod 588, that lifts the line-feeder to its normal position. This figure is as seen from the left of Fig. 1, the frame being removed, and the parts are in normal position, the tumbler being flat and at the level of the channel. Figs. 105^a and 105^b are respectively an end view and a plan of said shaft 590, with its eccentric-pin. Fig. 105^a also shows said rod 588. Fig. 106 is a sectional elevation of the right side of Fig. 105. Fig. 107 is a longitudinal section on the scale of Fig. 105 of the said pusher, which pushes the justified spaces into the line; and Fig. 107^a is an end elevation of the same. Fig. 108 is a sectional elevation on large scale and on a plane perpendicular to that of Fig. 1 and as seen from the right of said figure and showing the cam mechanism for locking the

justified-space magazine. This figure also shows the pusher 740 for pushing justified spaces into the line and slotted lever and disk for operating the same. This figure represents a justified space as just pushed into and a space-slug as just pushed out of the line. The galley is shown in section. Fig. 108[a] is a plan, and Fig. 108[b] an end view, of said pusher. Fig. 109 is a sectional elevation on the same scale as Fig. 108 and showing the cam mechanism for operating the contact-piece 675, which descends upon the line while in the channel and establishes the original circuit, which starts the line-feeder and also completes the other circuit, which continues the operation of said line-feeder. This figure also shows the cam mechanism for operating the ram which pushes up the justified lines after they have entered the galley. The parts are in the position assumed before the contact-piece 675 has descended to make contact with the line. Fig. 109[a] is an end elevation of the disk 715 and its metal segment 716, which completes and breaks the circuit which controls the operating of the line-feeder. The parts are in position to complete the said circuit. Fig. 110 is a sectional elevation on a large scale and on a plane parallel to that of Fig. 1 and showing the tumbler, galley, and connecting-way. A line of type is shown in the tumbler ready to be pushed into the galley. In practice the line of type may be nearly as long as the tumbler. Fig. 110[a] is a plan view of the pusher, which pushes the line through said tumbler 810 into the galley 850. Fig. 111 is a plan view of the parts shown in Fig. 110, but a line of type is shown in the galley. Fig. 112 is a broken elevation of the left end of the said pusher and of the lever 836, which operates it. The pusher is represented as passing through the tumbler 810, which has fallen and turned the line upright ready to go into the galley. Fig. 113 is an elevation of the same parts as are shown in Fig. 112, but showing the guide of said pusher in section and several lines of type in the galley. Fig. 114 is a plan of the ram which pushes the lines up in the galley. Fig. 115 is a front elevation, and Fig. 116 a rear elevation, of the same. Fig. 117 is a broken elevation of the right end portion of the galley, showing several lines of type therein. The extensible plate 880 of the wall 851 of the galley is seen in the position assumed when the ram has receded. Fig. 118 is an elevation of the right end of the galley and showing the ram advanced. Fig. 119 is a broken sectional elevation of a part of the wall 851 of the galley and illustrating the construction and arrangement of said plate 880. Fig. 119[a] is an end elevation of said wall 851. Fig. 120 is a vertical section through the galley and tumbler on a plane parallel with that of Fig. 1 and showing the construction of the adjustable wall 851 of the galley, the pivot of the tumbler, the way between the tumbler and the galley, and the upper part of the lever which operates the pusher that pushes the line out of the tumbler into the galley. The galley is opened for the longest line. Fig. 121 is a sectional elevation of the galley and showing the wall 851 adjusted to a shorter line. Fig. 122 is a broken end view of Fig. 121. Fig. 123 is a diagrammatic representation of the manner in which the pointers Q R and the line of type set the tilting bar T and the carriage V, thereby determining the distance bar W rises and the degree of opening of the molds. For simplicity this figure shows a line with but a single space-slug and represents the feeler S as vertically under the pointers, whereas in the actual construction of the machine said feeler S is some distance to the left of the pointers, as seen in Fig. 3. Fig. 124 is a diagrammatic representation, on a large scale, of the tilting bar T inclined when a single space-slug is in the line. The bar W is indicated as about to rise. Fig. 125 is a diagrammatic representation on the scale of 124, the solid lines indicating the tilting bar as inclined when two space-slugs are in the line and the bar W is about to rise. The dotted lines indicate bar T as inclined when six spaces are in the line. Fig. 126 is a section on a very large scale of the bar T.

Before beginning the detailed description of the machine I will briefly describe cam-shaft K and its cams, which determine the manner and order of the principal movements of the machine. Said shaft K, which is carried in suitable bearings on the rear of the machine, as shown in Fig. 2, derives its motion from the constantly-running shaft H through the medium of the gear train and clutch, which is hereinafter described. Taking the cams in order from the left end of shaft K, Fig. 2, cam 357 operates the hooks 350, which move the line of type almost up to the feeler S preparatory to setting the molds for casting the spaces. Said cam 357 and hooks 350 are shown on large scale in Figs. 47 and 50. Cam 377, next to the right of cam 357, operates the devices which advance arm 365 preparatory to its being oscillated, so as to push the line up to its full limit against feeler S. Said cam 377 is shown on large scale in Fig. 65 and said arm 365 in Fig. 54. Cam 393, next to the right of cam 377, operates the devices which oscillate said arm 365 after it is advanced, and thereby moves up the line against said feeler S. The cam is shown in large scale in Fig. 66. Cam 530[x], next to the right of cam 393, operates the devices which turn the line on the flat preparatory to the removal of the space-slugs and the insertion of the justified spaces. Said cam is shown on large scale in Figs. 76, 77, and 78. Cam 655, next to the right of cam 530[x], operates the levers which ultimately control the descent of contact-piece 675 upon the line to complete the electric circuit and start the devices which move the line step by step while the justified spaces are being inserted. Said

cam is shown on large scale in Figs. 78 and 109. Cam 861, next to the right of cam 655 and indicated on large scale by dotted lines on Fig. 109, operates the devices which actuate the ram 860, Fig. 109, which pushes the lines up together in the galley. Cams 580 and 581, next to the right of cam 861, oscillate shaft D′ and control the pusher 556, which pushes the lines out of holder 550, Fig. 79. Said cams are shown on large scale in Figs. 80 and 81. Cam 598, next to the right of cam 581, operates the devices which oscillate shaft 594, which shaft in its turn actuates vertical rod 588, Figs. 1 and 105ª, that raises the fingers of the line-feeder 582, Fig. 83, which line-feeder moves the line step by step during the operation of inserting the justified spaces. Said cam 598 is shown on large scale in Fig. 105. Cam 422, next to the right of cam 598, operates the devices which actuate the horizontal bar 411, Fig. 311, the descent of which permits bar W to rise, and thereby set the wedges 432 434, which determine the degree of opening of the molds which cast the justified spaces. Said cam 422 is shown on large scale in Fig. 35. Cam 795, next to the right of cam 422, operates the devices which lock the justified-space magazine, Fig. 101, when it has been opened to the proper width. Said cam is shown on large scale in Fig. 108. Cam 453, next to the right of cam 795, operates the devices which normally sustain bar 155, and that the mold-plates 160, in the open position, and which permits said bar 155 (and thereby also the certain mold-plates) to descend to the determined position, Fig. 43, before the spaces are cast. Said cam 453 is shown on large scale on Fig. 42. Cam 516, being the next cam to the right of cam 453, operates the devices which move casting-pot Y up against the molds, Fig. 73. Said cam is shown on large scale in Fig. 72. Cam 553, next to the right of cam 516, operates the devices which actuate the pump of casting-pot Y. Said cam is shown on large scale in Fig. 69. Cam 470, next to the right of cam 553, and also shown on large scale in Fig. 69, operates the devices which normally hold all the plates 160 and 160^x up. Cam 301 (shown on large scale in Figs. 56, 58, and 60) is immediately behind the gear 329, Fig. 2, and operates certain of the devices which control the clutch that in turn controls the motion of shaft K. Cam 750, which is near the extreme end of shaft K and is shown on large scale in Fig. 101, operates the devices which remove the justified spaces from the molds to the space-magazine.

Describing first the space-casting mechanism, A^x is the channel which contains the "space-slugs," Fig. 8. 1 is the key for the same, and operates the escapement a^x through the medium of the rod 1^x and lever 1^y, Fig. 8.

B^x is the apron or carrier which conveys the space-slug or the type to the guide c^x and rail 245 of the table, along which the assembled line is moved in order to operate the devices which determine the degree of opening of the space-molds, as will be hereinafter explained. Said rail 245 of the assembling apparatus abuts against or forms one with the corresponding rail 245^x of the casting apparatus.

Depressing key 1 depresses arm 2 on rock-shaft 3, said rock-shaft being made in several pieces connected by universal joints 44, Fig. 8ª.

5 is an arm on rock-shaft 3.

6 is a connecting-rod from the arm 5 to the walking-beam or lever 7, Figs. 9, 10, 17, 18, and 19, pivoted on the end frame X. Rods 8 9 connect opposite ends of lever 7, respectively, with bell-cranks 10 11, Figs. 17 and 19, the connecting-pins 13 14, respectively, working through slots 16 17 in the fixed circular plate 20, between which and the similar fixed plate 21 the said bell-cranks are pivoted. The pivots 10^x 11^x, respectively, of bell-cranks 10 11 turn, respectively, in short slots 10^y 11^y in said plates 20 21, the slots relieving the pivots from undue shock. Springs 18 19 normally tend to turn the bell-cranks 10 11 to the position taken by bell-crank 10 in Fig. 19. Adjacent to plate 21 is a shell 25, on the hub 26 of which is fixed pulley 28, Figs. 12 and 13, driven by the belt 30 from pulley 32, fixed on the constantly-running shaft H, Figs. 3 and 6, 35 and 36^x being guiding-idlers for the belt 30. Said shaft H is driven in any suitable manner from a motor and is the origin of all the movements of the machine. A short shaft 36 works freely through the hub 26 through plates 20 21, projects a short distance beyond plate 20, and is provided with the cam 38, Figs. 13, 20, and 21. Fixed on shaft 36 is the hub 39 of the cylindrical plate 40, positioned at the open side of shell 25, Fig. 13. On plate 40 are diametrically opposite guide-blocks 42 43, Figs. 14 and 16. The plungers 44 45 of blocks 46 47, respectively, work through said blocks 42 43. Shoes 48 49 are dovetailed into the blocks 46 47 and so as to be capable of a small amount of transverse motion. Springs 50 52 respectively connect blocks 46 47 with blocks 42 43. Rollers 54 55, carried at the inner ends, respectively, of blocks 42 43, work on the edges of the cams 57 58, which are fixed on the hub 59 of the arm 60, which hub turns freely on the hub of plate 40. When in normal position, Fig. 14, a projection 62 on arm 60 is engaged by the spring-catch 64, pivoted on plate 40, 65 being the spring of the said catch. A spring 66 tends to revolve arm 60 to the position of Fig. 15 when catch 64 is thrown off. A pin 68, fixed in arm 60, works through a curved slot 70 and projects behind plate 40 enough to be engaged by the projection 71 or 72, according to the position of the respective escapements 74 75, which are pivoted, respectively, at 74^x and 75^x, between said plates 20 and 21, Figs. 18 and 19, the pivots of said escapements working, respectively, in the slots 73 76, said projections 71 72 each passing through slots 77 78 in plate 21 enough to engage with the aforesaid pins 68 as the arm 60 turns, Fig. 9.

Escapements 74 75 are also respectively provided with hooks 80 81, so positioned that at each half-revolution of plate 40 hook 80 engages the end of bell-crank 10 or hook 81 is engaging the end of bell-crank 11. Fig. 19 shows hook 80 engaging the end of bell-crank 10. Projections 71 72 each project far enough through their said slots 77 or 78 to engage with pin 83, which projects from catch 64 through slot 85 in plate 40 when said catch 64 is in position for such engagement, Fig. 19 showing projection 71 engaging said pin 83. Springs 88 89 respectively tend to draw said escapements 74 75 inward and also to turn same so as to free the hooks 80 81 from their bell-cranks 10 or 11 until said escapements are arrested by the projections 71 or 72 coming against the wall of the slots 77 or 78. Fig. 19 shows escapement 75 turned so as to just release bell-crank 11. On the back of plate 21 are spring-actuated pivoted dogs 90 91, Fig. 18, so positioned that as arm 60 turns to its limit pin 68 will push by one or the other of said dogs and having pushed escapement 74 or 75 to the position of Fig. 19 will come to rest between the end of the said dog 90 or 91 and the projection 71 or 72 of the escapement 74 or 75. Thus the dogs 90 91 act as stops to prevent reverse motion of the arm 60 and plate 40.

The parts just described constitute a clutch for actuating shaft 36 whenever a space-slug is allowed to escape from its magazine and enter the line of type or matrices Z. A line, with space-slugs, is shown in Fig. 68, and a line is indicated in place in the machine in Fig. 50 and as being assembled in Fig. 7. The motion of shaft 36 determines the motion of the pointers which indicate to the operator the limits between which the end of the line of type or matrices must come, also determines the number of space-molds which will open automatically for casting the proper number of justified spaces, (and which equals the number of space-slugs fed into the type-line,) and finally determines the setting of the tilting bar, which is an important element in determining the amount of opening of the space-molds for casting the justified spaces. The clutch, therefore, in combination with the key of the space-slug magazine, is an element which effects the operative combination between any matrix or type assembling machine and a space-casting and justifying machine. Receiving its original impulse from the former, it communicates it to the latter.

The operation of the clutch is as follows: The depression of key 1 oscillates rock-shaft 3, vibrates lever 7, and causes bell-crank 10 to turn in the direction of small arrow *w*, Fig. 19. The free end of the bell-crank pushes escapement 74 outward until the projection 71 thereof passes pin 68. At the same time the end of escapement 74, pushing against pin 83, has pushed the catch 64 off the head of arm 60. Said arm 60 immediately turns by reason of the spring 66, and the cams 57 58 force the blocks 46 47 outward, pressing shoes 48 49 against the inner side of the flange of shell 25, thereby causing the plate 40 and shaft 36 to make a half-turn until pin 68 has pushed the hook of escapement 75 over the end of bell-crank 11. At this instant the arm 60 comes to rest, but the momentum of plate 40, shaft 36, and connected parts causes plate 40 to turn a little farther or until the hook of catch 64 has again engaged the head of arm 60 and the pin 83 has come in line with the end of escapement 75. The said additional motion of plate 40 has put proper tension on spring 66, and the parts are now in such position that the next depression of key 1 will cause escapement 75 to push catch 64 off the head of arm 60, causing plate 40 and shaft 36 to make another half-turn. Thus each depression of key 1 (which allows a space-slug to enter the type-line Z) causes the shaft 36 to turn one-half revolution, and these successive revolutions determine the number of space-molds to be opened in the following manner: Cam 38, Figs. 20 and 21, at every half-revolution of the shaft 36 raises pawl 98, which is pivoted loosely on the horizontal shaft 97, which said shaft 97 is parallel and adjacent to shaft 36, 96 being an antifriction-roller that rests on said cam 38. A pawl 99, pivoted on the lever 98, engages a tooth of the ratchet-wheel 100, that is fixed on shaft 97. The number of teeth for engagement with said pawl 99 equals the greatest number of spaces in a line of type, and every time the key 1 is depressed shaft 97 will be turned one tooth of the ratchet 100. Said ratchet also has additional teeth *x* for engagement with a pawl 102 to prevent a backward motion of the shaft 97. The heads 104 and 105 of the pawls 102 and 99, respectively, have at one side projections 106 107, which bear on cam-teeth 108 109, respectively, of a sleeve 110, which turns freely on the hub of ratchet 100. Rod 113 connects the arm 112 of said sleeve 110 with an arm 115 of a rock-shaft 117, turning in bearings in the frame, Figs. 21, 22, and 23. An arm 119 on said rock-shaft 117 is connected by link 120 with an arm 122 of a rock-shaft 123, and an arm 124 of said rock-shaft 123 carries a roller 125, which rests on the cam 127, which is fixed on the main cam-shaft K. Said shaft K carries the various cams which bring about the various operations of the machine, and the cam 127 is so set that each time the shaft K has made one revolution and is coming to rest in the manner hereinafter described the said cam 127 causes the said sleeve 110, Fig. 21, to turn sufficiently to raise pawls 99 and 102 off the ratchet 100 and permit the weight 130 on the rope 131, which is carried over pulley 132 and fastened to the drum or disk 133, that is fixed on shaft 97, to turn said shaft backward to its original position in which the pin 135 is arrested by the stop-pin 136, Fig. 22. Said shaft 97 actuates the mechanism which

moves the pointers, determines the number of molds which shall open, and inclines the tilting bar T, which aids in determining the distance the molds open. The mechanism for these functions is the following: Shaft 97 carries a bevel-pinion 140, which meshes with bevel-pinion 141 of half its diameter and fixed on vertical shaft 143, Figs. 7, 20, and 24. Shaft 143 rises some distance above the rails on which the line of type moves and has near its upper end a pinion 145, which meshes with a rack 146, Figs. 7, 44, and 45, which is adapted to move horizontally behind the mold-case N in a guide 147. One edge of said rack 146 and the corresponding side of the guide 147 may be beveled for securing accurate fit, Figs. 42 and 46. The rack 146 and guide 147 may be arranged in a stationary frame 148 (seen in Figs. 2, 3, 4, and 46) to protect the parts from injury. On the top of shaft 143 is an indicator 149, inclosed in a stationary case 150, provided with an aperture 151, Figs. 42 and 46[a], through which one number of the indicator can be seen by the operator. The indicator indicates the number of space-slugs that are fed into the line. Said rack 146 is connected by the plate 153, hinged to the under side of the rack, with a horizontal bar 155, to which the other edge of plate 153 is pivoted and which moves behind and parallel to the mold-case N, Figs. 42, 43, 44, and 45. Thus said bar 155 is capable both of a longitudinal motion when moved along by rack 146 and of a vertical motion when raised or lowered by the action of the devices which determine the amount of opening of the space-mold, which will be hereinafter described. Normally—that is, before the key 1, Fig. 8, has been depressed and before any space-slug has been fed into the type-line—said bar 155 is drawn completely back or to the right, Fig. 7, so that all the plates 160 of which the space molds are composed can descend and close the molds; but each time the key 1 is depressed and a space-slug fed into the line the bar 155 is moved a distance equal to the thickness of two plates of the space-molds, (because alternate plates $160^{\times}$ are partitions,) so that the said bar can engage the lugs 162 of the desired number of plates 160, and thus insure the opening of the molds, Figs. 42 and 45. In Fig. 45 the said bar 155 is shown advanced to the position for holding up six plates 160 and opening six space-molds. The intermediate or partition plates are indicated in this figure by $160^{\times}$ and are without lugs, because the partition-plates must always descend to form the closed walls between adjacent space-molds. On said vertical shaft 143, Fig. 24, is arranged a sleeve 170, so as to turn with and also slide on said shaft 143. The construction is similar to that shown in Fig. 24[a], where a pin on shaft 179 slides in a groove in sleeve 178. 171 is a pinion on said sleeve, and 172 an enlarged part equipped with parallel circumferential grooves, as shown. An intermediate pinion 174 on a horizontal shaft 175, that may be turned from outside the machine, meshes with the grooves of said sleeve 170 and also with the grooves 176 of the sleeve 178, Fig. 24[a], which is arranged to turn with and slide on vertical shaft 179. Said sleeve 178 carries a pinion 180, which meshes with an intermediate 181, and that in turn with a pinion 182, fixed on a vertical shaft 198 or on a sleeve that is fixed on said shaft. Other independent intermediates 183 184 of different sizes and meshing, respectively, with pinions 185 186, also of different sizes and fixed on said shaft 198 or a sleeve thereof, are so positioned that according as the sleeve 178 is moved up or down pinion 180 will mesh, through the proper intermediate, with either pinion 183 or 184, and the velocity of shaft 198 compared with that of shafts 143 and 179 will be correspondingly changed. The lower part of shaft 179 is provided with pinions 187 188 189 of different sizes, which respectively mesh with the loose independent intermediates 190 191 192, which intermediates are so placed that pinion 171 will mesh with one or the other of them, according to the position of the sleeve 170. In Fig. 24 pinion 171 is meshing with intermediate 191. Thus by revolving shaft 175 the relative velocities of the shafts 143, 179, and 198 can be varied, and the purpose of varying them is to adapt the relative motions of the parts which are actuated through the agency of said shafts to the different fonts of type. This is necessary because the rotation of shafts 179 and 198 moves the pointer R and Q in the manner hereinafter explained, and the motion of pointer R when a space-slug is fed into the line is to be equal to the running width of a quad of that font of type. To diminish friction, said shafts 143, 179, and 198 are supported on pins $143^{\times}$, $179^{\times}$, and $198^{\times}$, respectively. The rotation of the shafts 179 and 198, as before described, causes the separation of the pointers Q R, Figs. 7 and 47, and the space between the pointers is the limit, somewhere within which the left end of the completed line of assembled type and space-slugs must end. It is a matter of indifference where the line ends, provided it comes up at least to pointer Q and does not pass beyond pointer R. Pointer Q, operated from shaft 198, has the slower and pointer R, operated from shaft 179, the more rapid motion. The said motions of the pointers and the corresponding inclination of the tilting bar T are effected in the following manner: The pinion 210 on shaft 179 meshes with a rack 211 on the rod 212, with which the rod 214, which carries the pointer R, is connected or of which it is the extension. Pinion 215 on shaft 198 meshes with the rack 216 on the rod 218, with which the rod 219, which carries pointer Q, is connected or of which it is the extension, Figs. 26, 39, 40, and 41. The rods 212 and 218 are square and work through square holes in an end plate held between

side plates 225. Between the racks 211 216 is the horizontal plate 226, through which turns the shaft 198, Fig. 26. The rear end of rod 212 is connected by pins 230, which work in the slot 231 of one of the side plates 225, with a slide 232, which has at one end the yoke 233, in which is pivoted the lower end of the tilting bar T. The rear end of rod 218 is similarly connected by pins 235, which work in slot 237, with the slide 238, which is provided with the yoke 239. Pins 240 have a nice working fit in the groove 241 on the said tilting bar T, and the connection of said bar T with the yokes 233 239 is such that when the pointers Q R are together in their normal position, Figs. 1, 25, and 47, the tilting bar T will stand exactly vertical. The arrangement of rods 212 and 218 and slides 232 and 238 and their pins is shown in Figs. 40 and 41; but when the space-key 1 is depressed to feed a space-slug into the type-line and the shafts 179 198 are rotated in the manner hereinbefore described, thereby moving rods 214 and 219 to the left, the quicker motion of the former will cause the tilting bar T to incline, Figs. 32 to 34, the inclination increasing for each space-slug that is fed into the line. The inclination of said tilting bar T controls the degree of opening of the space-molds. It is utilized for this purpose through the agency of the completed type-line, which sets in motion certain parts which coöperate with the said tilting bar T in the following manner:

The type-line Z, Figs. 7, 47, and 48—such a line, for example, as is indicated in Fig. 68—is assembled in any usual manner, the assembling devices X standing at the immediate right hand of the space casting and justifying devices, and the rail 245, which supports the line, being continued between the two sets of parts. As the operator has assembled the type into words in the line he has, preferably at the end of each word, fed space-slugs into the line. Therefore the pointers Q R have been moved to the left and separated in the manner hereinbefore explained, Figs. 50 and 51. Now the operator must continue assembling the line until its left end reaches at least to pointer Q, and must not in any case extend the left end of said line beyond pointer R. He can, however, stop at either of these limits or anywhere between them that his convenience dictates. The reason why the line may end at either pointer Q or R or anywhere between them will be hereinafter explained.

Now, having set the line to its proper length, the operator takes hold of the knob 260, Figs. 3 and 50, which knob moves in a slot or chamber x' and slides the hook 256, which turns on pin 257, which is guided in slot 258, behind the type-line and then draws the said line to the left and over onto the space casting and justifying apparatus. In its normal position, before being drawn along by the operator, said hook 256 stands behind the right end of the line—that is, at the right end of the slot x' and considerably to the right of its position in Fig. 50, said figure showing the hook nearly at the end of its movement to the left. As he draws it along, the left or front end of said hook 256 pushes against the pin 262 of rod 263, the other end of which is connected with the oscillating arm 264, that is pivoted at 265, Fig. 52. The other end of said arm 264 is formed with or carries triangular cam 266, the end view of which is shown in Fig. 53^a and a side view in Fig. 56. Against cam 266 rests the roller 268 on the arm 269 of the horizontal rock-shaft 270, supported in suitable bearings in the frame of the machine. Comparison of Figs. 51 and 52 renders the arrangement of said cam and rock-shaft clear. The arm 271 of said rock-shaft 270 engages under the pin 272 of the vertical sliding rod 274, Figs. 52 and 58, the lower end of which is connected with the block 275, which moves vertically in suitable guides in the frame, Figs. 58, 56, and 60. Said cam 266 is so shaped that when hook 256 pushes pin 262 to the right said cam permits arm 269 to rise and arm 271, with block 274, to descend, the weight of said block 274 and connected parts being sufficient to cause this descent, and a notch 276 in block 275 is positioned to receive the hook 278 of one arm 279 of a bell-crank when said block 275 is at its lowest position, Fig. 58. The other arm 280 of said bell-crank is rigidly connected or formed integral with said arm 279, and said bell-crank turns freely on the hub of the bent arm 285, which is fastened to the axle 282. In certain positions arm 279 bears against a shoulder 284 of said arm 285, so as to press said arm to the left, and said arm 285 is connected by the link 287 with an arm 288 of a dog 289, which is pivoted at 290 in the short arm 291 of a hand-lever pivoted at 292. Said link 287 is connected with said arm 288 by a slot-and-pin connection, as shown. The other arm 291$^\times$ of said lever is provided with a handle 294, which projects outside the frame, Figs. 5, 56, 58, and 60. In its normal position, Figs. 5 and 56, said dog 289 stands over the end of the arm 280 of the aforesaid bell-crank, 295 being a spring tending to revolve said bell-crank to the right, and 293 being a spring which tends to revolve dog 289 to the right. Fixed on the said axle 282 and at opposite sides of cam 301 and so as to move with said arm 285 are arms 296 and 302. Arm 296 is connected by vertical rod 297 with a lever 298, pivoted at 299 and carrying a roller 300, which works on the periphery of said cam 301, which cam is fixed on the main cam-shaft K. Said cam 301 is a circle, except for the depression 301$^\times$, in which normally rests roller 300. A vertical bent rod 303, properly guided and connected at its lower end with arm 302, supports on its curved upper end 304 the pin or roller 305 of an arm 306, which is fixed on an axle 307, on which is also fixed an arm 308, preferably curved as shown.

On said arm 308 rests a stud 310 of a hook 311, which is pivoted on one of the guides 330 of a clutch, 330× being a spring which tends to press said hook 311 inwardly, Fig. 61. Said hook 311 normally, (or when at its lowest position,) Figs. 56 and 61, engages the head of an arm 313, fixed on a cam 314, Fig. 61ª, which works on a hub 315 of a plate 316, springs 319 tending to always turn said arm and cam to the position of Figs. 58 and 62. Said hub 315 in turn is loose on the aforesaid constant-motion shaft H. Fixed on said shaft H is the shell 318, which is formed integral with or fastened to the aforesaid pulley 32, which, as hereinbefore stated, drives the belt 30, Fig. 6. On the hub or sleeve 315 of said plate 316 is fixed the pinion 325, which meshes with a pinion 326 on 326×, which carries the pinion fixed on the axle of pinion 327, and that in turn with a gear 329, which is fixed on the aforesaid cam-shaft K. Guides 330 on plate 316 are recessed on their edge to receive sliding and oscillating arms 332, which are connected with said guides by a slot-and-pin connection, as shown. The outer ends of said arms 332 are connected with the aforesaid springs 319, so that said springs both tend to slide said arms 332 inward and to turn them somewhat about the pins 334, both movements being arranged to free the shoes 336, which are on the ends of said arms 332, from the flange of the shell 318. The inner edges of said arms 332 are curved to fit and bear on the aforesaid cam 314. Thus, as will be evident from the foregoing description, the cam-shaft K derives its motion from the plate 316 and that from the shaft H through the shell 318, which is in effect one part of a clutch, and the gearing is such that shell 318 (or plate 316) revolves fifteen times to one revolution of the cam-shaft K, since the motion of the latter is required to be quite slow. The cam-shaft K is started in the following manner every time a line of type has been drawn along by the hook: The operator having drawn along the line by the hook 256, as hereinbefore described, causes the block 275 to descend to the position of Fig. 58, wherein the notch 276 is in line with the hook 278, the clutch mechanism being in the position of Figs. 56 and 61. The operator now raises handle 294 and dog 289 depresses arm 280, moving arm 279 to the left, so that hook 278 enters notch 276 in block 274, arm 279 at the same time pushing arm 285 to the left, thereby raising arms 296 and 302, lifting roller 300 partly out of the depression 301×, and also through rod 303 and arms 306 and 308 lifting the hook 311 off the head of arm 313, Fig. 38. Immediately cam 314 revolves and forces arms 332 outward, pressing the shoes 336 against the flange of the constantly-running shell 318. Plate 316 now revolves, causing the revolution of cam-shaft K and all the cams thereon and producing the various operations of the machine. As cam 301 has revolved it has raised lever 298 still higher, and therefore arm 296, and has turned arm 285 to the position of Fig. 60, pushing the dog 289 off the end of arm 280, which immediately rises to its original position (indicated in Figs. 56 and 60) by reason of the spring 295, and freeing the hook on arm 279 from the socket in block 275, so that even if the operator should hold lever 291 down too long he cannot prevent the stopping of cam-shaft K when it has made one revolution. When said cam-shaft K has made one revolution, roller 300 drops into depression 301× and rods 296 and 303 fall, allowing arm 308 and hook 311 also to fall and restoring arm 288 to the position of Fig. 56, and as soon as the operator lets go of handle 294 the lever 291× drops to its original position and the spring 293 moves the dog 289 over the arm 280. As plate 316 now approaches to its original position, having revolved nearly fifteen times, the head of arm 313 catches under hook 311 and the cam 314 stops, while the momentum of plate 316 and connected parts carries it still onward until it reaches its original position, thereby freeing the shoes 336 from the flange of shell 318 and bringing cam-shaft K to rest in its original position. Meanwhile block 275 and hook 256 will have been returned to their original positions either by the operator or by suitable springs or weights. In this single revolution of the cam-shaft all the operations necessary for casting the spaces of a single line of type, for inserting such spaces in the line, and for bringing the line onto the galley for printing from will have been accomplished.

It will thus be seen from the foregoing description that the operator cannot by mistake start the cam-shaft before he has moved up the line and depressed block 275, so that hook 278 can enter socket 276.

The operator having drawn the line to the left with the hook 256 and having started the cam-shaft K in the manner described, the machine automatically moves the line so that its right end comes to a determined point and its left end moves a "feeler" S in proportion to the length of the line—*i. e.*, to the number of space-slugs in the line. This motion of the feeler effects the opening of those molds which the previous motion of the rods 214 219 and the pointers Q R has determined shall be opened to the proper degree for the casting of such spaces as shall justify the line. The motion of the feeler and the opening of the space-molds are effected in the following manner: Two hooks 350, one for the lower and one for the upper part of the type-line, Figs. 50 and 51, pivoted to a pin in the end of a horizontal lever 351, fixed on shaft 354 and guided by a pin 352, sliding in a slot 353, Fig. 50, stand normally at the right end of said slot 353 and so as to be out of the way of and behind the line of type when the same is moved up by the hook 256, as hereinbefore described. The aforesaid pin, which connects said hooks 350 with lever 351, recipro-

cates through the slot 350×, Fig. 47. The right end of slot 353 is turned at an angle away from the said line of type, as at 353×, Fig. 50, in order to turn the hook 350 out of the way of the line. The other end of said lever 351 carries a roller 355, which works in the groove 356 of a cylindrical cam 357, which is fixed on the main cam-shaft K, Figs. 2, 4, 47, and 50, so that the rotation of said cam 357 causes lever 351 to vibrate from the position of Fig. 47 to that of Fig. 50 and to move the line to the left and very nearly, but not quite, up to the extreme limit of the motion of the line. A spring coiled on the shaft 354 always tends to bring shaft 354, lever 351, and hooks 350 back to their normal position, Fig. 47. Now suppose there are no space-slugs in the line Z, (which will in this case be only exactly the column width.) The front end of the line Z or its left end will not quite touch the feeler S, so that in this case the said feeler will not be pushed to the left, even by reason of the subsequent small movement of the line, which will be hereinafter described, and no space will be cast; but suppose some space-slugs are fed into the line and that the pointers Q R have moved to the left and apart, as in Fig. 50, the operator has now set the line so that it ends either at one of the pointers or somewhere between them, and in all cases the line will be so long that when moved to the left by the hooks 350 it will push back feeler S, but not quite to the full extent. The final motion of the line, which requires to be very exact, is effected by the arm 365, which is pivoted to the horizontal and transverse sliding block 366, Figs. 54, 55, 65, and 66, which is guided rectilinearly in the frame and reciprocated by the link 368, which is connected with one end of the vertical lever 369, fixed on one end of a sleeve 370, which turns loosely on horizontal longitudinal shaft 372. Said shaft 372 and sleeve 370 are shown on large scale in Figs. 50, 53, 65, 66, and 67, and, in relation to the parts of the machine, in Fig. 2. An arm 374, fixed on said sleeve 370, Figs. 65 and 67, carries a roller 375, which works on the periphery of a cam 377, fixed on the main cam-shaft K, and said cam 377 is so positioned that the arm 365 is normally out of the way of the line of type, Fig. 54. Said arm 365 is vibrated by the roller 379 on one end of a horizontal bent lever 380, pivoted at 381. The other end of lever 380 is pivotally connected with the adjustable horizontally-reciprocating rod 382. The total throw of the rod 382 is made adjustable by the nut 386, which is held to whatever position it is set by the spring knife-edge 387, Fig. 66ª, entering notches on the rim of the nut 386. The play of the nut limits the throw of rod 382, and the play of said nut is limited by the plate 384. Rod 382 is pivotally connected at 382× with a yoke on the end of the lever 388, which is fixed on the aforesaid shaft 372, Fig. 67. An arm 389, also fixed on said shaft 372, carries a roller 391, which works on the periphery of a cam 393, fixed on said cam-shaft K, and said cam 393 is so positioned that normally the roller 379 and the arm 365 are drawn back to the position of Figs. 54 and 66. A spring 390, coiled on sleeve 370, Fig. 50, always tends to push arm 365 out behind the type-line, Fig. 55, when the cam 377 turns, so as to permit the roller 375 to fall into the depression 377×. At the proper time a spring 365× pushes said arm 365 back to normal position, and a spring 395, confined between the box 396 and the nut 386, Figs. 54 and 55, pushes the rod 382, and therefore the roller 379, forward when cam 393 turns, so that the depressed surface 393× is adjacent to the roller 391. Now the hook 350 having advanced the line of type almost to its limit, as hereinbefore described, cam 377 causes rod 365 to advance to behind the line and cam 393 causes roller 379 to push the line to its exact limit of movement, (position of Fig. 55.) The line accordingly pushes feeler S back to its full limit for that line, and that determines the amount of opening of the space-molds in the following manner: Said feeler S is made adjustable in the rod 395 by a set-screw, Fig. 28, or other means, so that the position of the feeler and connected parts can be adjusted for lines of different column widths. Said rod 395 is guided and supported through a block 396, in which turn antifriction-rollers 398, which center said rod 396 and suffer it to move with little friction, Figs. 25, 27, and 30. The end of rod 395 is fastened to a carriage V, provided at one end of the upper edge with rollers 400, which travel on the rail 401. The left end of the lower edge of said carriage V travels on roller 403, carried on the frame, and the right end of said lower edge is provided with a roller 402, which travels in a suitable runway on the frame, this construction insuring a true rectilinear movement of the carriage. Thus said carriage V is moved to the left by the pressure of the type-line on the feeler S, and after the casting of the spaces for a line is finished is returned to the right by the weight 404 and the rope 405, which is carried partly around pulley 408, 413 being a screw-stop to arrest the carriage in its normal position, Fig. 25. Said carriage V is directly under the tilting bar T and is provided with a vertically-reciprocating bar W, which works in vertical guides in said carriage and is provided with rack-teeth, in which meshes a toothed segment 406, pivoted in the carriage V at 407, Figs. 31 to 34. Said segment 406 is provided with an arm 409, carrying a roller which normally rests on a vertically-moving horizontal bar 411, fixed on the ends of parallel vertical rods 412 412, which pass down outside of the carriage V, being suitably guided through the frame of the machine and at their lower ends are connected by links 414 with an arm of a bent lever 416, pivoted to the frame at 417, Fig. 35, the plane of said lever 416 being perpendicular to the plane of said bar 411. The other arm of lever 416 carries a roller 418, which bears against the end

of a horizontally-guided reciprocating rod 420, which carries a roller 421, that works on the periphery of a cam 422, fixed on cam-shaft K. A yoke 424 on the inner end of rod 420 freely spans a ring which is loose on shaft K and aids in guiding the rod. (Compare Figs. 25, 31, 32, 33, and 35.) Said rod 420 is normally pressed to the right, Fig. 35, by the spring 425, which is coiled between the collar of the yoke 424 and box 426. Said cam 422 is so positioned that the bar 411 is normally at its highest position, Figs. 25, 31, and 32, and that therefore the bar W is at its lowest position and under the end of the tilting bar T, Fig. 31.

Fixed on the same axle as and moving with the gear-segment 406 is the larger gear-segment 430, which meshes with the rack 431 at the end of the horizontally-reciprocating wedge 432, which is guided rectilinearly in the carriage V between the plates 428. On the inclined edge of wedge 432 bears the inclined edge of wedge 434, both wedges having the same slope and the upper edge of wedge 434 being accurately level. Said wedge 434 is so held in guides and by pin and slot, Fig. 25, in the carriage V as to be capable of vertical but not of horizontal motion, and therefore as wedge 432 reciprocates wedge 434 rises and falls, Figs. 32, 33, and 34. Directly over said wedge 434 is the vertically-moving rod 436, which is guided through suitable holes in the frame. Said rod 436 is indicated in large scale in Figs. 24, 25, 26, 32, 33, 34, 43, and 45, and its relative position in the machine is shown in Fig. 7. A bracket 437, fixed on the upper part of said rod 436, bears under a pin 439 of a horizontal plate 440, pivoted at 442, Figs. 42, 43, and 45, and said arm or pin bears under the aforesaid rod or bar 155, which is connected with the aforesaid rack 146, Figs. 42 and 43, and said bar 155 comes under the lugs 162 of a greater or less number of mold-plates 160, according to the number of times the space-key 1 is depressed to feed space-slugs into the type-line, as hereinbefore described. Evidently, therefore, the height at which the rod 436 is sustained by the wedge 434 determines the height at which those plates 160 whose lugs 162 are caught by the bar 155 will remain up, and this determines the thickness of the spaces which will be cast, and the height of wedge 434 is determined by the distance which bar W rises under tilting bar T. The less the tilting of bar T and the shorter the distance that the carriage V is moved to the left the greater the rise of bar W and wedge 434, and therefore the greater the height at which rod 436 is sustained and the greater the opening of the space-molds; but the fewer space-slugs there are in the type-line the less will be the tilting of the bar T, and the shorter the line is the less will carriage V move to the left. The various movements are so adjusted that in all cases the number and thickness of the spaces cast shall justify the line. Under the shoulder formed by the sleeve of the bracket 437 bears the end of a horizontal lever 445, Figs. 42, 43, and 45, pivoted at 446 and connected by a rod 448 with a horizontal lever 450, pivoted at 451, and at its other end carrying a roller 452, which works on the periphery of a cam 453, fixed on the main cam-shaft K. This cam is so shaped and positioned that the rod 436 is normally up, Fig. 42. As the cam 453 revolves it permits the rod 436 to descend until it rests on the wedge 434, such of the mold-plates 160 as were held by the bar 155 descending accordingly, the surface $453^{\times}$ of said cam being cut only sufficiently to allow the said rod 436 to drop to its extreme lowest position if the wedge 434 does not prevent. For instance, if no space-slug were fed into the type-line the wedge 434 would be at its lowest position and the revolution of cam 453 would permit rod 436 to descend to its lowest limit. I prefer that even at its lowest position wedge 434 shall be high enough for the casting of the thinnest space; but until a space-slug is fed into the line no mold will open, because the bar 155 will not hold up any plate, since said bar 155 has not been advanced sufficiently far to catch the lugs 162 of any of the mold-plates. All the plates 160 and $160^{\times}$ are traversed by a rod 460, which passes through a slot 462 in each of said plates, Figs. 42, 43, and 74. The ends of said rod 460 are held in links 461, the upper ends of the links having a pin-and-slot connection with the yoke-shaped arm 463 of a lever 464, Figs. 3 and 69, pivoted on top of the machine at 465. The other end of said lever 464 is pivotally connected with the upper end of a rod 466, which carries a roller 467, that works in a groove 468, shaped, as shown, in the side of a cam 470, which is fixed on said main cam-shaft K, Figs. 2, 4, and 69. A yoke 471 on the lower end of said rod 466 works easily on a ring, which is loose on shaft K and guides the said rod. Said groove 468 is so shaped and positioned that normally all the said plates 160 $160^{\times}$ are raised to the highest position, Fig. 69, but as the cam-shaft K starts up the said cam 470 will turn to a position to allow all said plates to descend to their lowest limit just after the rod 436 has descended upon wedge 434, and said cam-groove 468 will permit said plates to remain down until the operation of casting is finished. In this position all the partition-plates $160^{\times}$ will be clear down, as also all such plates 160 as are not held up by bar 155, as before described. Such plates as are held up by said bar 155 remain up until the casting is finished. Each of said plates 160 $160^{\times}$ is normally depressed by a spring 475, Fig. 71, and said plates work in a frame or case N, composed of a top plate 476, side plates 479 480, front plate 482, back plates or blocks 484, 485, and 486, base-block 488, Figs. 69 and 75. The top plate 476 and the side plates are cut away or recessed, respectively, at 481 and 477 for the links 461. The front plate 482 does not extend down to the bottom plate 488, but leaves a space open, where the mold-plates are seen

and against which comes the nozzle of the casting-pot Y, Figs. 69 and 73. The back plate 484 is bolted or secured to plate 485, as shown in Fig. 75, and forms a true solid back and guide for the upper part of the mold-plates 160 160$^{\times}$, while plate 486 serves for a solid back and guide for the lower part of said mold-plates. As will be clear from Fig. 75, there is an open space *n* at the back of the mold-case N, in which work the bar 155, the bracket 437, the arm 440, and the other devices for opening the molds. The said mold-plates 160 160$^{\times}$ work side by side, and the whole group are confined with a true working fit between the side plates 479 480. The construction of the mold-case N is made clear by comparing Figs. 69, 74, and 75.

The molds are opened in the following manner: The depression of space-key 1, Fig. 8, has moved the bar 155, Figs. 7 and 45, so as to engage the lugs 162 of the proper number of mold-plates 160, all said plates, as well as the rod 436 and bar 155, being in the elevated position, Fig. 42. Now the operator having started the cam-shaft K the wedges 432 434 have been brought to the proper position by the rising of bar W against the tilting bar T, as hereinbefore described, for limiting the descent of rod 436 and bracket 437, so as to hold up the aforesaid number of plates 160 to the proper degree. Immediately cam 453, Figs. 2, 4, and 42, turns so that lever 445 allows rod 436 and bracket 437 to descend until said rod 436 rests on wedge 434, Fig. 43, cam 470 having also turned so as to allow all the plates 160$^{\times}$ and such of the plates 160 as were not held up by bar 155 to descend upon the block 488 of the mold-case N. Thus a number of molds equal to the number of space-slugs in the matrix-line will each be open to a degree necessary to cast a justified space. If six space-slugs are fed into the line, six molds will be open, Fig. 45; and now the casting-pot Y is brought up to the molds and operated in the following manner: Secured to the casting-pot Y are horizontal bars 502 503, which pass by the sides of the mold-case N, being guided truly in the horizontal slots 504 in the sides of the mold-case N, Figs. 69 and 74, and connected at their rear ends by links 505 with bell-crank levers 506, pivoted at 507, Figs. 6, 69, and 72. Said levers 506 are connected by links 508 with a cross-head 511 by springs 512, so that there will be a yielding pull on the casting-pot Y as it comes against the mold-plates. A rod 513 is attached to said cross-head 511 and carries at its lower end a roller 514, which works in the groove 515 of a cam 516, fixed on said main cam-shaft K, and said cam 516 is so positioned and shaped as to bring the nozzle *y* of the casting-pot Y up against the front of the mold-case N just after the molds have been opened, as hereinbefore described. Said casting-pot Y is equipped with rollers 504$^{\times}$, which travel on the rails or table 509, Fig. 6. The rod 513 is equipped with a guide-yoke 518, which works easily on a ring which is free to revolve on shaft K. Said casting-pot Y contains a chamber 520 for molten metal, connecting with the cylinder 521, in which works the piston 523, by a narrow passage 525, in the usual manner, 527 being the passage leading to the nozzle *y*, Fig. 73. A rod 530 connects a piston 523 with a crank 531 on a rock-shaft 533. One end of said shaft 533 works in a box 535, carried by the casting-pot, the said shaft moving sidewise with the casting-pot because of the collar 536 and crank-collar. The other end of said shaft 533 is squared and works through a square hole in the arm 537, which is held against lateral movement in any suitable manner. The other end of said arm 537 carries a roller 538. Said arm 537 is acted on by roller 539, carried on the plate 540, fixed in a box 543, which is pressed normally down by the spring 542, coiled in the said box 543 around the bolt 536, which passes easily through a hole in the end of box 543, Figs. 4 and 70, and said roller 538 is acted on by a rod 545, the lower part of which is provided with rack-teeth 546, with which meshes a gear-segment 548 on one arm of a bent lever 549, pivoted at 550, Fig. 69. The other arm of said lever 549 carries a roller 552, which works on the periphery of a cam 553, fixed on the main cam-shaft K and so shaped and positioned as to hold arm 537 up until the casting-pot Y has moved up against the molds. Then the revolution of the cam-shaft K turns the said cam 553 so that the spring 542 can depress arm 537 and rock-shaft 533, so as to force down piston 523 and force the proper quantity of molten metal into the molds.

Now, having described the devices for casting the spaces to justify the line, the principle of the operation of the pointers Q R, the tilting bar T, vertically-reciprocating bar W, and wedges 432 434 will be explained, reference being made particularly to the diagrams Figs. 123, 124, 125, and 126.

The operator is allowed to end a line at pointer Q, pointer R, or anywhere between the pointers in order to permit him to always end a word or at least a syllable at the end of the line, and, as will appear from the following explanation, the machine will in all cases cast spaces of such width as will justify the line.

The running width of the space-slug—*i. e.*, its width parallel to the line of type—is always greater than the running width of the largest justified space—the quad—and equals the said quad plus the running width of the thinnest space. The movement of the fast pointer R each time a space-slug is fed into the line equals the running width of the quad, and the corresponding movement of the slow pointer Q equals the running width of the thinnest space. The gearing of segments 406 and 430, respectively, with bar W and wedge 432 is such that when bar W rises to its greatest height, Fig. 34, wedge 434 will

sustain rod 436 in such a position that one or more molds will be full open to cast one or more quads. Tilting bar T is so constructed with an internal bar *t*, held in an outer case *t'*, Fig. 126, that the plane of the inner inclined surface of bar *t*, against which the end of bar W abuts, cuts through the center of the pivots 233 240. When the parts of the machine are at rest and bar T is upright, the upper left-hand corner of bar W, which is now at its lowest position, is exactly in the horizontal line through the pivots 233.

The operator must set the line at least up to pointer Q, because the line must be long enough to push feeler S back at least as much as pointer Q moved to the left in order to move carriage V and bar W at least that much to the left, so that bar W shall be at least as far back as pivot 240. The end of the line must not stand to the right of pivot 240, because that pivot marks the highest point to which bar W can rise in order to open the molds full width; also, the operator must not set the line beyond fast pointer R, because if he did the carriage V would be moved so far to the left by feeler S that bar W would be to the left of pivot 233, which is the extreme end of tilting bar T and marks the least height bar W rises from its normal position. In other words, feeler S and carriage V must move at least as much as pointer Q and may not move more than pointer R.

Now suppose a line of type is set containing only one space-slug, Fig. 123. Pointer Q will have moved to the left a distance equal to the thinnest space—that is, equal to the distance between lines *y y* and *x x*, Fig. 123—and will stand on line *y y*, as shown in said figure. Pointer R will have moved to the left from line *x x* a distance equal to the width of a quad, and the space between said pointers will be the difference between these movements—that is, the distance between lines *z z* and *y y*. The tilting bar T will incline, as seen in Figs. 123 and 124, the tangent of the angle-bar, Fig. 124, which is the angle of inclination of bar T with the vertical, being the distance $bc=(y-z)$, divided by the distance *ac*, which is the perpendicular distance between pivots 233 and 240. Now suppose the operator sets the line only up to pointer Q. Bar W then will stand exactly under the center of the pivot 240 and will rise until it abuts against bar T on the horizontal line through said pivot 240. So rising it will cause wedge 434 to rise and support bar 436 in such a position that one plate 160 will remain up to its full height and one quad will be cast. This will exactly justify the line, because the quad, plus the movement of pointer Q, equals the space-slug, the movement of said pointer Q equaling the thinnest space and the slug equaling the quad plus the thinnest space. Again, there being only one slug in the line, suppose the operator sets the line up to pointer R, as indicated by dotted line W', Fig. 124, so that the bar W will stand at the point *b*—*i. e.*, on the line of the center of the pivot 233. Now the length of the assembled line will exceed its proper length by the amount of movement of the pointer R—that is, an amount which is less than the space-slug by the width of the thinnest space. Consequently when the slug is removed it will require the thinnest space to justify the line; but bar W being against bar T at the horizontal line through pivot 233 cannot rise; but in this position, as hereinbefore stated, the rod 436 will be at such a height as to hold one plate 160 up to cast the thinnest space. Therefore one thinnest space will be cast and this will justify the line.

Now the distance between the pointers Q R when one space-slug has been fed into the line is equal to the distance wedge 434 or rod 436 rises from its lowest to its highest position, because such distance is equal to a quad less the thinnest space. From this it follows that if the operator ends the line anywhere between pointers Q and R, as at *e*, Fig. 124, still supposing there is but one space-slug in the line, one mold will open just wide enough to cast a space to justify his line, for, referring to Fig. 124, and calling the full amount of motion of a mold-plate when rising from its lowest to its highest position *h*, we have $h=bc$, *bc* being the distance between the pointers when one space-slug is fed into the line. Now if the line ends at *e* bar W can rise only to *f* and will stand the distance *fg* below where it stood when the line ended at *c*. At the same time the mold-plate will rise to a proportional height and will stand a proportional distance below where it stood when it before rose to its full limit. Call this last proportional distance *h'*, and the proportional motions of bar W and rod 436 give us $h:h::ag:ac$; but the similar triangles *afg* and *abc* give us $fg:bc::ag:ac$; but $h=bc$, and therefore *h'*, must equal *fg*; but *fg* is the amount which the length of the line has increased over what it was when it ended at *c*, and *h'* is the amount by which the running width of the new space is less than the running width of the former space. Therefore the new space will justify the new line.

Suppose two slugs had been fed into the line. The distance between pointers Q and R would be twice as great as in the preceding case, as diagrammatically indicated in Fig. 125, and bar 155 would have moved to hold up two plates 160 and keep two molds open. Now if the operator ends the line at pointer Q it will require two quads to justify it, because there are now two slugs in the assembled line and pointer Q has moved twice as far as in the preceding case; but as bar W rises from *c'* to *a'*, Fig. 125, it causes rod 436 to stand at its highest position for casting a quad, and as two molds are now open two quads will be cast, which will justify the line. Suppose the line ends at pointer R. Then it will require two thinnest spaces to justify it,

because pointer R has moved twice as far as when only one slug was in the line and there are now two slugs in the line. That is the difference between two slugs, and the distance moved by pointer R is now two thinnest spaces; but the line will now have moved feeler S, so that the carriage V will have carried bar W back to pivot 240, as indicated by W^2 in Fig. 125. Consequently bar W cannot rise, as in this position rod 436 is at the height for casting the thinnest spaces, and as two molds are now open two thinnest spaces will be cast, which will justify the line. In a similar manner whatever the number of space-slugs in the line and whether the line ended at pointer Q or pointer R the spaces cast will justify their line, and also in every case, for the reason above given, if the line ends anywhere between pointers Q and R, the spaces cast will justify the line.

Apparatus for turning the line.—The line of type having been assembled with the proper number of space-slugs in position in the line and having been moved from the assembling device into the device for casting the justified spaces, as hereinbefore described, I provide automatic devices for removing the space-slugs, inserting the justified spaces, and placing the completed line in the galley, now to be described.

The line has been pushed by the hooks 256 350 and lever 351, in the manner hereinbefore described, into the jaws 552 553 of the holder 550, Figs. 76 and 77. These jaws are as long as the longest line which may be set in the machine, and said holder 550 then turns and raises the line to the level of the channel 557 in the following manner: The groove $531^{\times}$ of a cam $530^{\times}$, shaped as shown in Fig. 76, actuates the arm $538^{\times}$ by means of roller $536^{\times}$, fixed on said arm, the forked end $535^{\times}$ of the arm being guided on the ring $532^{\times}$. Said arm $538^{\times}$ is pivotally connected at $539^{\times}$ with the oscillating plate lever $542^{\times}$, fixed on the rock-shaft $541^{\times}$. A pin or axle $544^{\times}$, pivoted in pintles on the upper edge of said plate-lever $542^{\times}$, Figs. 76, 77, and 79, carries arms or webs $545^{\times}$, on which is fixed the said holder $550^{\times}$. Another arm $546^{\times}$, also fixed on pin $544^{\times}$, carries a roller $547^{\times}$, which as plate $542^{\times}$ oscillates to the left of Fig. 76 works on the concave surface of the flange 548 and is thereby deflected downward, thus raising and turning the holder 550 to the position of Fig. 77, in which the line of type and space-slugs is on the flat and at the level of the channel 557, the grooved side of the space-slugs, Fig. 96, being up. When the line arrives at this position, it is pushed out of holder 550 into channel 557 by the pusher 556, Figs. 77, 79, and 83, which is provided with jaws $556^{\times}$, Fig. 86, at its lower edge. Said pusher moves through holder 550, pushing the line to the left of Fig. 79. A rabbeted guide-piece 558 on the upper part of said pusher 556 works on the guide-bars 559, which are secured to the frame. Said pusher 556 is reciprocated by the arm 561, which is pivotally connected with said pusher by the link 560. Said arm 561 is oscillated by the rock-shaft D, Figs. 1 and 80. An arm 563 on said rock-shaft D is pivotally connected with the swiveling-link 564, and that with a collar 566, swiveled on the end of rocking arm 568, fixed on rock-shaft D′, which rock-shaft is arranged at right angles to rock-shaft D, Fig. 80. Fixed on said rock-shaft D′ are arms 570 571, connected by an arc 572, as shown. Roller 575 of arm 571 works on cam 581 and roller 574 of arm 570 on cam 580, both cams being fixed on said cam-shaft K and both said arms 570 571 oscillating together. A bolt $572^{\times}$ enables the arms 570 571 to be adjusted from time to time to take up any lost motion arising from wear of the said cams 580 581. Said pusher 556 is normally at the left, as seen in Fig. 1, but moves to the right, Fig. 79, just before the holder 550 raises and turns the line, as described. Then at its next movement to the left said pusher 556 pushes the line out of the holder 550 into the channel 557, Fig. 79, and to such a position that its right or rear end is ready to be engaged by the line-feeder 582, Figs. 79 and 82, which feeds the line along to receive the justified spaces from the mold. The line is seen in the channel in Figs. 78 and 82. Said arm 561 is connected by connecting-rod 839 with arm 836, Fig. 1, which actuates devices for pushing the completed line into the galley in the manner hereinafter described. Said connecting-rod 839 is preferably made in two parts, which are connected by a right and left hand threaded sleeve 841 to secure accurate adjustment of movements of the arm 836.

The line-feeder.—The type-line Z, Figs. 78 and 82, is fed along by the said line-feeder 582 in order that the cast and justified spaces may be fed into the line at the proper places, as between words, the space-slugs having been first removed from the line. It is necessary, therefore, that the line move a proper distance, then stop while the justified space is being put into the line, and then move again to a proper position for the insertion of the next justified space, and so on, it being understood that the justified spaces for that particular line have been meantime removed from the mold to a proper magazine, as will be hereinafter described. The movement of the line-feeder 582 to produce the proper movement of the type-line is effected as follows: Said line-feeder 582, electrically insulated in any suitable manner from the frame of the machine, is made with a body-plate 582, Fig. 88, which slides in guides $582^{\times}$, Fig. 83, and a vertically-movable plate 584, which works in vertical guides in said plate 582 and is provided at its lower edge with fingers 585. When not in operation, fingers 585 stand above the line, Fig. 83, being sustained by the fingers or hooks 581 581, Figs. 83 and 84, which engage proper holes in plate 584, 583 being a spring to push the line-feeder down. Said

plate 584 is raised to this position by the vertically-guided rod 588, which is actuated by the eccentric-pin 591 on the end of rock-shaft 590 engaging under the end of rod 588, Figs. 1 and 105ª. Said rock-shaft 590 is oscillated by the rack 592 on reciprocating rod 593 engaging pinion 594 on said rock-shaft 590, Figs. 105 and 106. Said rod 593 is pivotally connected with the curved vibrating arm 595, pivoted at 596 and carrying roller 597, which works on cam 598, fixed on cam-shaft K. A projection 602 on said cam 598 causes a sudden momentary movement in the rack 592 and that in the rock-shaft 590, which thereby momentarily raises rod 588 before the line enters channel 557, lifting plate 584 until said plate is engaged by the hooks 581. Immediately thereafter rod 588 drops back out of the way and plate 584 can descend when freed from said hooks 581 until arrested by the engagement of the slot 587 on the pin 586, Fig. 85. Just as pusher 556 has pushed the line to the position to be engaged by the said line-feeder 582 the link 560 or its pin 560× engages an arm of a bell-crank 575, Figs. 1, 82, and 89, and the other arm of said bell-crank lifts an arm 577, fixed on the pivot 579 of said hooks 581, Fig. 82, thus withdrawing the hooks from the plate 584 and allowing same to fall into the channel 557, which is open at the top, and between the jaws 556× of the pusher 556, Fig. 88, where said line-feeder is ready to feed the line by a kind of step-by-step motion generated in the following manner: A vertically-reciprocating contact-piece 675, Figs. 76, 78, 95, and 109, working in guides in a block 678, which is insulated from the frame by suitable material 680 and positioned near the entrance of channel 557, Figs. 78 and 95, is connected with an electrical circuit-wire 676, properly insulated—as, for instance, covered wire—and finally leading to a pole Z′ of a battery. Channel 557, properly insulated from the other electrical devices, is connected by insulated wire 686 with the other pole K′. Until piece 675 descends upon a line of type in the channel 557 the circuit is broken; but when the aforesaid pusher 556 pushes a line into the channel the circuit is completed by said piece 675 descending into contact with a type or space slug of said line. The descent of piece 675 is effected by the projection 656 of cam 655, Fig. 109, on cam-shaft K, which momentarily lifts roller 658 of arm 659, which is fixed on shaft 660. Arm 662, also on said shaft 660, then pushes rod 664 to the left, and a shoulder of said rod 664 oscillates bell-crank 665 667, so as to allow the non-conducting pin 670 to drop. This permits piece 675 to descend and momentarily rest on the line, thus completing the circuit. Rod 664 is guided in holes in the frame, and the forked end 666 of said bell-crank fits loosely on the reduced end 663 of said rod 664; but said projection 656 of cam 655 only momentarily lifted arm 659, which almost immediately dropped back, permitting spring 672, Fig. 109, to lift bell-crank arm 667, and that lifts pin 670 and piece 675, again breaking the circuit; but the brief duration of the circuit has started up the line-feeder 582 and has established the other circuit, which continues to move the said line-feeder, or the said short-duration current went from brush 675 by wire 676 to small magnet 680, meantime attracting the switch 682 over to post 684. Thence said current went to brush 718 to metal segment 716 in insulating rotatable disk 715, (compare Figs. 95 and 109ª,) thence to brush 719, which is insulated from brush 718 in any suitable manner and is connected with a branch of wire 676, as shown, thence to brush 677, which bears on a disk or plate 677×, on which are secured a group of magnets E, and to the windings of the said magnets, thence to another disk 677ʸ, insulated from the disk 677×, but connected with the other end of the windings and revolving with said magnets E, thence to brush 678, and thence to the field-windings of a group of magnets G, thence to a small magnet 687, whereby it attracts spring-switch 688 from post 695, breaking the circuit through wire 700, and finally to pole Z′ of the battery. The aforesaid switch 682 is a friction-switch which stands normally in contact with the pole-piece of magnet 681 and will remain in whatever position it is thrown until again acted on. Switch 688 is spring-acting and normally stands in contact with post 695 and whenever the current from brush 675 is broken will immediately fly over to said post and reëstablish circuit 700. Said disk 715 is normally in the position of Fig. 109ª, so that the circuit is established through brushes 718 and 719; but a slight rotation of the disk 715 suffices to break the circuit. Said magnets E and their disks are arranged to move lengthwise on but turn with shaft 624, Figs. 94 and 95, and when energized by the current through circuit 676 are attracted upon and revolved by armature 621, which is fixed on horizontal shaft 620. Said shaft 620 is ultimately driven by bevel-gears 616 614 and other suitable gears, Figs. 77, 94, and 95, from the aforesaid constant-motion shaft H. Thus the momentary energizing of magnets E by the descent of contact-piece 675 revolves shaft 624, and that through bevel-gears 628 629 starts horizontal shaft 630, Fig. 95. Long teeth 631, cut in shaft 630, mesh with and revolve gear 632, fixed on horizontal shaft 634, which shaft 634 carries a shell 636, forming one part of a friction-clutch, disk 640 on shaft 644 forming the other part of said clutch. Normally the parts of said clutch are kept separated by suitable means, as springs. Said shaft 634 also carries armature 638 and slides through the base of said magnets G. Said magnets G are fixed not to move lengthwise, but when energized attract said armature 638 and force shell 636 down on disk 640, thereby revolving shaft 644 and its gear 643. (See Figs. 94 and 95.) The relative position of said gear 643 is shown on Fig. 2. Said

gear 643 meshes with rack 645 an the slide 646, Fig. 83, which is guided horizontally in the frame and carries said line-feeder 582 at its front end. A spring 637 in a chamber of shaft 635 and a pin 639, working in said chamber and bearing on the end of shaft 644, press shell 636 off disk 640 as soon as magnets G are demagnetized. The line having begun to move, as stated, is kept in motion after the said contact-piece 675 has risen out of contact with the line by the current, which now goes from channel 557 to circuit 685, to switch 682, to post 684, and thence by circuit 676 to brushes 718 719, magnets E, magnets G, and to pole Z′, as above described, said current maintaining the said parts 636 640 of the friction-clutch in contact, and thus causing the continued motion of the said gear 643, rack 645, and line-feeder 582; but presently the front end of the line comes under the brushes F U F, Figs. 95 and 108, and it is to be noted that in the practice of type-setting there will never be a space-slug *z* with depressions, as shown in Fig. 96, at the extreme front end of the line, but always either a type *o* or an ordinary space or quad *p*, Figs. 97 and 98, so that the brushes F F, as well as brush U, make contact with the line. Now a current goes from F F, which are connected by circuit-wires *f f* above, Fig. 95, by wire 690 to magnet 681, attracting switch 682 off post 684 and breaking the circuit from channel 557, thence to circuit 676 and to magnets E and G, as above described, and the line continues moving until a space-slug comes under brushes F F. Then the depressions in said slug break the circuit at F F, the magnets E and G become demagnetized, and the line-feeder 582 stops, thereby arresting the line, and at the same time switch 688 flies against post 695; but brush U is wider than the brushes F F and is so positioned as to continue in contact with the raised middle portion of said type-slug *z*, so that the current now goes from U by circuit 700 to brush 701, to disk $701^{\times}$, to the field-windings of magnets E′, to disk $702^{\times}$, which is insulated from disk $701^{\times}$, to brush 702, and thence by circuit 700 to post 695, to switch 688, to circuit 676, and to pole Z′ of the battery. Said magnets E′ and their disks $701^{\times}$ $702^{\times}$ are arranged to slide on but turn with shaft 625, on which is fixed said insulating-disk 715. When said magnets E′ are energized, they are attracted to and revolved by armature 622 on said shaft 620, and thus shaft 625 is revolved, turning disk 715, so as to break the circuit from brush 718 to brush 719. Therefore the circuit from F F remains broken under all circumstances during one revolution of disk 715, so that the line cannot move during the time that a space-slug is being pushed out and a justified space is being pushed into the line, as might otherwise occur whenever brushes F F come into contact with a justified space. The several operations of the machine are so timed, however, that just before the disk 715 completes its revolution a justified space *q* will have been pushed into the line, as hereinafter described. When said justified space has come into line and the disk 715 has completed a revolution, the circuit will be again established from brushes F F, as hereinbefore described, and the line will again be moved by the line-feeder 582. Whenever the circuit through F F is established, switch 688 is attracted off post 695, thereby breaking the circuit 700 through brush U. Said brushes F F U are preferably constructed, as shown in Figs. 93, 93^{a}, 93^{b}, and 93^{c}, of flat brushes f^{2}, set in rubber or other insulating holders f^{3}. The aforesaid revolution of shaft 625 revolves vertical shaft 710 through the bevel-gears 705 706, Figs. 95 and 109, and said shaft 710 revolves horizontal shaft 730 through bevel-gears 725 726, on which shaft 730 is a disk 731, carrying a pin 732, which works in a slotted vibrating arm 733, pivoted to the frame at 734, Figs. 105 and 108. The upper end of arm 733 is pivotally connected with a sliding plunger 735, which carries a pusher 740, Figs. 107, 108, and 108^{a}. Said pusher 740 moves at right angles to the motion of the line and is so positioned that whenever the line stops by reason of a space-slug *z* coming under the brushes F F, as above described, the pusher 740 will be in line with a justified space *q*, which has come from the mold, in the manner hereinafter explained, and that will be in line with said space-slug *z*, and therefore the advance of said pusher 740 pushes justified space *q* into, and the space-slug *z* out of, the line, Fig. 108. Further movement of shaft 625 (after the space-slug *z* has been pushed out of the line) returns the pusher 740 to its normal position, at which instant the rotation of said shaft 625 will have caused the aforesaid metal segment 716 to come into contact with the brushes 718 719, Fig. 95, and brushes F F having made contact with the new justified space *q* the line will again be started in the manner hereinbefore explained, switch 688 again being attracted off post 695 and breaking the circuit through U.

Feeding justified spaces into the magazine.—The cast justified spaces *q* are removed from the molds N to their proper magazine or chute and pushed one by one into the line in the following manner: A cam 750 on cam-shaft K operates a roller 751 on an arm 752, fixed on a vertical rock-shaft 753, Fig. 101. Said rock-shaft 753 carries at its upper end an arm 755, which is pivotally connected with a link 756 and that with a pusher 760, which is guided in a holder 762, that is secured to a bracket 763, carried on the frame, Fig. 104. Said pusher 760 is positioned to move over the base 488 of the space-molds, and the cam 750 is so timed that the pusher 760 will advance just after the mold-plates 160 $160^{\times}$ have risen to open the molds after casting the justified spaces, as hereinbefore described. The advance of said pusher 760 pushes all the spaces *q* off the base 488 into a magazine chan-

nel or chute 770, formed between a stationary block 771 and an adjustable plate 772. The spaces *q* fall sidewise into the magazine, the lowermost space resting on a foot 779, and the spaces pile on one another in the channel 770. Therefore the clear opening of said channel must change according to the thickness of the spaces in order to prevent several spaces from sliding past each other, and this is accomplished in the following manner: Ears 773 774 on plate 772 are respectively connected by links 775 776 with arms 777 778 of geared segments 780 781 on short shafts 782 783, Fig. 101. On the arm of vertically-sliding rod 436 (which determines the degree of opening of the space-molds, as hereinbefore described) is a pin 785. As rod 436 descends on the wedges 434, as hereinbefore described, said pin operates lever 786, the other end 787 of which is connected with a spring 790 to restore said lever 786 to its normal position. (See Fig. 103.) Said lever 786 is fixed on said shaft 782 of gear-segment 780, and thus the descent of rod 436 causes plate 772, which is normally wide open from block 771, to close to the exact width of the space that is to be cast. The descent of rod 436 is aided by spring 791. When plate 772 is adjusted, it is locked in the following manner: A projection 796 on a cam 795 on shaft K, Fig. 108, operates a roller 798, carried by an arm 799, fixed on rock-shaft 800, which is carried on the frame of the machine. Another arm 801, fixed on said rock-shaft 800, bears against a nut 803 on horizontally-reciprocating rod 802. A spring 805, confined by a cap 804, through which rod 802 works, normally tends to push said rod 802 against the said arm 787 of lever 786, and thereby hold said lever stationary and lock the plate 772. Cam 795 is so timed that the parts will come into the position of Fig. 108 and lock plate 772 immediately after the same has been adjusted, and that after the justified spaces *q* have all been pushed into the line projection 796 will withdraw rod 802, releasing lever 785 and permitting the plate 772 to be again adjusted.

From the foregoing description it appears that the line has moved by a kind of step-by-step motion, the space-slugs *z* have all been pushed out, and the justified spaces *q* pushed in. The line Z, which is now in a tumbler 810, is then turned upright and is finally pushed into a galley 850 in the following manner: As the line moves under the brushes F U F it gradually enters into said tumbler 810, Figs. 89, 90, 105, 106, 111, and 120, until when the said line is fully pushed up by the line-feeder 582 it is entirely in said tumbler 810 and is held by the jaws 811 812 thereof. The line is held firmly by the friction-bars 830, which are pressed inward against the line by the spring 831, (compare Figs. 105 and 111,) and the end of said tumbler 810 is cut away between the projections 833, Fig. 90, to permit said tumbler to pass the line-feeder and brushes F F U as it descends. When the apparatus is not in operation, said tumbler 810, which is hinged on the rod 813, is down; but when the machine is started said tumbler 810 is raised to the position of Figs. 105 and 106, wherein it is horizontal and at the level of the channel 557, by the rising of the link 816, in a slot 817 of which works a pin 818, fixed on the tumbler 810. The lower end of said link is pivotally connected with an arm 815, fixed on the aforesaid rock-shaft 590, Figs. 105 and 106. A spring 819, Fig. 106, bearing against rod 816, serves to push arm 815 off the center. As said rock-shaft 590 revolves the slotted end of link 816 raises tumbler 810 to the horizontal position. As said tumbler 810 rises a stud 820 thereof pushes aside and finally catches on the pivoted hook 825, Figs. 90 and 91, which hook holds the tumbler 810 up until it is released by the guide-bar 646 of line-feeder 582 engaging against the pin 828, which is pivoted on hook 825 and projects into the guide of said bar 646. This occurs just after the whole line, with the justified spaces in place, has been fed into the said tumbler 810. Now hook 825 is pushed off stud 820 and the said tumbler falls to the position of Figs. 112 and 120, thereby turning the type-line upright and into line with the galley 850, Fig. 120.

The various cam motions are so coördinated that just after tumbler 810 has dropped the lever 836, Figs. 1, 110, and 113, will impel the pusher 844, Figs. 110, 112, 113, and 120, lengthwise through the tumbler 810, and thereby push the line into the galley 850, which has an opening for the purpose on the side next the said tumbler. Said pusher 844 is attached at one side of a guide-head 840, which is pivotally connected with the upper end of lever 836 and guided in a T-shaped groove in the frame, Fig. 113. The stud 839, which connects pusher 844 with head 840, slides through the open side of the tumbler 810, Figs. 112 and 113. The tumbler 810 does not touch against the wall of the galley proper; but there is a way for the line between the tumbler and the galley equipped with spring-actuated horizontal and parallel friction-bars 845, housed in a block 849, supported on the frame, Figs. 110 and 111, and parallel stationary bars 848 opposite said friction-bars 845, Fig. 120. Thus as the line is being pushed into the galley 850 it is held upright between said bars 845 and block 848. Just after the line has been pushed clear into the said galley ram 860, Fig. 109, advances and pushes the line sidewise along in the galley and hard against any line that may have been previously in the galley. Said ram 860 is as long as the longest line which will be set and is carried on the block $860^{\times}$, which is pivotally connected with the pintles on the upper end of a vibrating plate-lever 869, pivoted at 870 and actuated by the link 868, which connects it with vibrating lever 866, which is

pivoted at 867 and has a head which bears against the end of a reciprocating rod 865, that is guided horizontally in the frame of the machine, Fig. 109. Said rod 865 is pushed to the right by spring $866^{\times}$, so as to retract the ram, but at proper times is pushed to the left by the vibration of lever 863, pivoted at 864 and carrying a roller 862, which is operated by cam 861, (indicated by dotted lines in Fig. 109.) Said motion to the left causes ram 860 to advance and push a line into the galley. Said ram 860 carries spring-actuated parallel bars 874, housed in said ram, near the top and bottom thereof, Figs. 114 and 115, to allow a yielding pressure as the ram comes against the line. Said ram 860 is normally at the left of Fig. 109 and up against the line which last entered the galley; but when cam 861 turns to the proper position to permit roller 862 of lever 863 to enter the recess in the periphery of said cam spring $866^{\times}$ pushes rod 865 to the right, permitting arm 866 to move to the right, and now spring 871 oscillates arm 869 and retracts ram 860. When the next line has come to a position for being pushed into the galley, cam 861 will turn to a position to move roller 862 to the left, whereby rod 865, arm 866, arm 869, and ram 860 will be again moved to the left, pushing said next line into the galley.

The galley 850 is made adjustable to different lengths of lines by adapting its side wall 851 (which is remote from the tumbler 810) to be set at any desired position by set-screws 1000, which work in a rabbeted groove 1001 in the base of the galley, Figs. 120 and 121. Said wall 851 is set by hand to suit the desired length of line and is provided with a horizontal spring 875, which presses against the end of the last line of type which ram 860 has pushed into the galley and holds that line upright while the ram is receding. The end of wall 851 adjacent to ram 860 is equipped with a spring-actuated follower, Fig. 119, which consists of a plate 880, provided with studs 881, which work in holes in said wall 851. Springs 882, partly in said holes and partly in recesses in the studs 881, normally press the follower 880 outward, so that it follows the ram 860 as the latter recedes. The purpose of said follower is to afford a support for the adjacent end of the type-line when said line first enters the galley, at which time the ram 860 has receded. At this instant the follower will be out, Fig. 119, and the end of the line will come against its side. Slots 1003 are provided in the front of said follower to receive the bars 874 of ram 860. The throw of the ram is only about an eighth of an inch or not much greater than an average em-quad, and the movement of the follower is only as great. Slot 1004 is provided in the side of the follower to receive the end of spring 875 when the follower is pushed back. Thus as line after line is brought by the tumbler 810 and pushed into the galley 850 endwise it is moved up sidewise by the ram 860, pushing any previous line farther into the galley, and so the matter is accumulated in the galley until the same is full, when the matter is removed to the form.

Fig. 99 shows one mode of carrying the insulated circuit-wire from inside the machine to the outside electrical devices to facilitate the ready removal of the said devices from the frame. The bare end of the wire 1005 is inserted in a hole in brass sleeve 1006, which is held in insulating-bushing 1007, and said sleeve is fastened from the inside by means of screws 1009, between the head of which and rubber washer 1012 is clamped wire 1010. Fig. 100 shows another construction for the same purpose. The bare end of insulated wire 1015 is clamped between the rubber block 1016 and the brass post 1017. Said post 1017 is held in the rubber bushing 1019 by a flange on one end and a washer 1018, screwed on the other end. The inside part of post 1017 contains a screw 1021, which clamps the bare end of the wire against a post, as shown.

It is desirable that after the line-feeder 582 has advanced to its limit it should be brought easily back without having to revolve the various gear-trains backward. The reverse movement of the said pusher is effected in the following manner: A block 556^{x} on the inside of the slide which carries the pusher 556 engages an adjustable block or nut 646^{x} on the right end of slide 646, which actuates line-feeder 582, Fig. 90. Therefore as lever 561 draws back pusher 556 slide 646, with line-feeder 582, is also drawn back, and gear 643 revolves freely as the slide 646 moves back and without revolving the electrical gear-trains, because clutch 640 is now disconnected.

Summarily the action of the entire apparatus is as follows: The operator assembles a line of type with space-slugs between the words. While he is doing this the movement of the key which feeds the space-slugs into the type-line has opened the proper number of molds and in conjunction with the length of the line has determined the degree of opening of each mold, so that the spaces when cast and inserted into the line will justify it. The casting of the justified spaces is completed immediately after the line is assembled by the operator, and said justified spaces are forthwith collected in their adjustable magazine ready to be pushed into the line when it arrives opposite said magazine. Now the line, having been assembled, is moved along by the electrically-operated line-feeder by the step-by-step motion described, the space-slugs pushed out, and the justified spaces pushed into the line, which resumes its travel until at last it arrives in the galley. While the first line was thus moving along the next line was being assembled and the justified spaces therefor were being cast. That line is in its turn moved along toward

the galley and the justified spaces inserted into it while the third line is being assembled, and so on, until all the matter is set.

Now, having described my improvements, I claim as my invention—

1. The combination in a machine of the kind specified, of means for assembling type in order, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, and devices operatively connecting the said assembling devices and said molds, substantially as described.

2. The combination in a machine of the kind specified, of apparatus for assembling type and space-slugs into a line, a magazine for space-slugs, a key controlling said magazine, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, and devices operatively connecting said key and said molds, whereby the operation of said key controls the molds, substantially as described.

3. The combination in a machine of the kind specified, of apparatus for assembling type and space-slugs into a line, a magazine for space-slugs, a key controlling said magazine, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, means for removing the space-slugs from and inserting the justifying-spaces into the line, and devices operatively connecting said molds and said means for removing space-slugs and inserting justifying-spaces, substantially as described.

4. The combination in a machine of the kind specified, of apparatus for assembling type into a line, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, and means adapted to be moved according to the length of a line and to open said molds accordingly, substantially as described.

5. The combination in a machine of the kind specified, of apparatus for assembling type into a line, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, wedges to determine the degree of opening of said molds, and means adapted to be operated according to the varying length of the line and set said wedges accordingly, substantially as described.

6. The combination in a machine of the kind specified, of apparatus for assembling type into a line, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, a tilting bar and wedges adapted to determine the degree of opening of the molds, and means actuated according to the length of the line for setting said tilting bar and wedges, substantially as described.

7. The combination in a machine of the kind specified, of a magazine for space-slugs, means to feed the space-slugs therefrom, a mold for casting justified spaces, a plurality of independently-movable mold-plates on said mold, devices for retaining a desired number of said plates in the open position, a clutch adapted to operate said devices, and connections between said clutch and said means for feeding space-slugs, whereby the number of opened molds is made to equal the number of space-slugs fed from said magazine, substantially as described.

8. The combination in a machine of the kind specified, of a magazine for space-slugs, means to feed the space-slugs therefrom, a mold for casting justified spaces, a plurality of independently-movable plates 160 in said mold, a bar 155 adapted to hold any number of said plates 160 in the open position, a clutch adapted to effect the desired movement of said bar 155, and devices connecting said clutch with said means for feeding spaces, whereby the number of plates 160 held opened shall equal the number of space-slugs fed from said magazine, substantially as and for the purpose described.

9. The combination in a machine of the kind specified, of a mold-case, a plurality of independently-movable plates therein adapted to form chambers for simultaneously casting all the justifying-spaces of a line, means for assembling a line of type, means for setting the desired number of said plates at the desired degree of opening and devices operated according to the length of the line and adapted to actuate the means for setting the said mold-plates, substantially as described.

10. The combination in a machine of the kind specified, of a mold-case, a plurality of independently-movable plates therein adapted to form chambers therein for simultaneously casting all the spaces of a line, means for setting any desired number of said plates at any desired degree of opening, wedges for controlling said means, devices for assembling a line of type, and devices actuated by the line of type adapted to actuate said wedges, substantially as described.

11. The combination in a machine of the kind specified, of molds for casting justified spaces, independently-movable mold-plates therein, means for setting any desired number of plates at any degree of opening, individually-movable wedges 432, 434 adapted to actuate the means for setting said plates, a tilting bar adapted to control the relative motion of said wedges, pointers adapted to actuate said tilting bar, means for assembling a line of type adapted to operate said pointers, a feeler S operated by the type-line and adapted to regulate the position of said wedges with reference to said tilting bar, and means operatively connecting said wedges with said feeler, substantially as described.

12. The combination in a machine of the kind specified and with means for assembling a type-line, of a feeler S adapted to be operated by the line, a carriage actuated by said feeler S, a wedge 432 in said carriage, a wedge 434 movable relatively to wedge 432, a rack and gear for moving said wedge 434, a vertically-moving bar W adapted to actuate said gear, a tilting bar T adapted to limit the mo-

tion of bar W, and pointers actuated by the assembling mechanism and adapted to operate said tilting bar, substantially as described.

13. The combination in a machine of the kind specified and with means for assembling a type-line, of a mold for casting justified spaces, a plurality of independently-movable mold-plates therein, a movable bar 155 adapted to hold open any desired number of said plates 160, a vertically-movable rod 436 adapted to regulate the height of bar 155, and means for actuating said bar 155 and said rod 436 from the means for assembling the line, substantially as described.

14. In a machine of the kind specified, a mold composed of a plurality of independently-movable plates each of which is adapted to be independently set at any degree of opening, and means for setting any number of said plates at any degree of opening, substantially as described.

15. In a machine of the kind specified, the combination of devices for assembling a line of type, a mold for casting justified spaces adapted to be set at any desired degree of opening, a cam-shaft adapted to be operated in connection with said devices for assembling the line of type, and cams on said shaft adapted to operate said mold, substantially as and for the purpose described.

16. In a machine of the kind specified, the combination of devices for assembling a line of type and feeding space-slugs into the line, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line of type and adapted to be set at any degree of opening, means for removing the space-slugs from and inserting the justifying-spaces into the line of type, a cam-shaft adapted to be operated in connection with the said devices for assembling the line of type, and cams on said shaft adapted to control said molds and said means for removing the space-slugs from and inserting the justifying-spaces into the line of type, substantially as described.

17. The combination in a machine of the kind specified, of means for assembling a line of type, a plurality of molds for simultaneously casting all the justifying-spaces of a line of type, devices for opening said molds operatively connected with said means for assembling the line of type, and devices for restoring said last-named devices to their normal position after a line of type has been assembled, substantially as described.

18. The combination in a machine of the kind specified, of means for assembling a line of type, molds for casting justifying-spaces, a cam-shaft, cams thereon, devices operatively connecting the cams and the molds, and devices for locking said cam-shaft and for starting the same adapted to be controlled through the line of type, substantially as described.

19. The combination in a machine of the kind specified, of means for assembling a line of type, molds for casting justifying-spaces, a cam-shaft, cams thereon, devices operatively connecting the cams with the molds, means for moving the line of type, and devices adapted to be actuated by the line of type as it moves and to release said cam-shaft, substantially as described.

20. The combination in a machine of the kind specified, of means for assembling a line of type, a plurality of molds for casting justifying-spaces, a casting-pot adapted to charge said molds, a cam-shaft, cams thereon, devices operatively connecting said cams with said molds and said casting-pot, devices for moving the line of type, and devices actuated by the line as it moves for releasing said shaft, substantially as described.

21. In a machine of the kind specified, the combination with means for assembling a line of type, of a mold containing a plurality of independently-movable plates, some of which are adapted to constitute partitions and others to develop chambers in the mold, a stringer 460 adapted to operate said plates, devices for operating said stringer, and operative connections between said devices and said line of type, substantially as described.

22. The combination in a machine of the kind specified, of means for assembling a line of type, a hook for moving said line, a cam-shaft and cams thereon for operating said machine, a device for locking and releasing said cam-shaft operatively connected with said hook, and means operatively connected with said cam-shaft for producing additional movement of said line, substantially as described.

23. The combination in a machine of the kind specified, of means for assembling a line of type, a hook for initial movement of said line, a cam-shaft, cams thereon for operating said machine, a clutch adapted to control said cam-shaft and operatively connected with said hook, and means operatively connected with said cam-shaft for producing additional movement of said line, substantially as described.

24. The combination in a machine of the kind specified, of means for assembling a line of type with space-slugs therein, a plurality of molds adapted to simultaneously cast all the justifying-spaces of a line, and means for removing the space-slugs from and inserting the justifying-spaces into the line, substantially as described.

25. The combination in a machine of the kind specified, of a plurality of adjustable molds adapted to simultaneously cast all the justifying-spaces of a line of type, devices for moving the line of type, and means actuated by said line of type for opening the desired number of molds, substantially as described.

26. The combination in a machine of the kind specified, of a plurality of adjustable molds adapted to simultaneously cast all the justifying-spaces of a line of type, means for assembling a line of type with space-slugs, de-

vices for moving the line of type, an electric circuit for controlling said last-named devices and arranged to be closed and broken by the line as it moves, and devices for pushing the space-slugs out and the justifying-spaces into the line, substantially as described.

27. The combination in a machine of the kind specified, of means for moving a line of type by a step-by-step movement, a plurality of molds for simultaneously casting all the justifying-spaces of a line of type, a magazine for said spaces, and a space-pusher adapted to push said spaces from the molds to the magazine, substantially as described.

28. The combination with a mold for casting spaces of an adjustable magazine for said spaces, and devices for removing said spaces from the mold to the magazine, substantially as described.

29. The combination of a mold for casting spaces, a magazine for said spaces adapted to be adjusted to the width of said spaces, and devices for removing the said spaces from the mold to the magazine when the latter has been adjusted, substantially as described.

30. The combination of a mold for casting spaces, means for adjusting the mold to different degrees of opening, a magazine for the spaces, means for adjusting the magazine according to thickness of the spaces and coördinated with the means for adjusting the mold, and devices for removing the spaces from the mold to the magazine, substantially as described.

31. The combination of a main cam-shaft, a mold for casting spaces, means for adjusting the mold, a magazine for the spaces, means for adjusting said magazines according to the thickness of said spaces, and cams on said shaft operatively connected with the means for adjusting the mold and the magazine, substantially as described.

32. The combination of a main cam-shaft, an adjustable mold for casting spaces, an adjustable magazine for the spaces, devices for removing the spaces from the mold to the magazine, and operative connections between said cam-shaft and said mold magazine and devices, substantially as described.

33. The combination of means for moving a type-line, an adjustable mold for casting spaces and an adjustable magazine for the spaces, devices for removing the spaces from the mold to the magazine, devices for pushing the spaces into the line, and means for adjusting the mold, for adjusting the magazine, and for operating said devices coördinated with the aforesaid means for moving the type-line, substantially as described.

34. The combination of means for moving a type-line, a plurality of molds for simultaneously casting all the justifying-spaces of a line of type, devices for inserting justifying-spaces into the type-line, a galley adapted to be adjusted to lines of different lengths, and means for assembling lines in the galley, substantially as described.

35. The combination of means for moving a type-line, a plurality of molds for simultaneously casting all the justifying-spaces of a line of type, devices for inserting justifying-spaces into the type-line, a galley adapted to be adjusted to lines of different lengths, and means for assembling the completed lines in the galley, substantially as described.

36. The combination of means for moving a type-line, a mold for casting spaces, devices for inserting spaces into the type-line, a galley adapted to be adjusted to lines of different lengths, a ram adapted to assemble completed lines in the galley, and a follower on a wall of the galley adapted to advance and recede with the ram, substantially as described.

37. The combination of a main cam-shaft, an adjustable mold for casting spaces, an adjustable magazine for the spaces, devices for removing the spaces from the mold to the magazine, a galley for the completed lines, a ram adapted to assemble the lines in the galley, and cams on said cam-shaft adapted to operate said mold magazine devices and ram, substantially as described.

38. The combination of means for moving a line, a plurality of molds for simultaneously casting all the justifying-spaces of a line of type, devices for pushing justifying-spaces into the line, a tumbler adapted to receive and turn the completed line, a galley adapted to receive the line from the tumbler, and a ram for assembling the lines in the galley, substantially as described.

39. The combination of means for moving type-lines, a mold for casting spaces, a magazine for the spaces, means for inserting spaces into the type-lines, a tumbler for turning the lines, a galley adapted to receive the lines, a ram adapted to assemble the lines in the galley, and devices for operating the mold, the magazine, the means for inserting spaces into the lines, the tumbler and the ram, all coördinated with the means for moving the lines, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 27th day of February, 1897.

WILLIAM BERRI.

Witnesses:
GEORGE T. MUSSON,
CLEMENT FRENCH TAYLOR.