

No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 1.

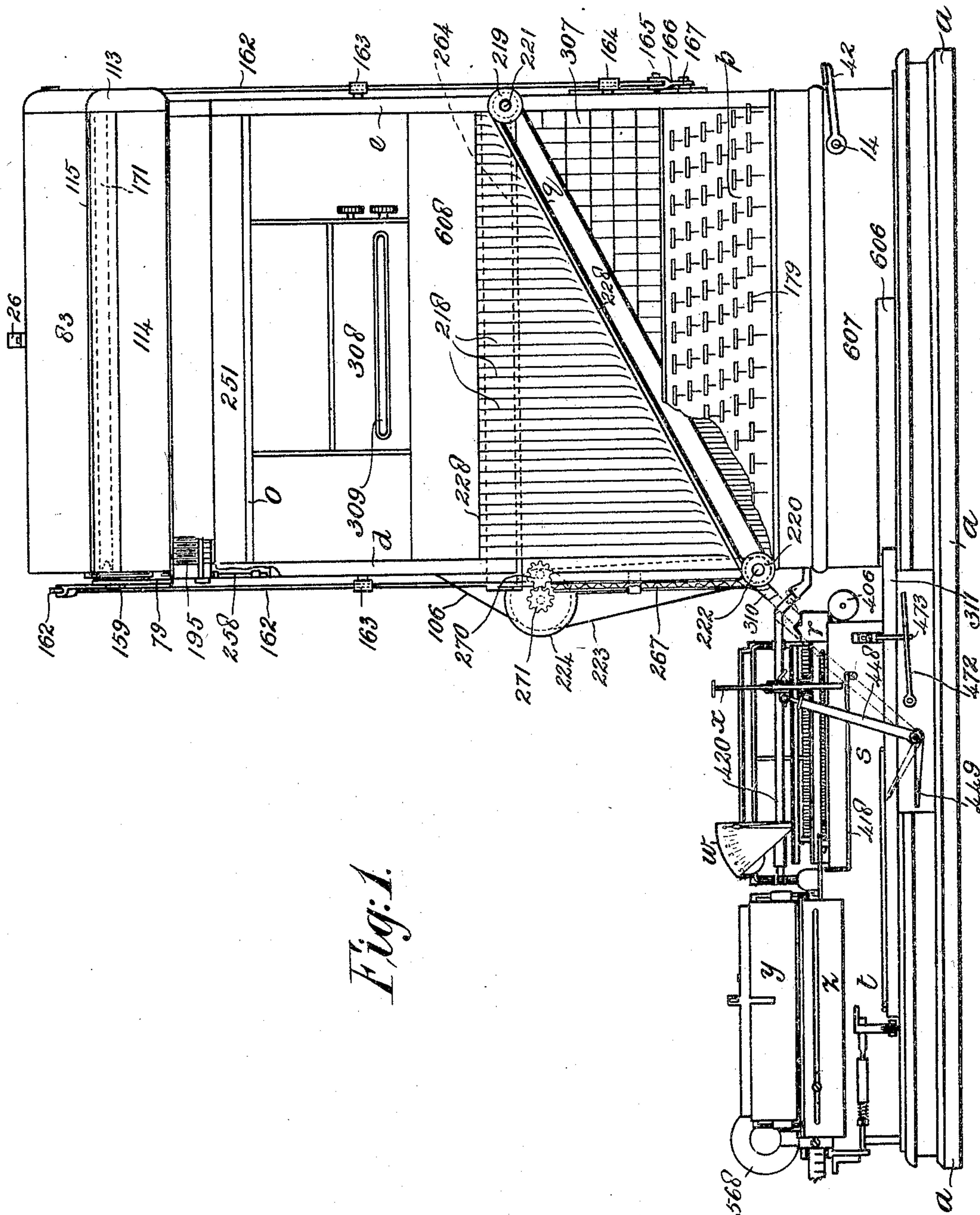


Fig. 1.

Witnesses
Leonard E. Haynes.
Edwin D. Bartlett.

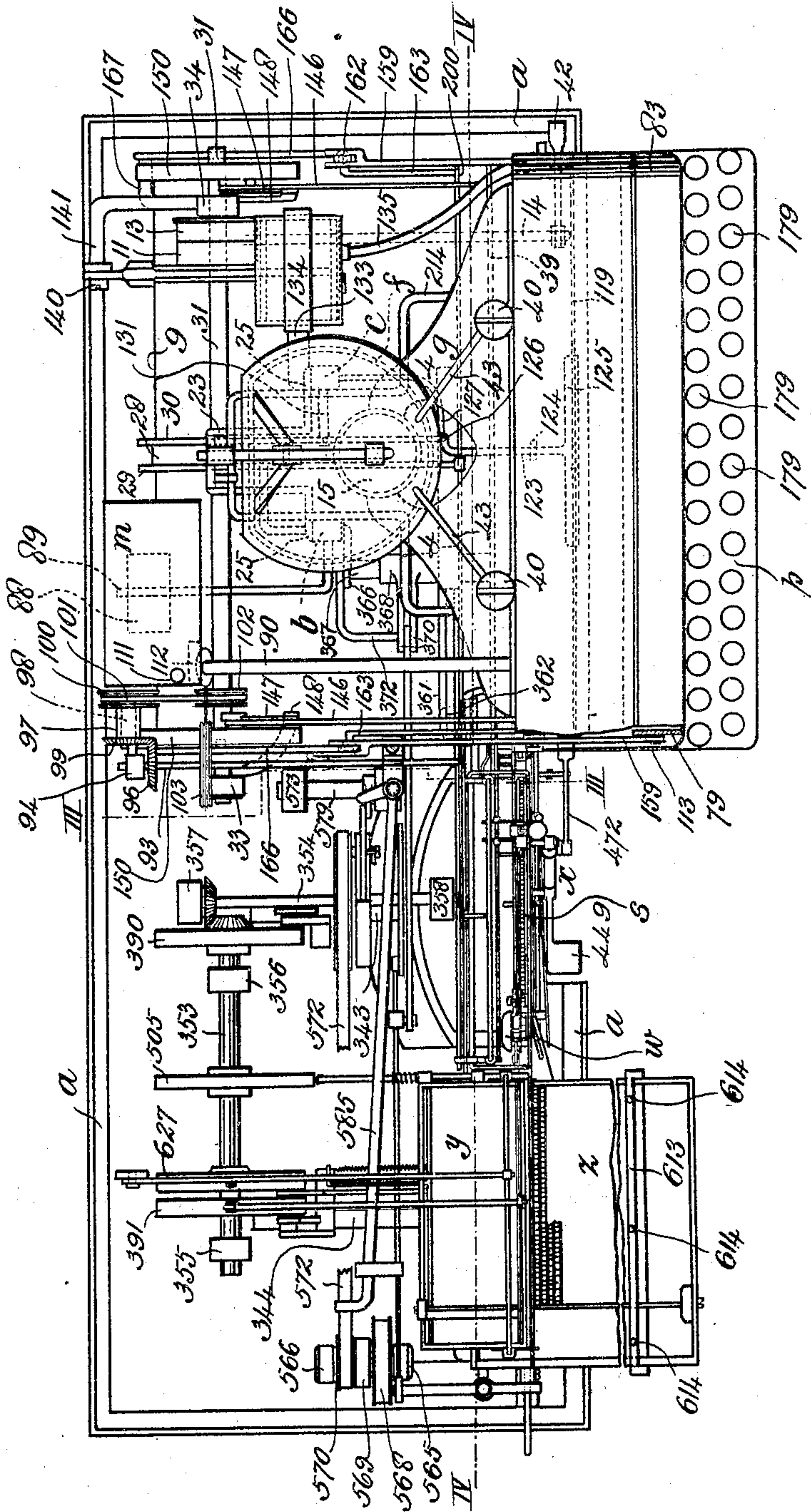
Inventor.
Shanker Abaji Bhisey.
per Herbert Sefton Jones
Attorney.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 2.

Fig. 2.



Witnesses
Leonard C. Haynes.
Edwin D. Bartlett.

Inventor.
Shankar Abaji Bhisey
per Hubert Sefton Jones
Attorney.

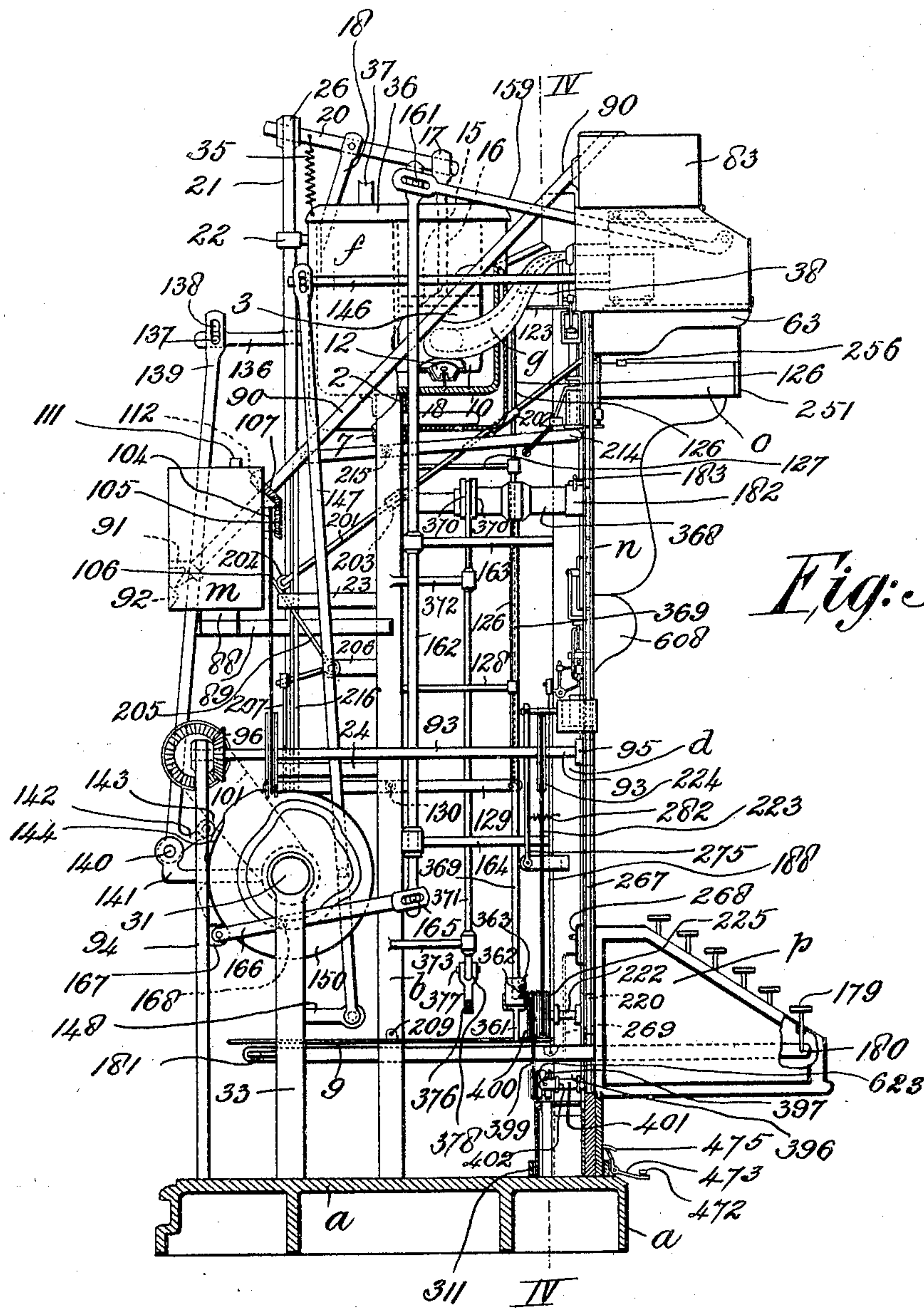
No. 789,708.

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25 SHEETS—SHEET 3.



Witnesses
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TYPE MAKING AND SETTING MACHINE.

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26 SHEETS--SHEET 4.

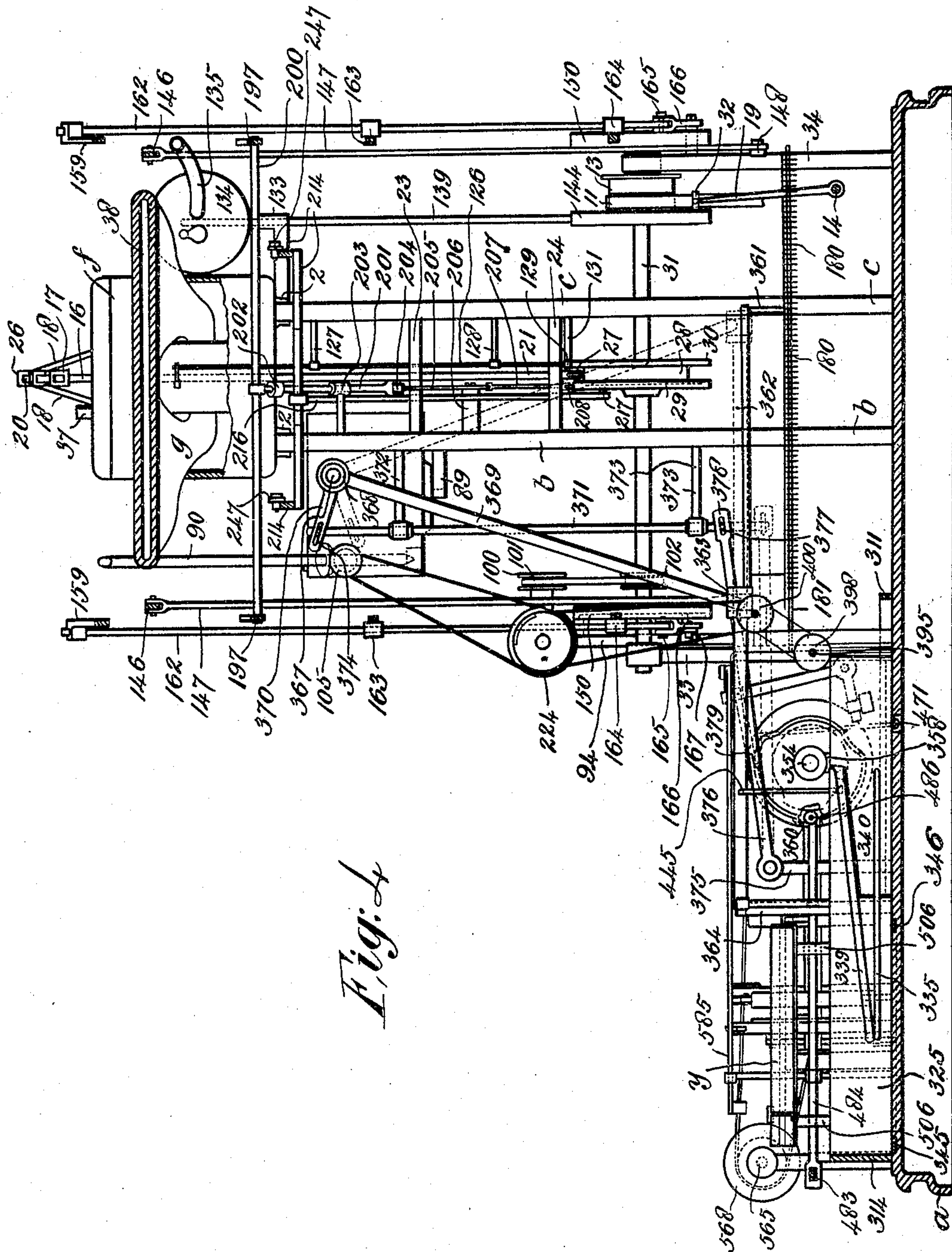


Fig. 4

Witnesses
Leonard E. Haynes.
Edwin D. Bartlett

Inventor
Shanker Abaji Bhisey
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No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 5.

Fig:5.

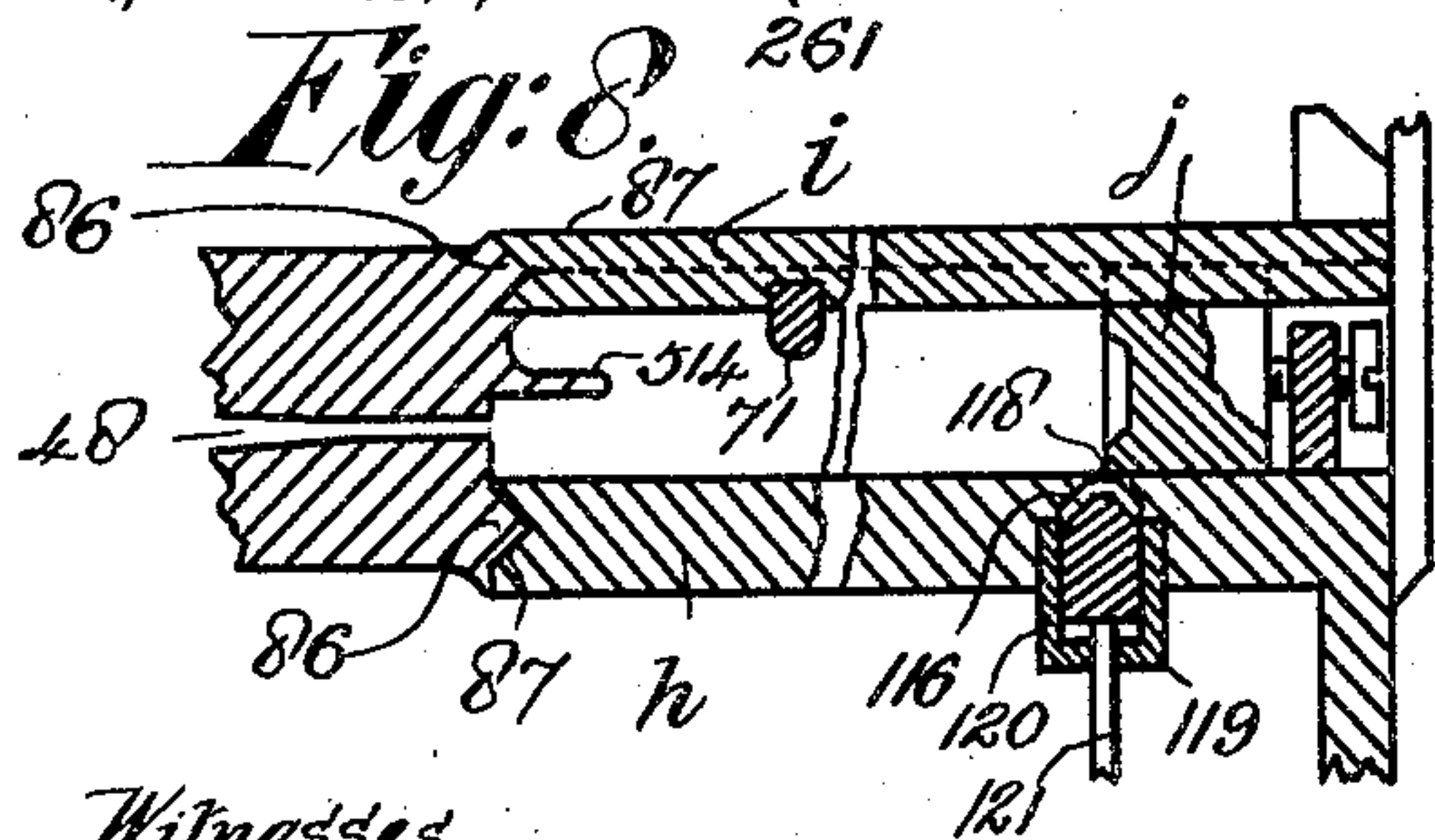
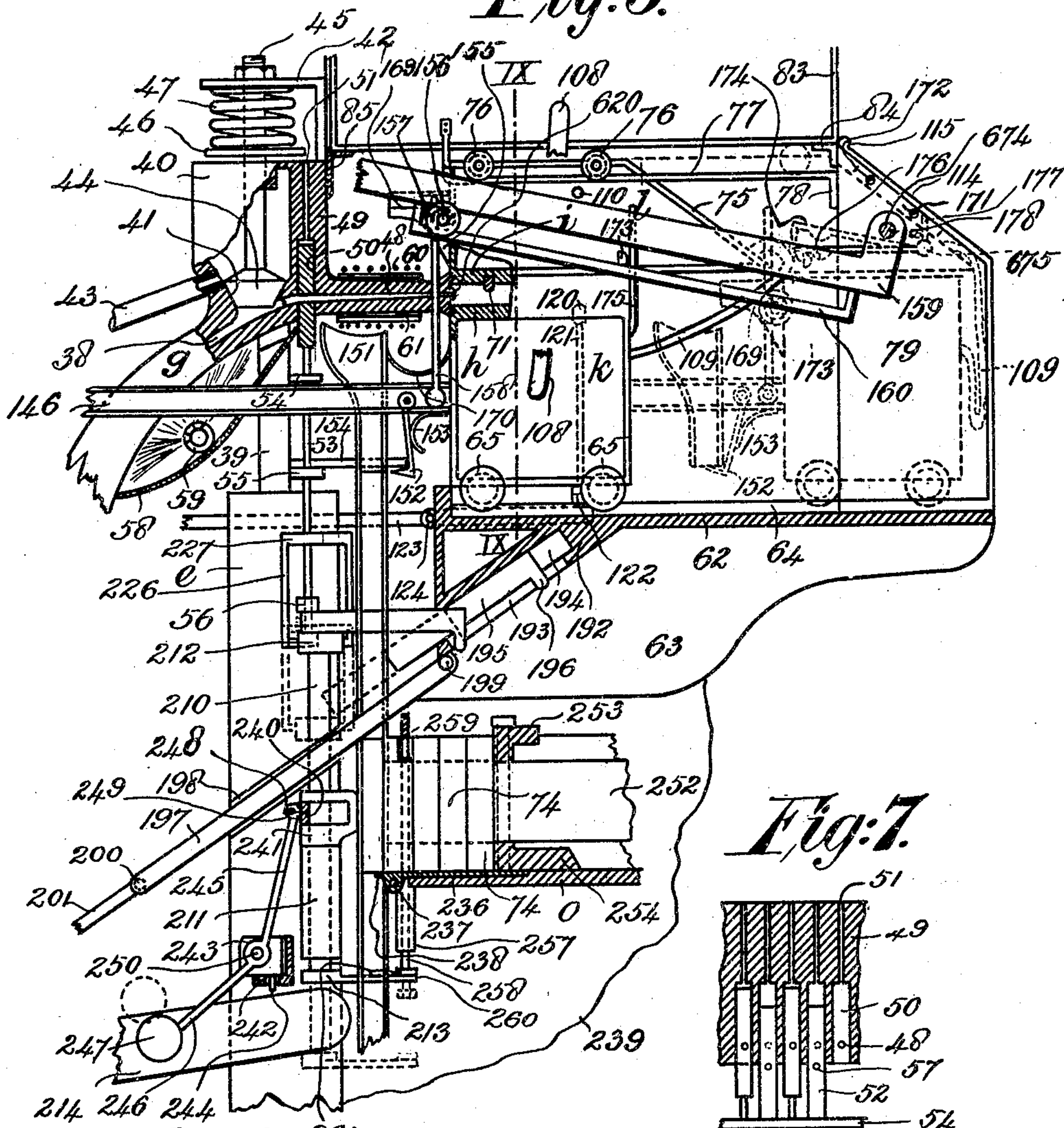
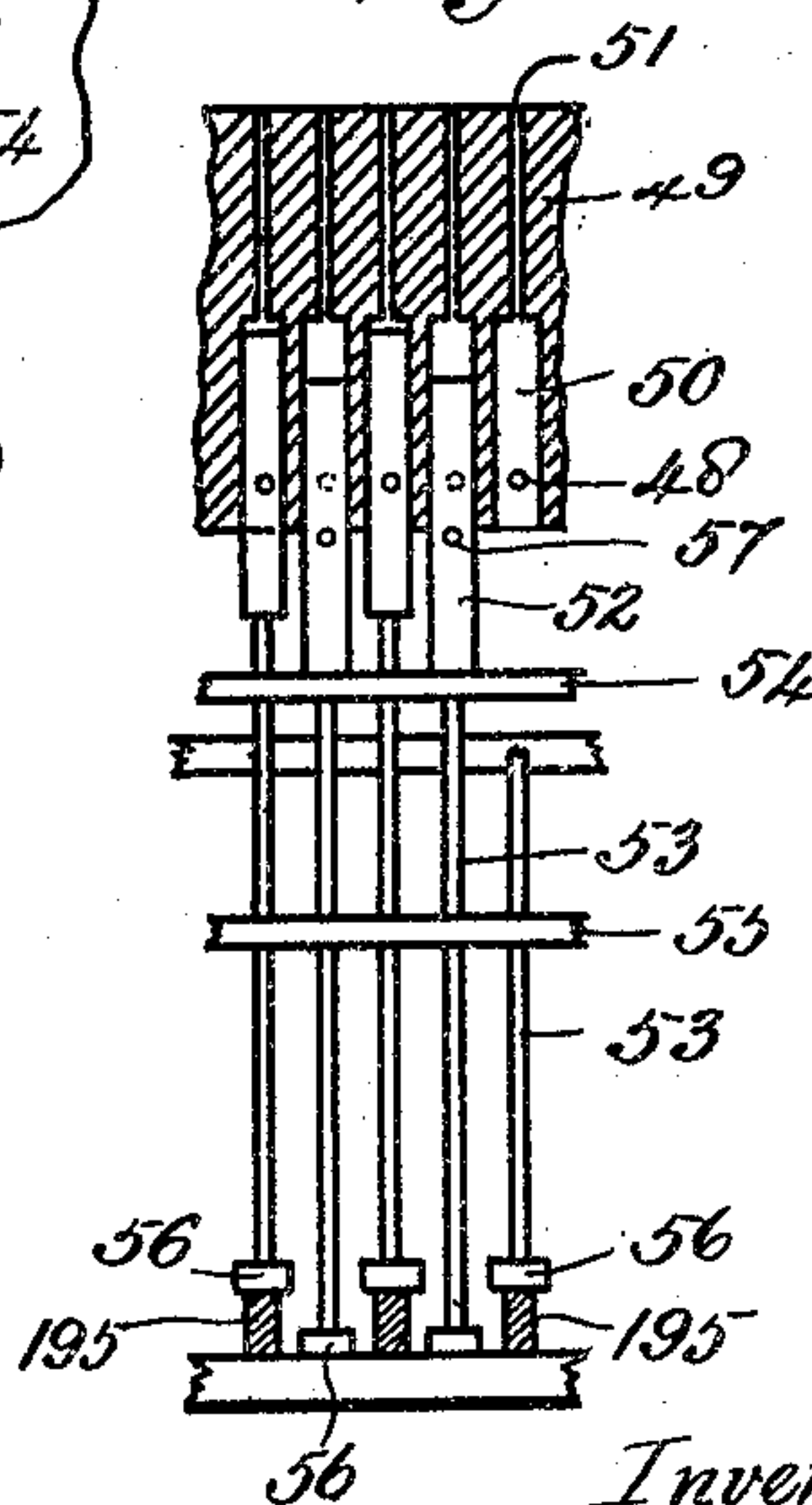


Fig:7.



Witnesses
Leonard E. Haynes,
Edwin J. Bartlett.

Inventor
Shankar Abaji Bhisey
per Hubert Sefton Jones
Attorney.

No. 789,708.

PATENTED MAY 16, 1905.

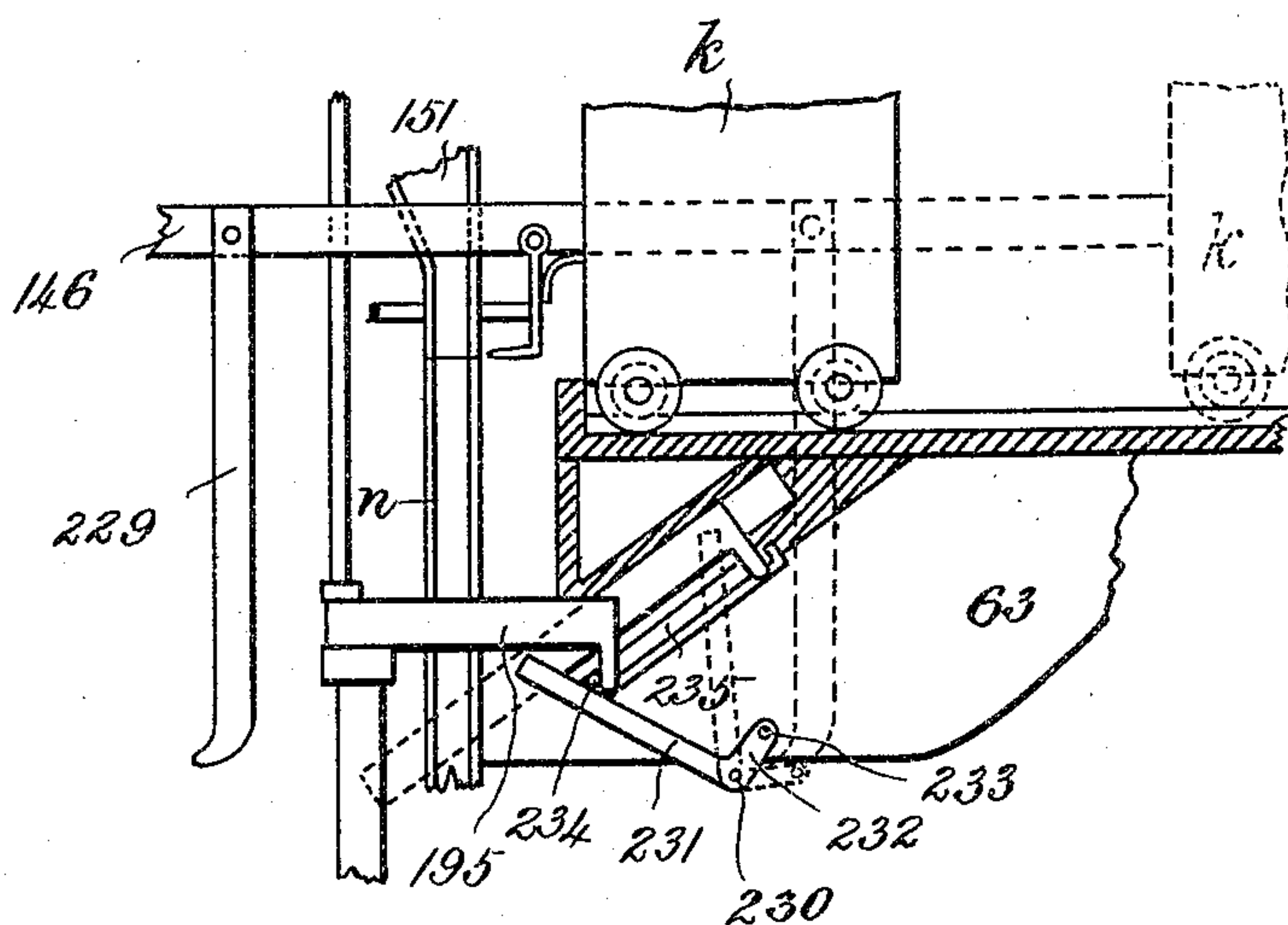
S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 6.

Fig: 6.



Witnesses
Leonard C. Haynes.
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No. 789,708.

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TYPE MAKING AND SETTING MACHINE.

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25 SHEETS—SHEET 7.

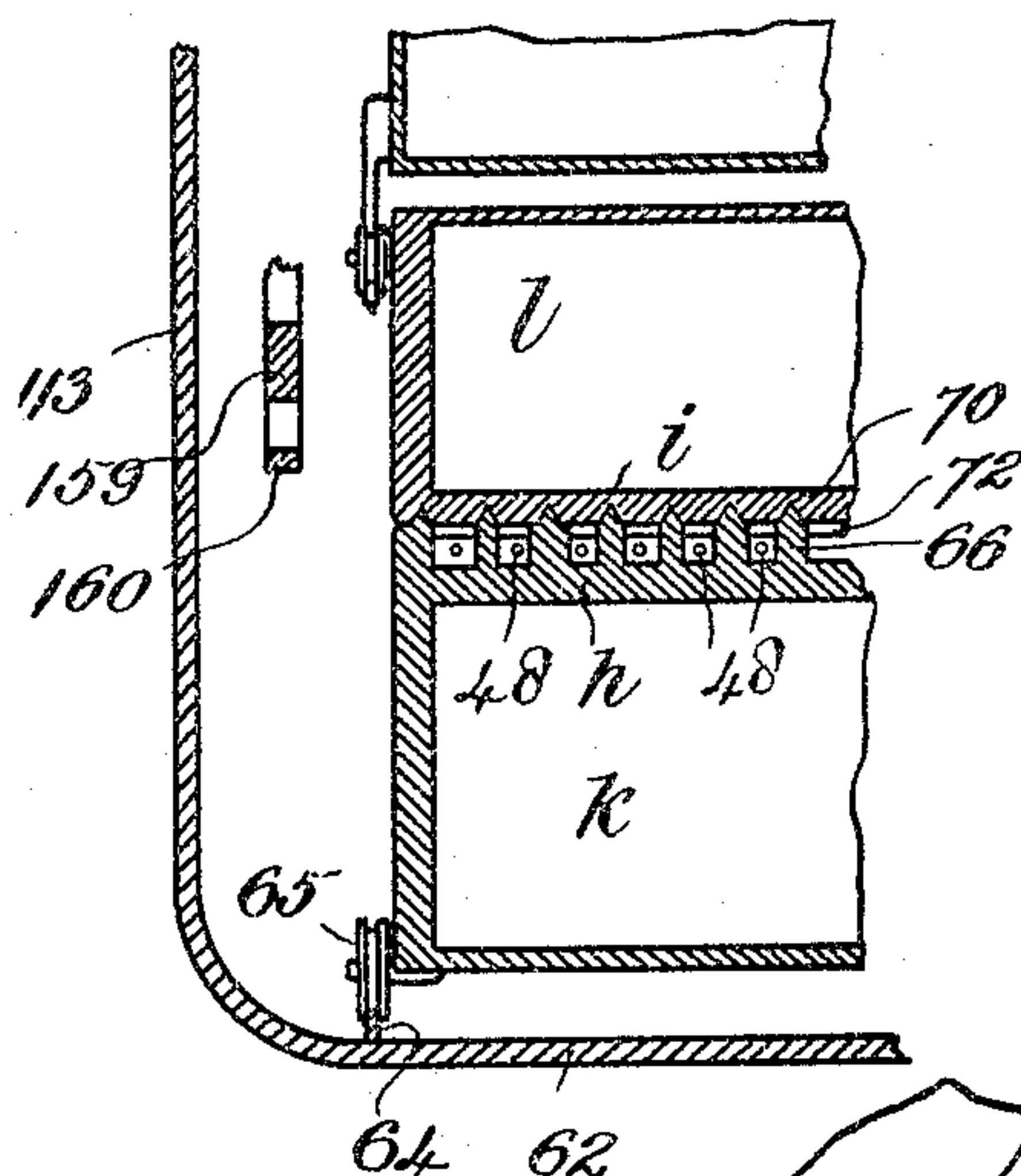


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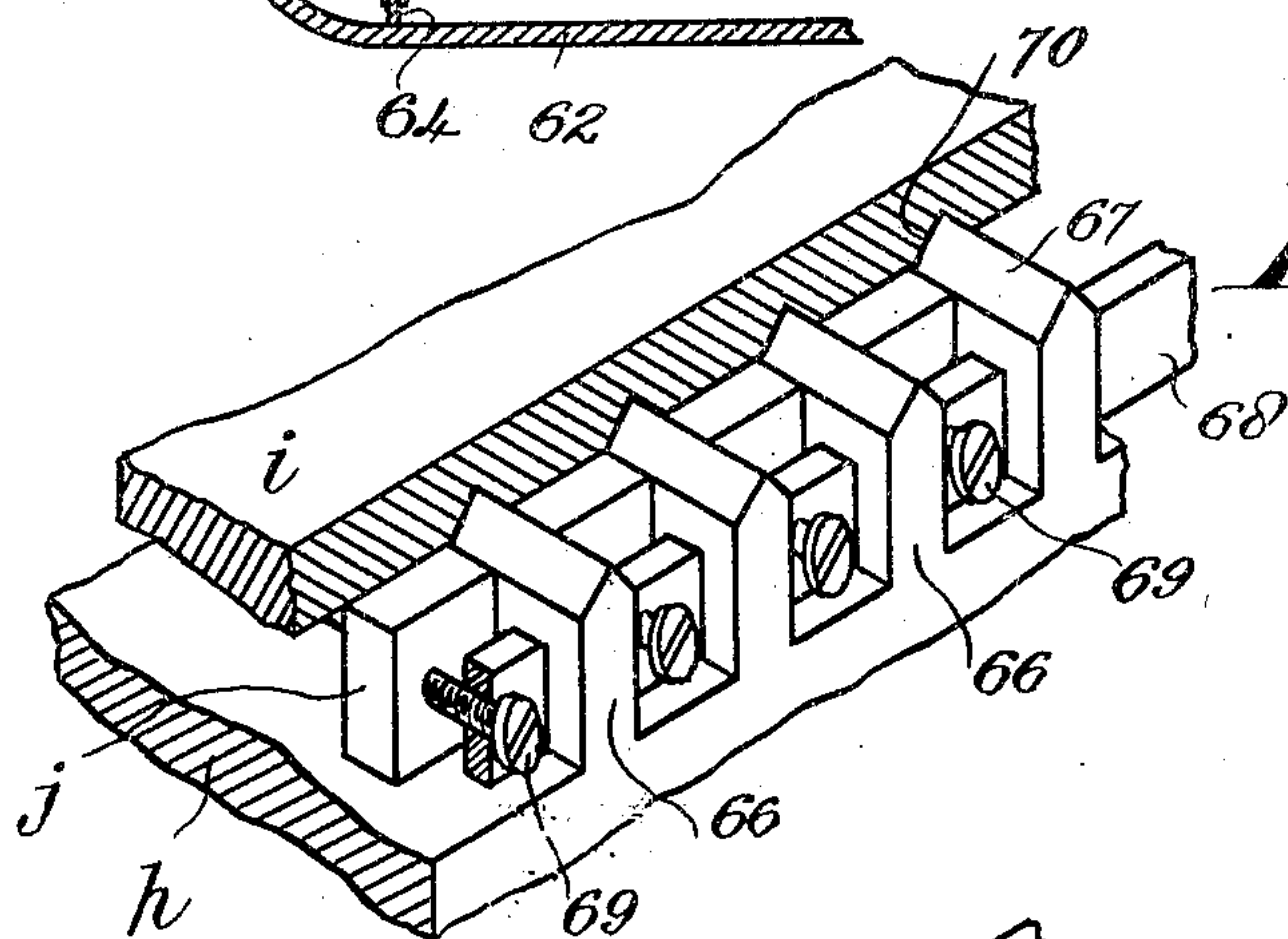


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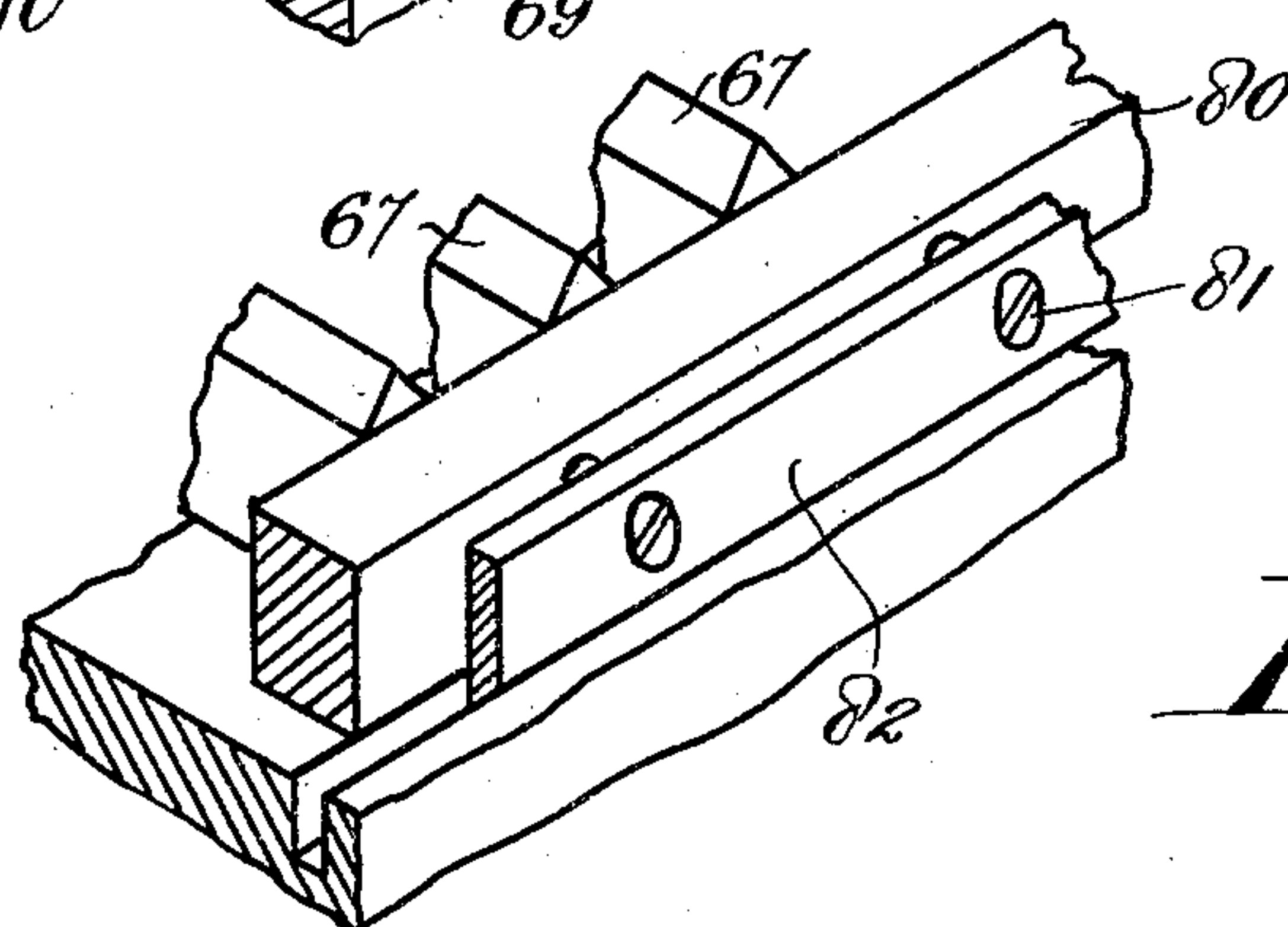


Fig:11

Witnesses
Leonard E. Haynes.
Edwin D. Bartlett

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per Herbert Sefton Jones
Attorney

No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 8.

Fig: 11.^a

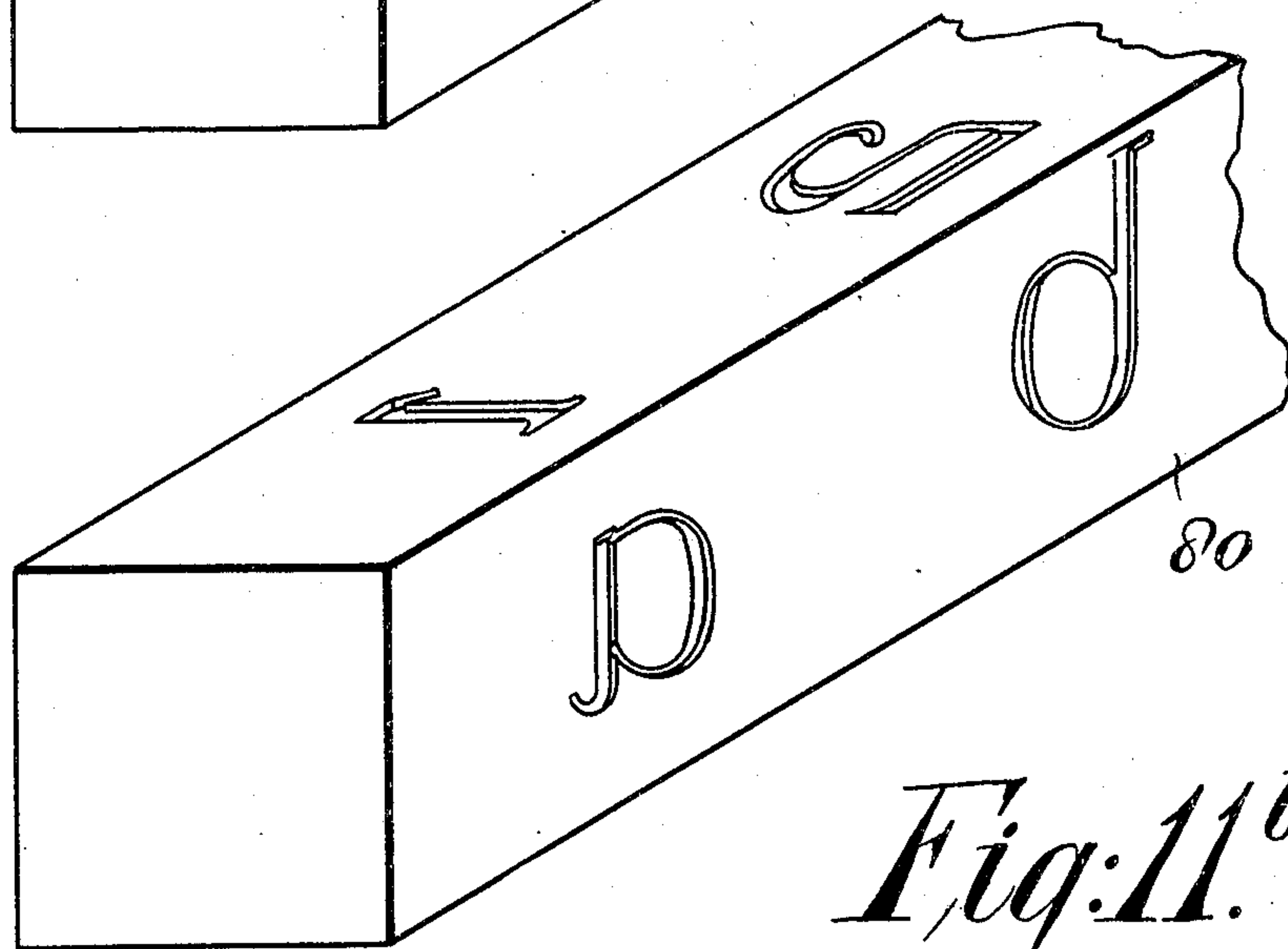
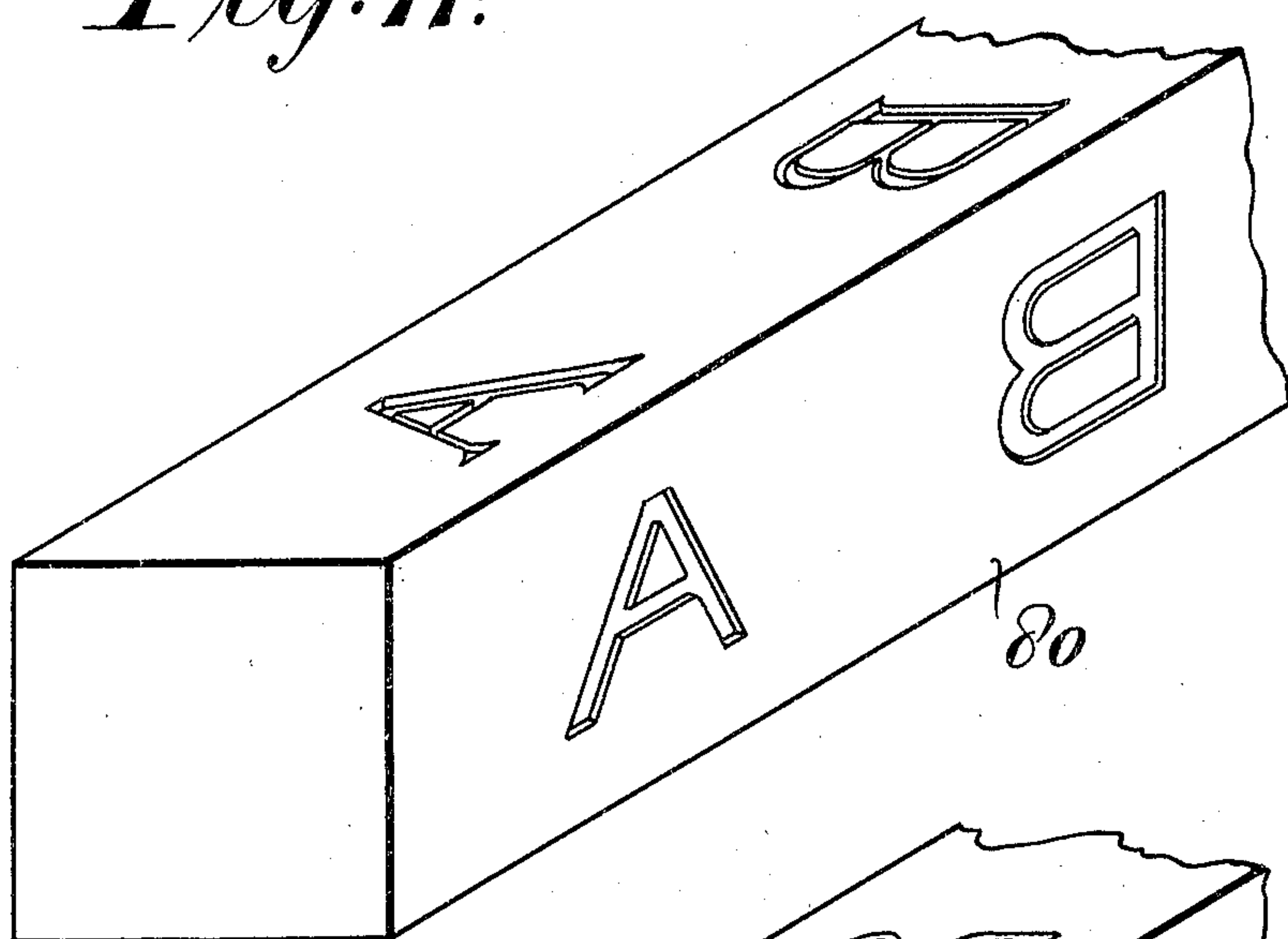


Fig: 11.^b

Witnesses

Edwin D. Bartlett

Myer

Inventor

Shanker Abaji Bhisey

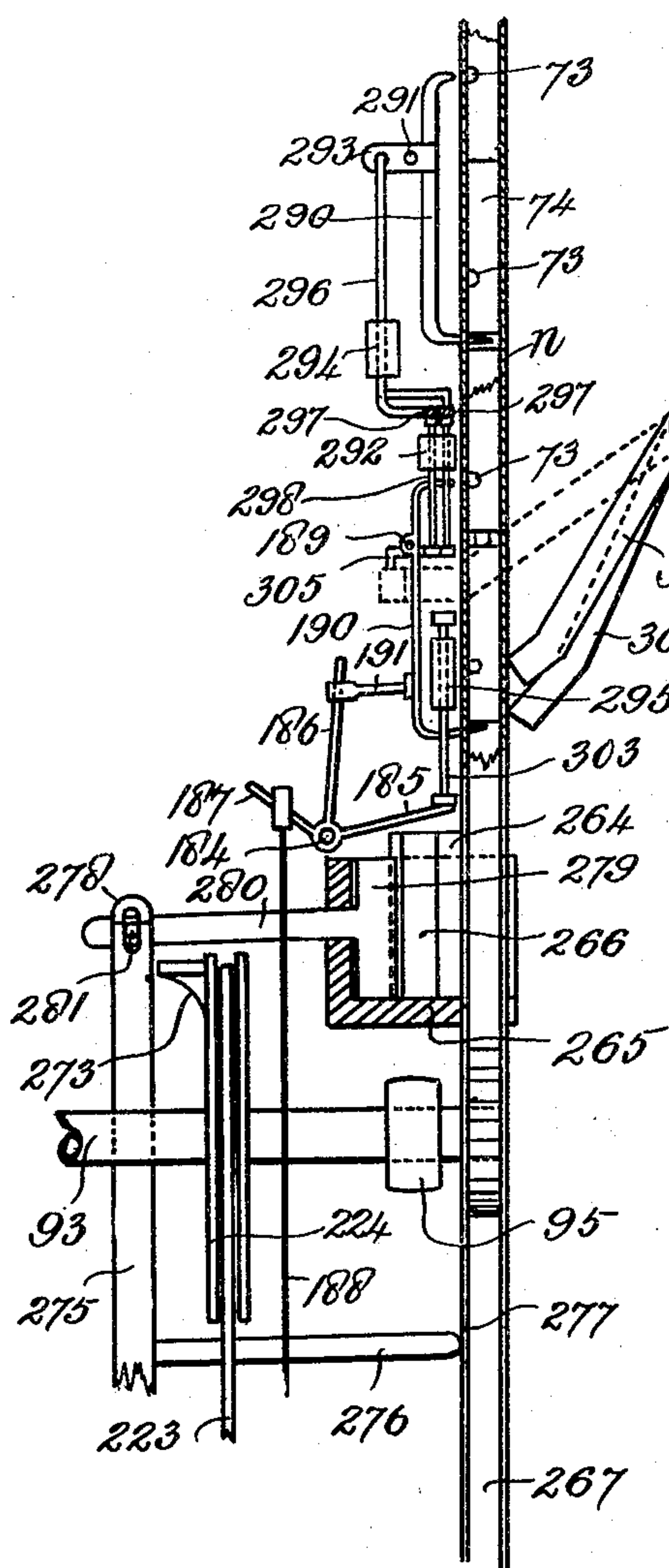
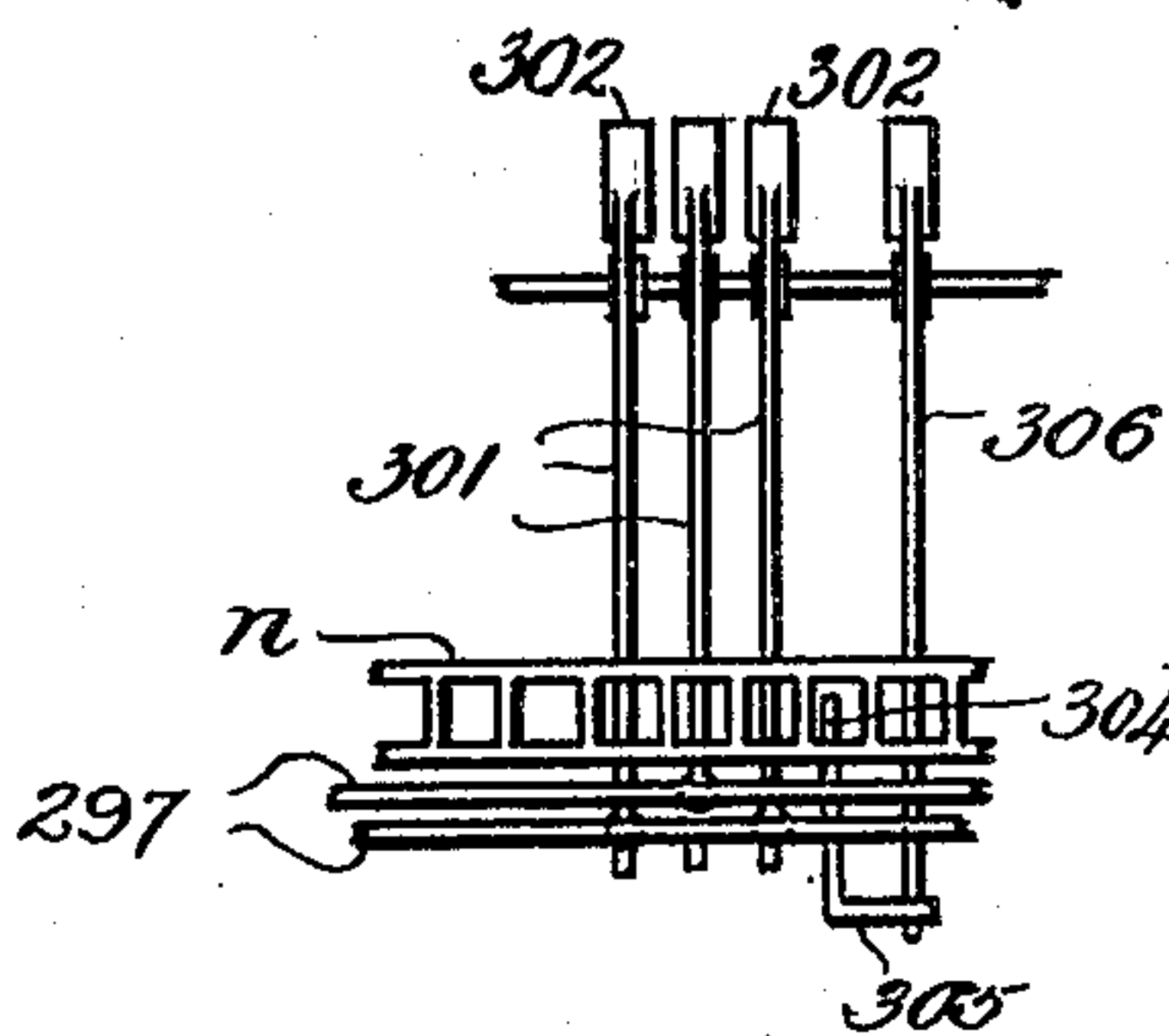
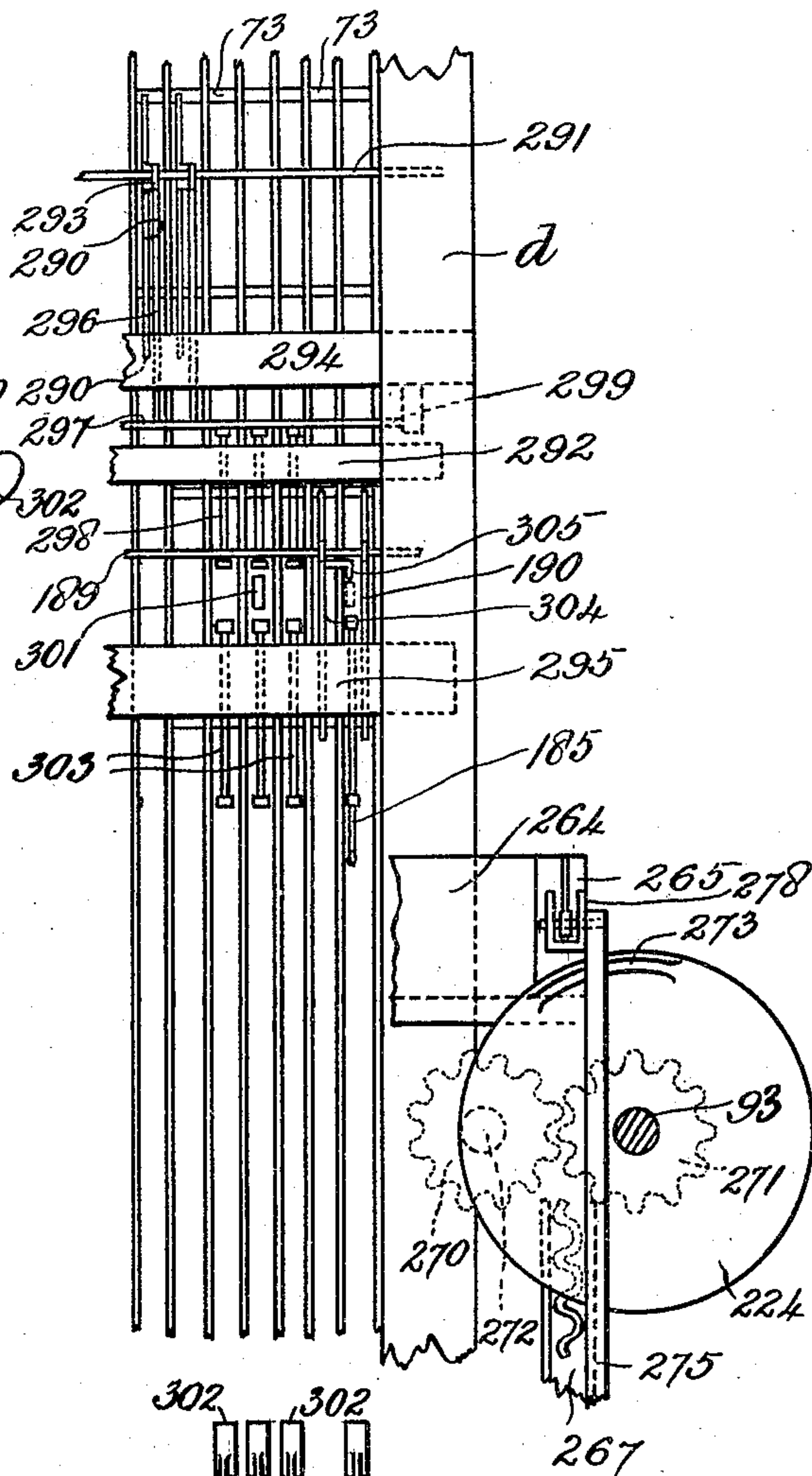
Mason, Fenwick & Lawrence
Attorneys.

S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 9.

Fig:12*Fig:13.**Fig:14.*

Witnesses
 Leonard C. Haynes.
 Edwin D. Bartlett.

Inventor
 Shanker Abaji Bhisey.
 per Herbert Sefton Jones
 Attorney.

No. 789,708.

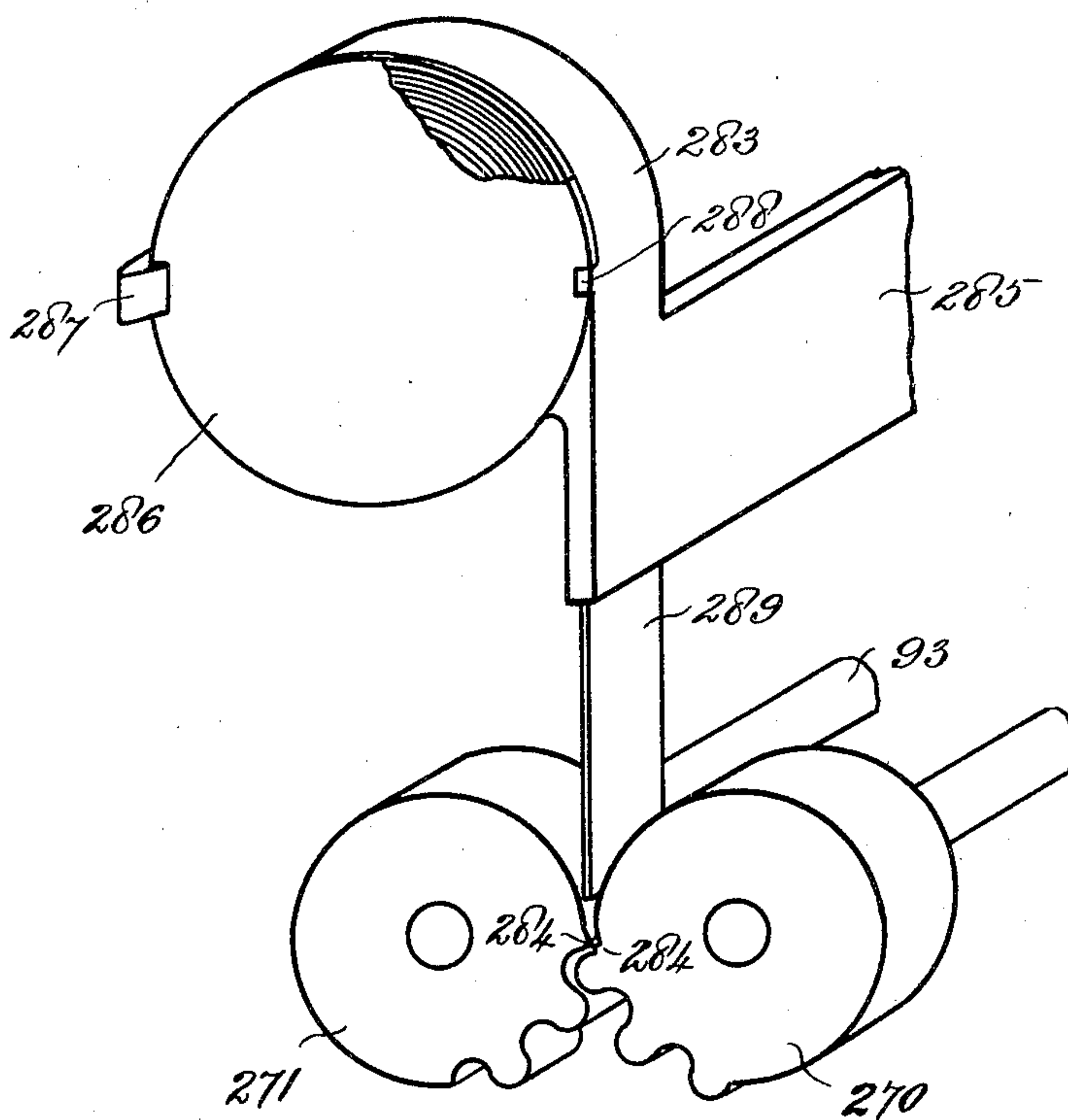
PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 10.

Fig. 15.



Witnesses.
Leonard E. Haynes.
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No. 789,708.

PATENTED MAY 16, 1905.

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TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 11.

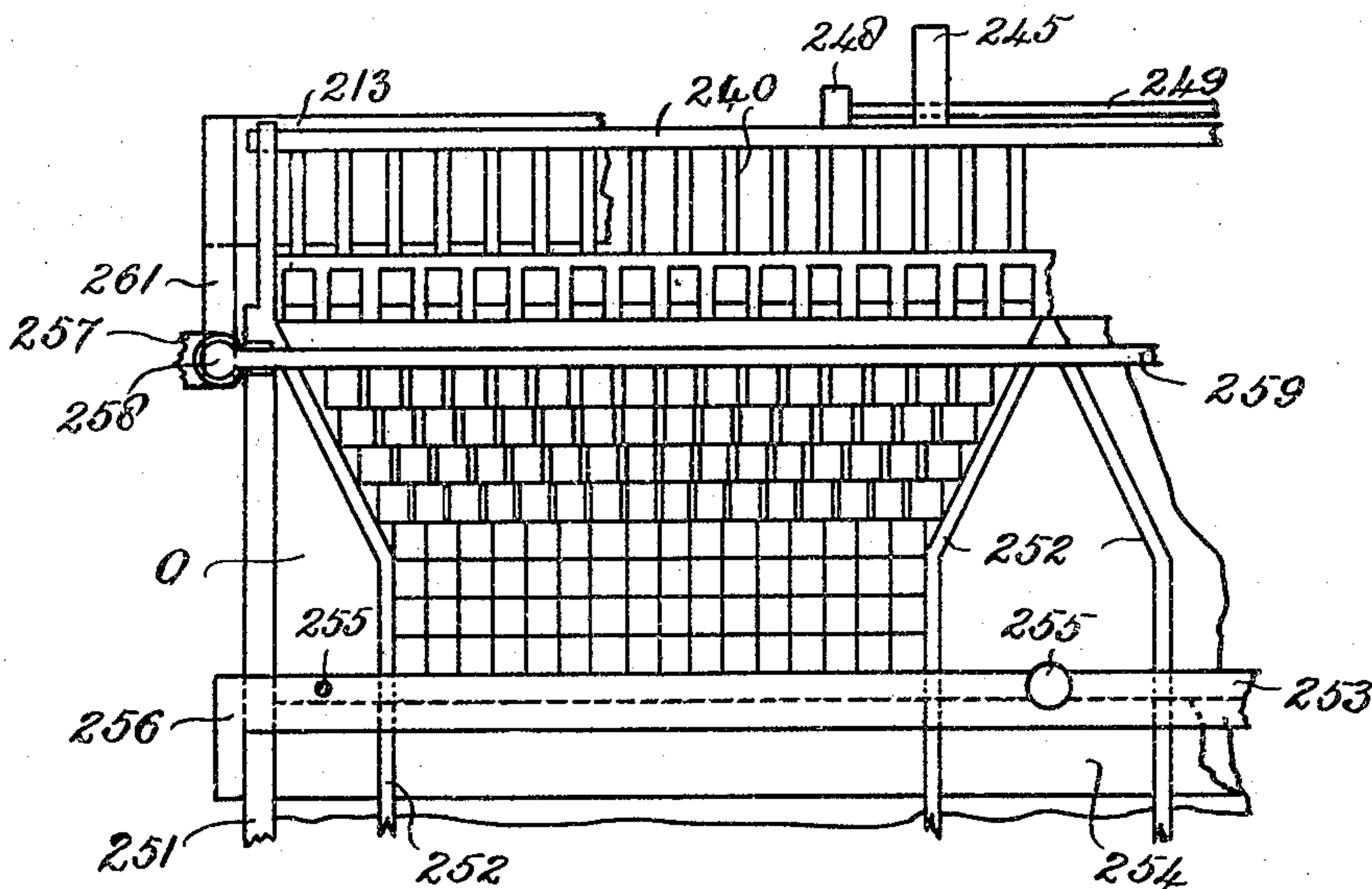
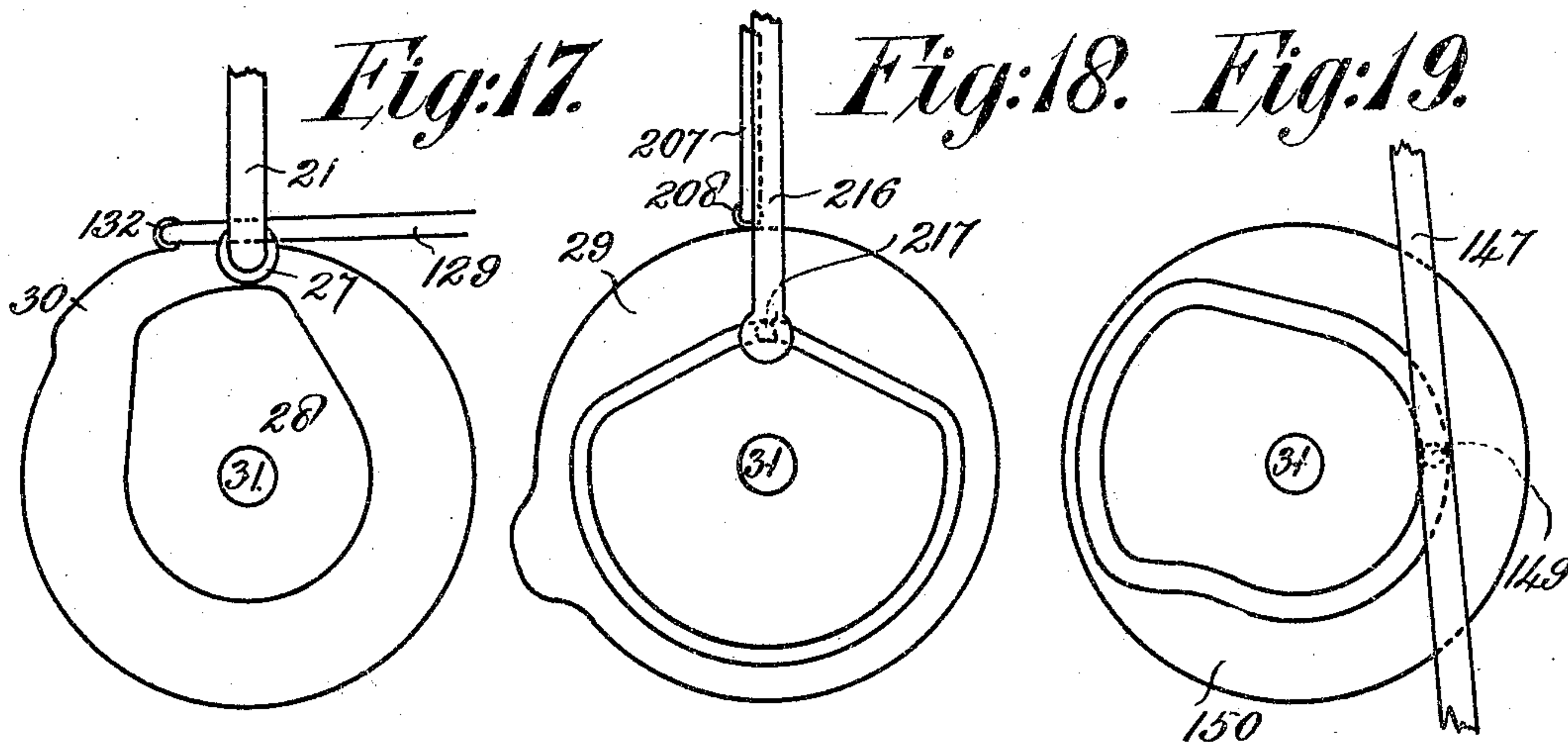
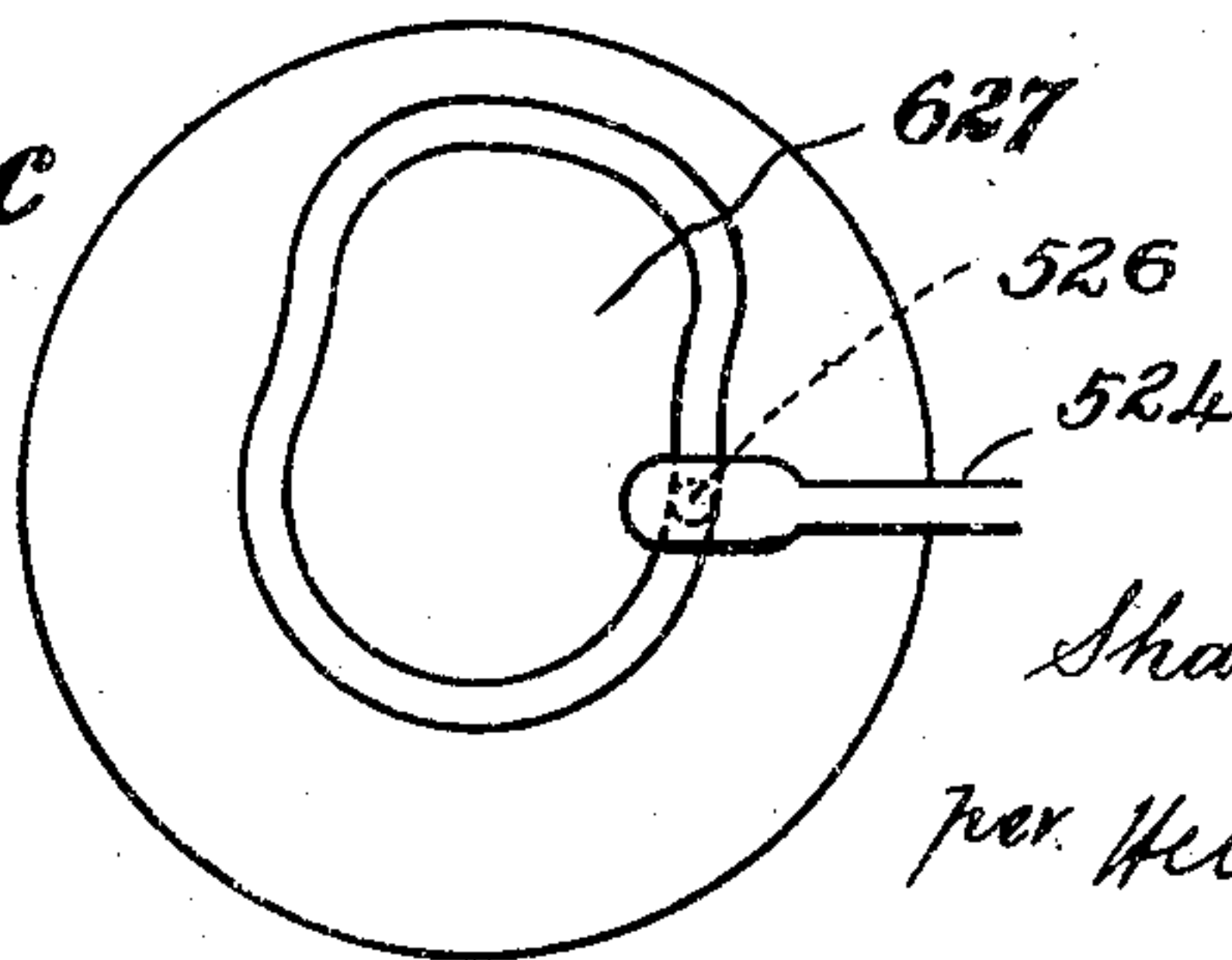


Fig:16.

Fig:19.^c

Witnesses
Leonard E. Haynes.
Edwin D. Bartlett.



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No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 12.

Fig: 19.^a

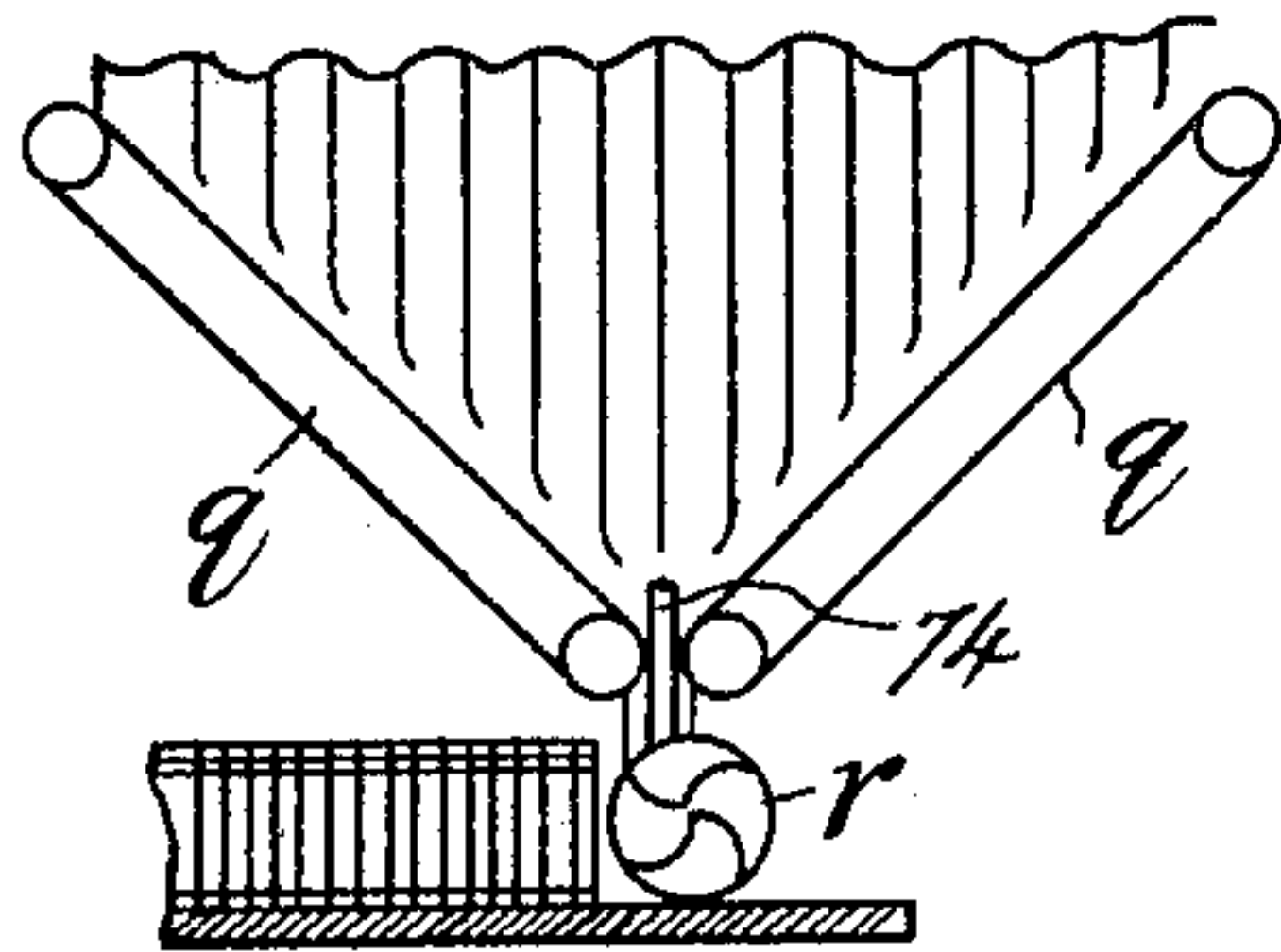
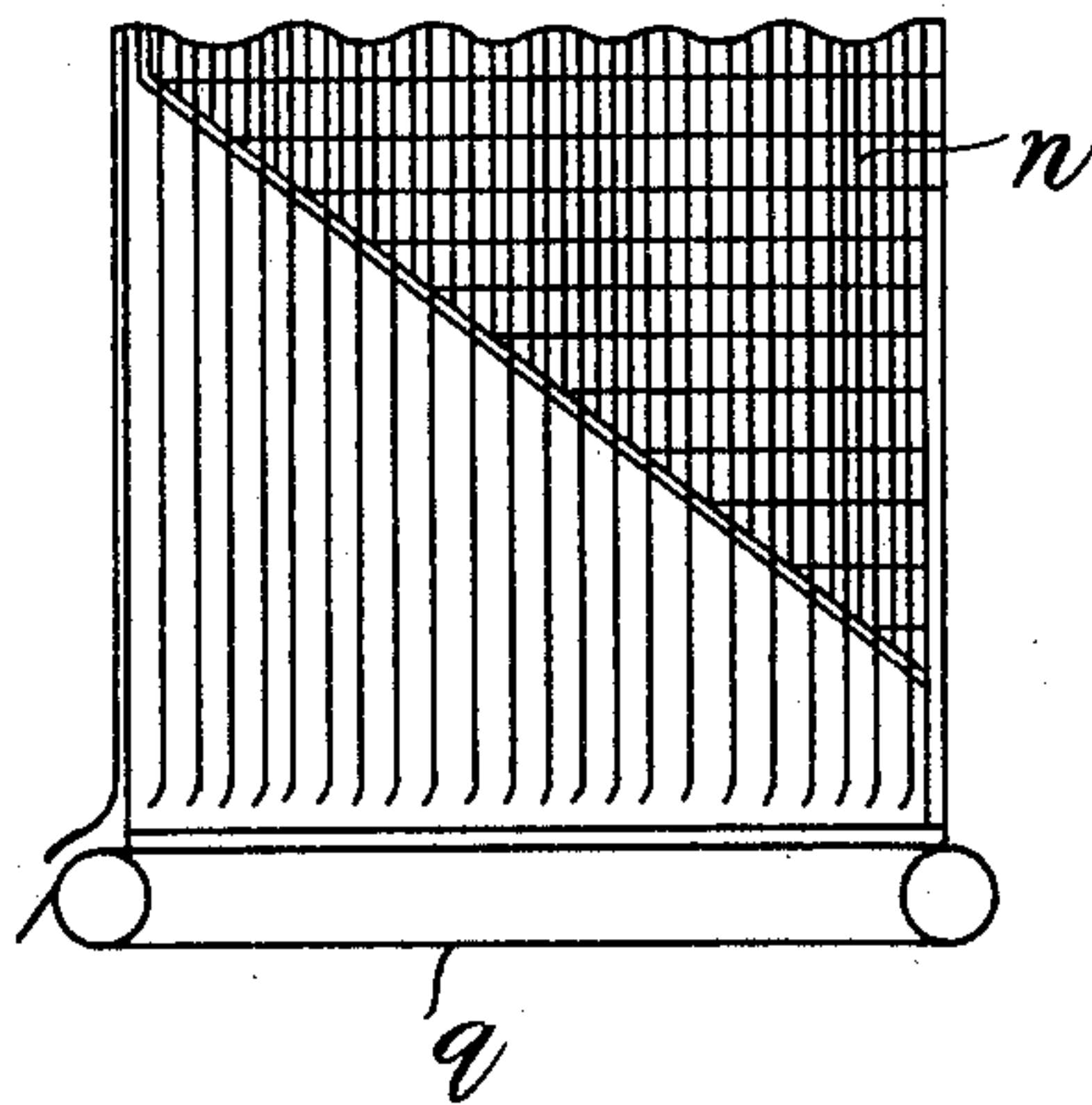


Fig: 19.^b



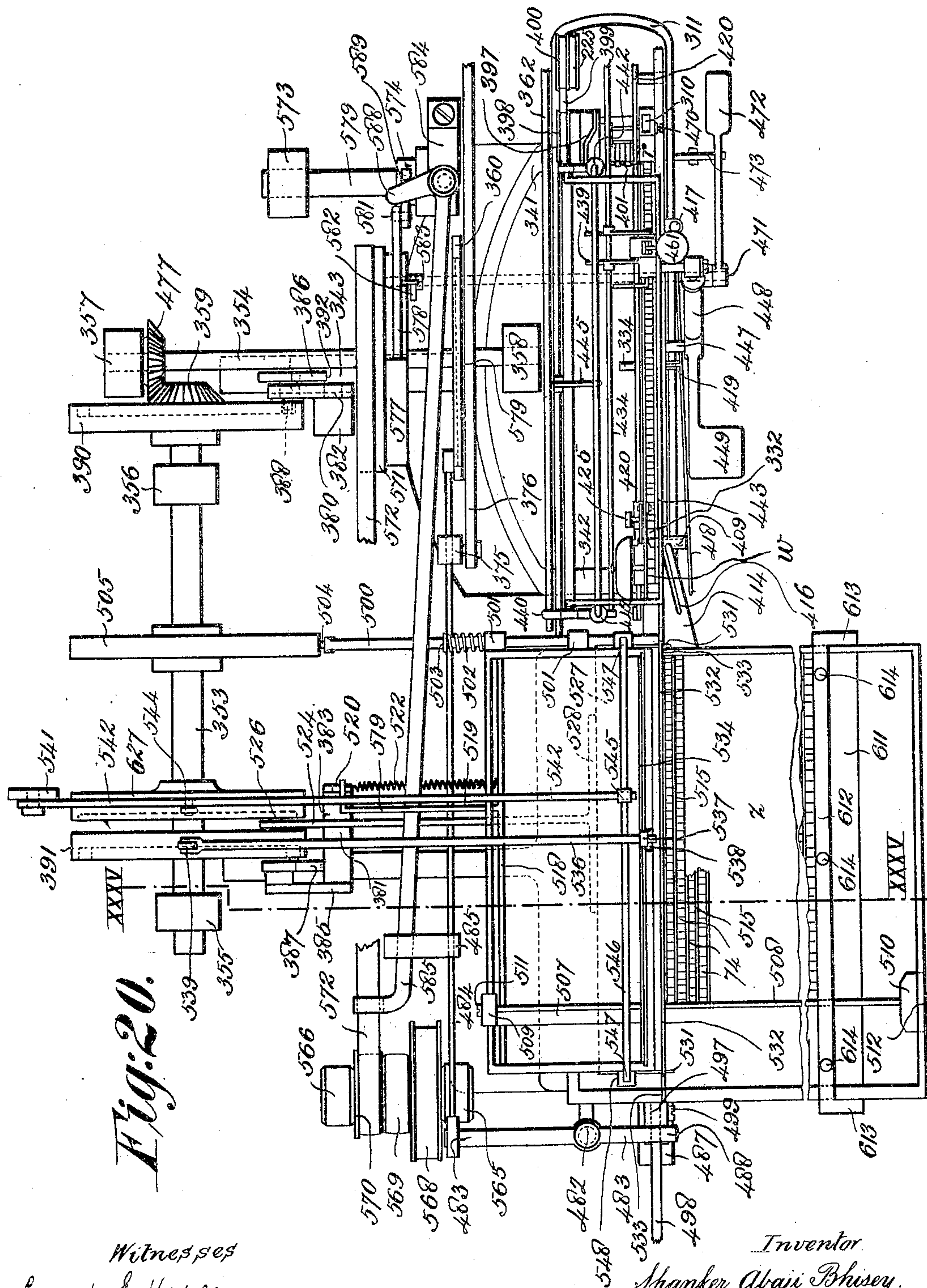
Witnesses
Leonard C. Haynes.
Edwin D. Bartlett

Inventor
Shanker Abaji Bhisey
per Herbert Lepton Jones
Attorney.

PATENTED MAY 16, 1905.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 13.



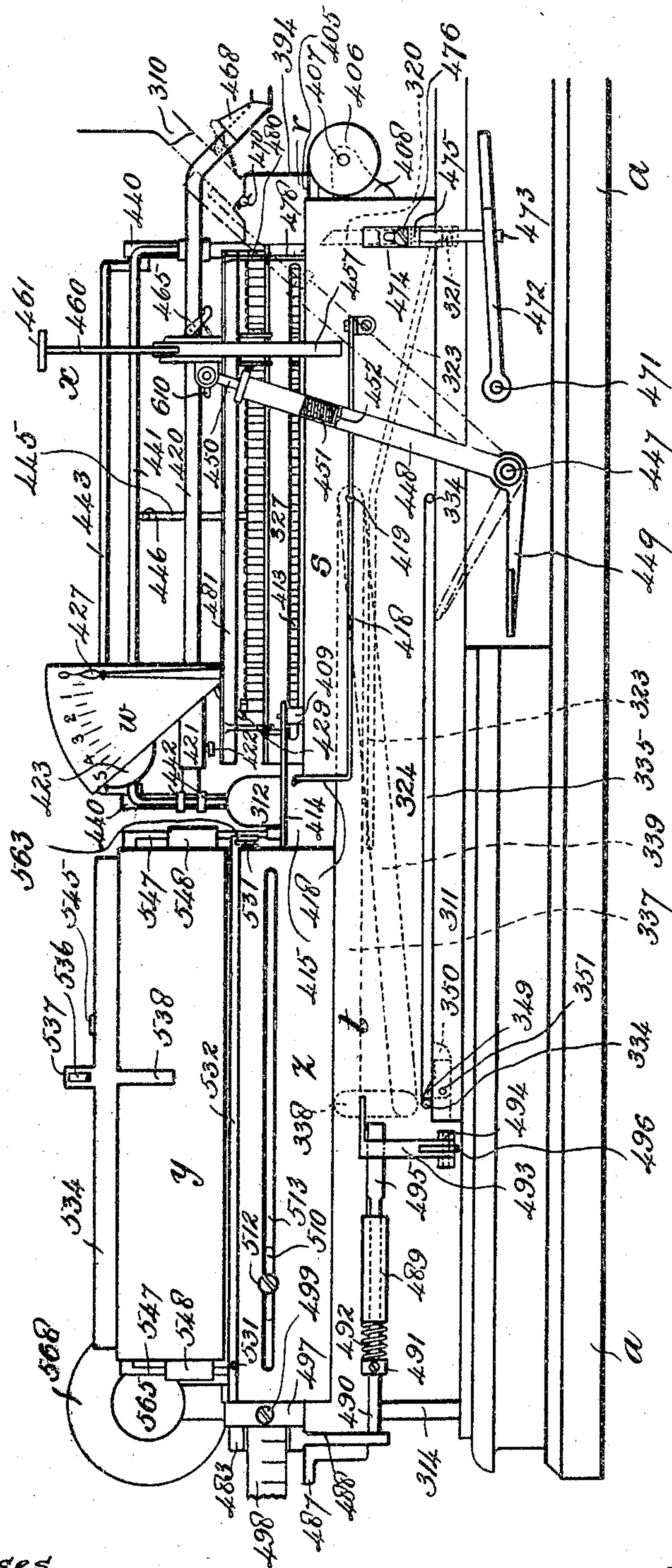
548
 533
 42
 Inventor.
 Shanker Abaji Bhisey.
 per Herbert S. Fourn. Jones
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S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 14.

Fig. 21.



Witnesses
Leonard C. Hayes.
Edwin D. Bartlett

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per Herbert Sefton Jones
Attorney

No. 789,708.

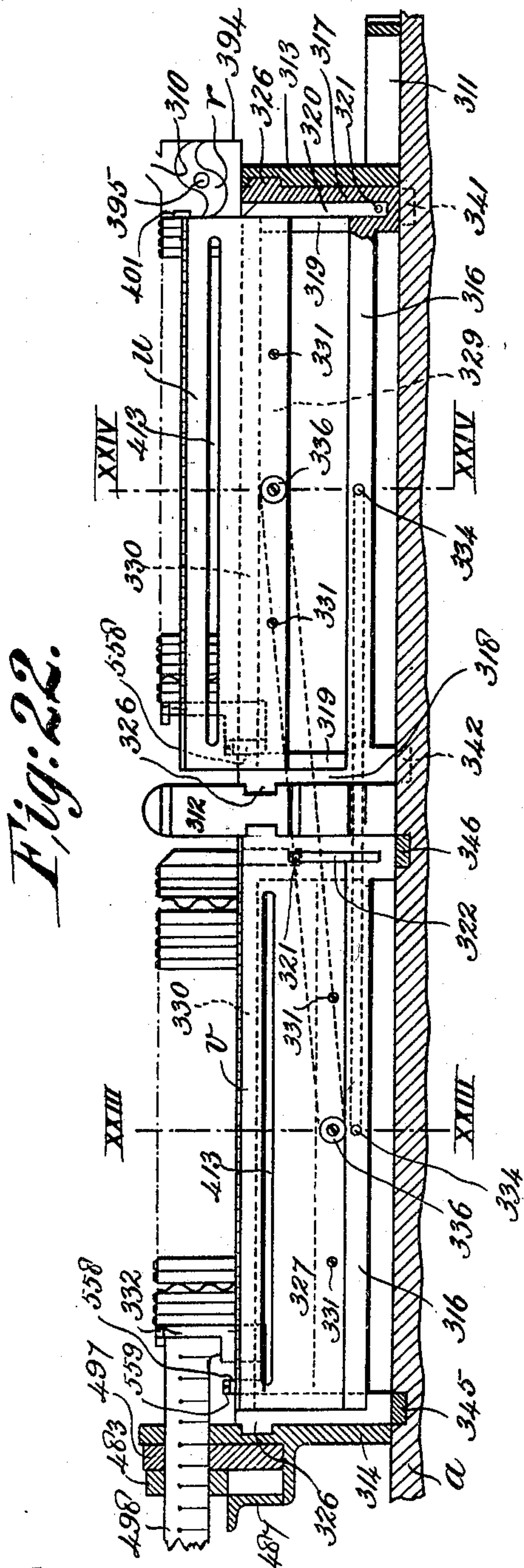
PATENTED MAY 16, 1905.

S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

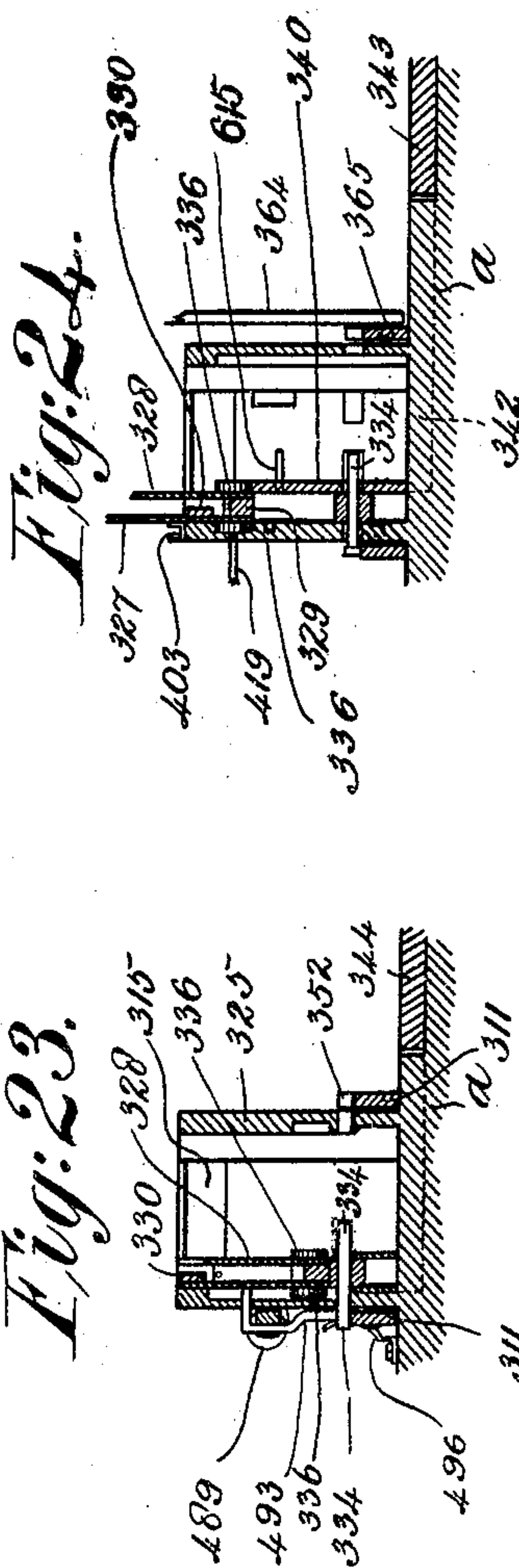
APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 16.



Witnesses

Leonard C. Haynes
Edwin D. Barkett



Inventor.

Shanker Abaji Bhisey
per. Herbert Sefton-Jones
Attorney.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 16.

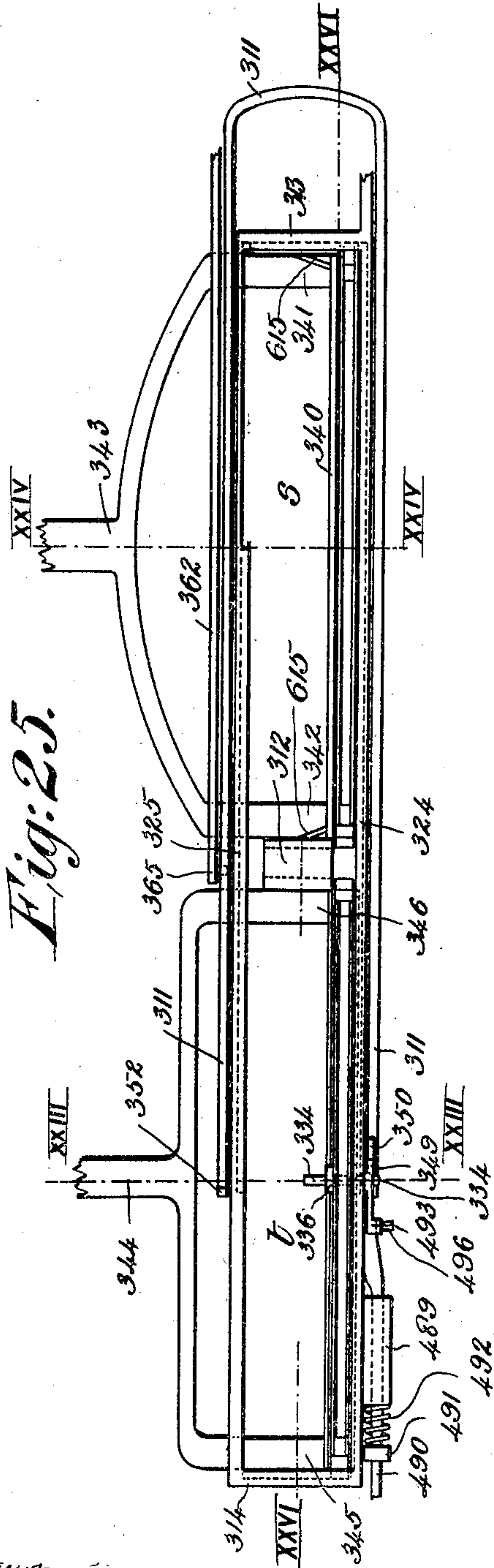
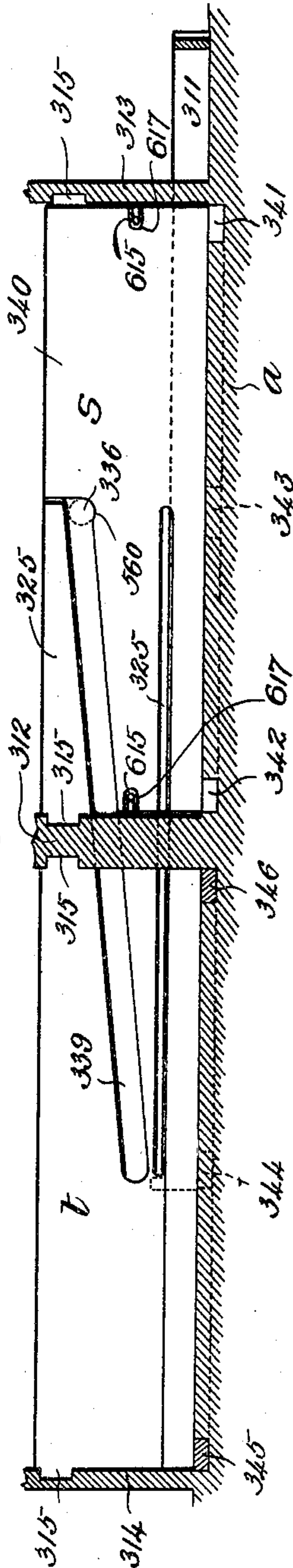


Fig. 25.

Fig. 26.



Witnesses
Leonard E. Haynes.
Edwin D. Bartlett.

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Shanker Abaji Bhisey
per Herbert Sefton Jones
Attorney.

S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 17.

Fig: 29.

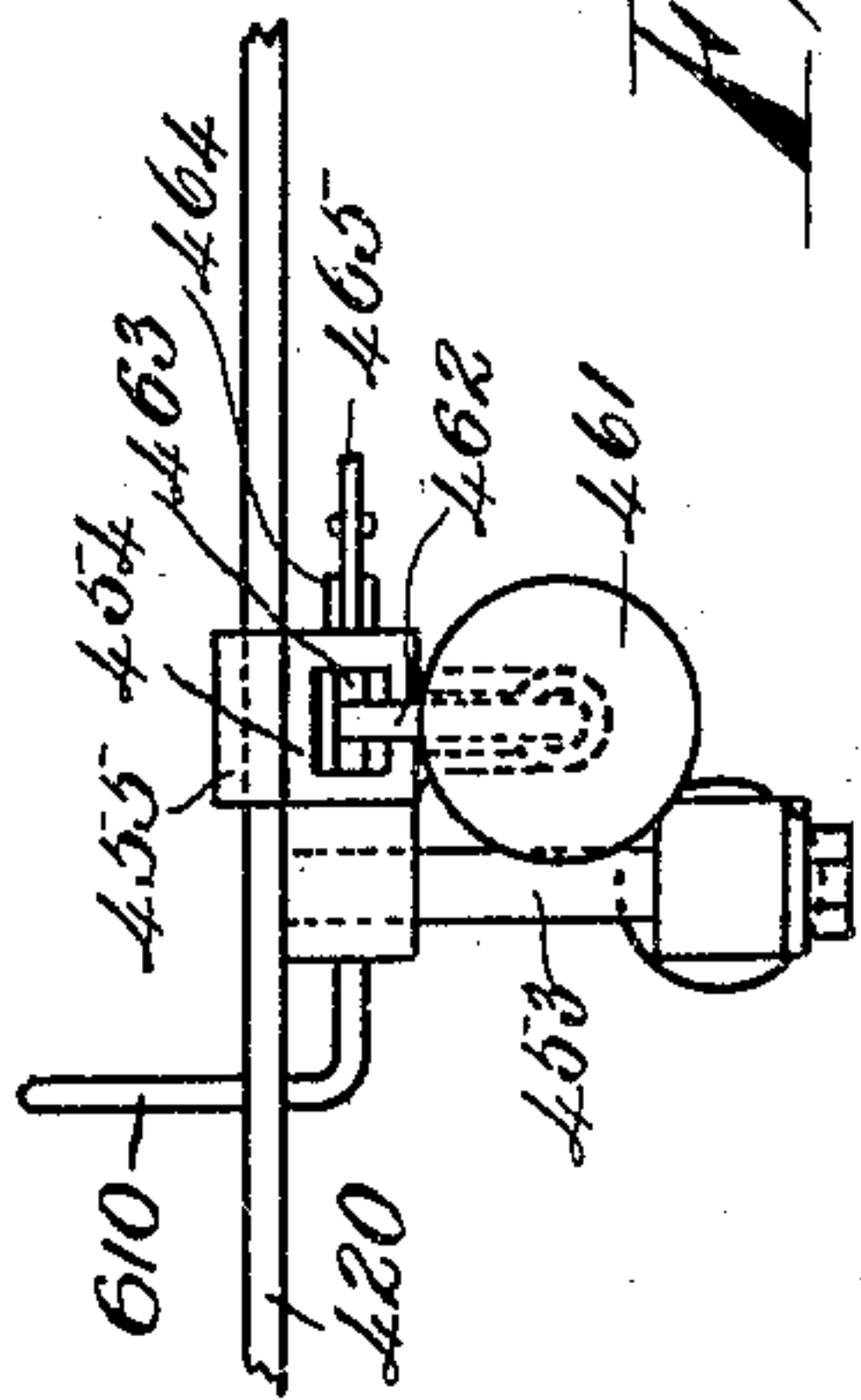


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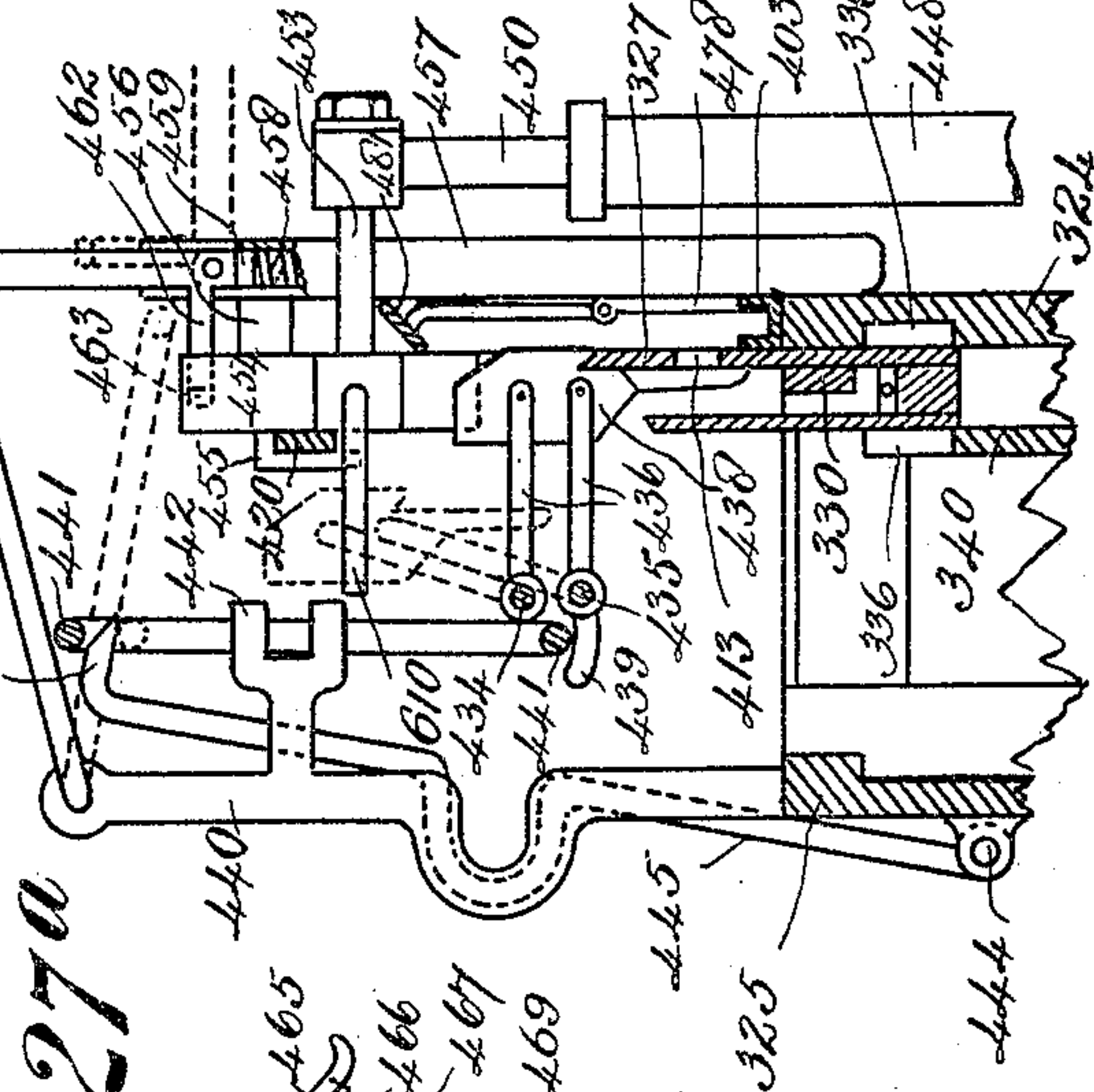


Fig: 27a

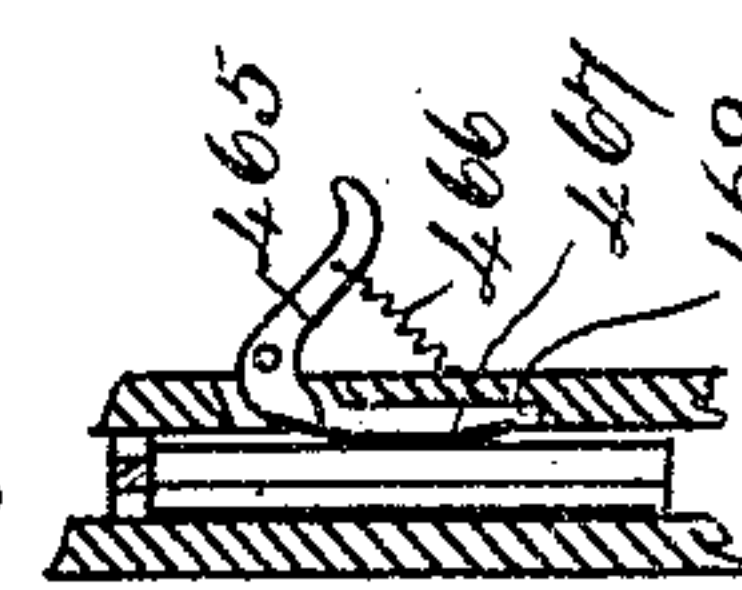


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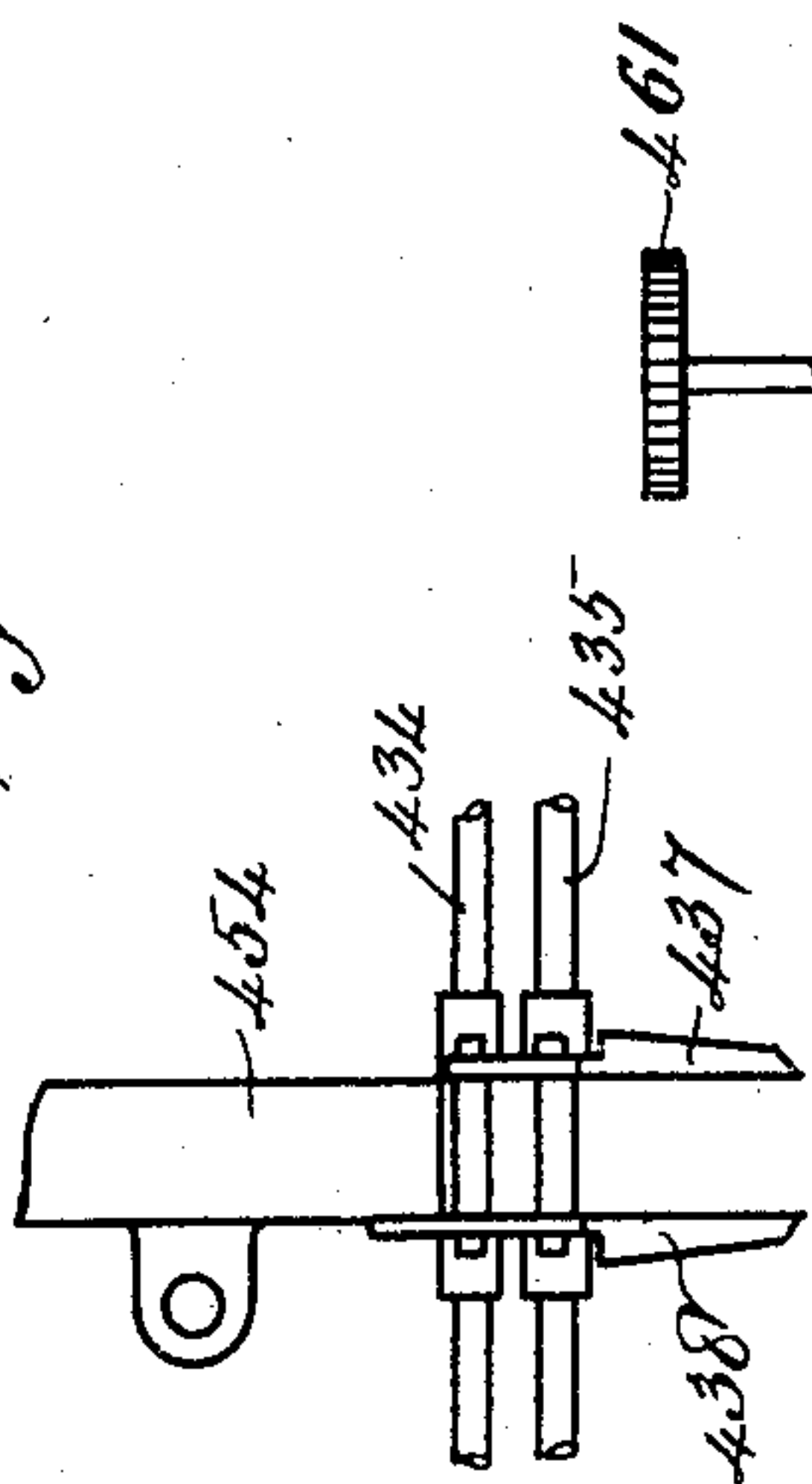
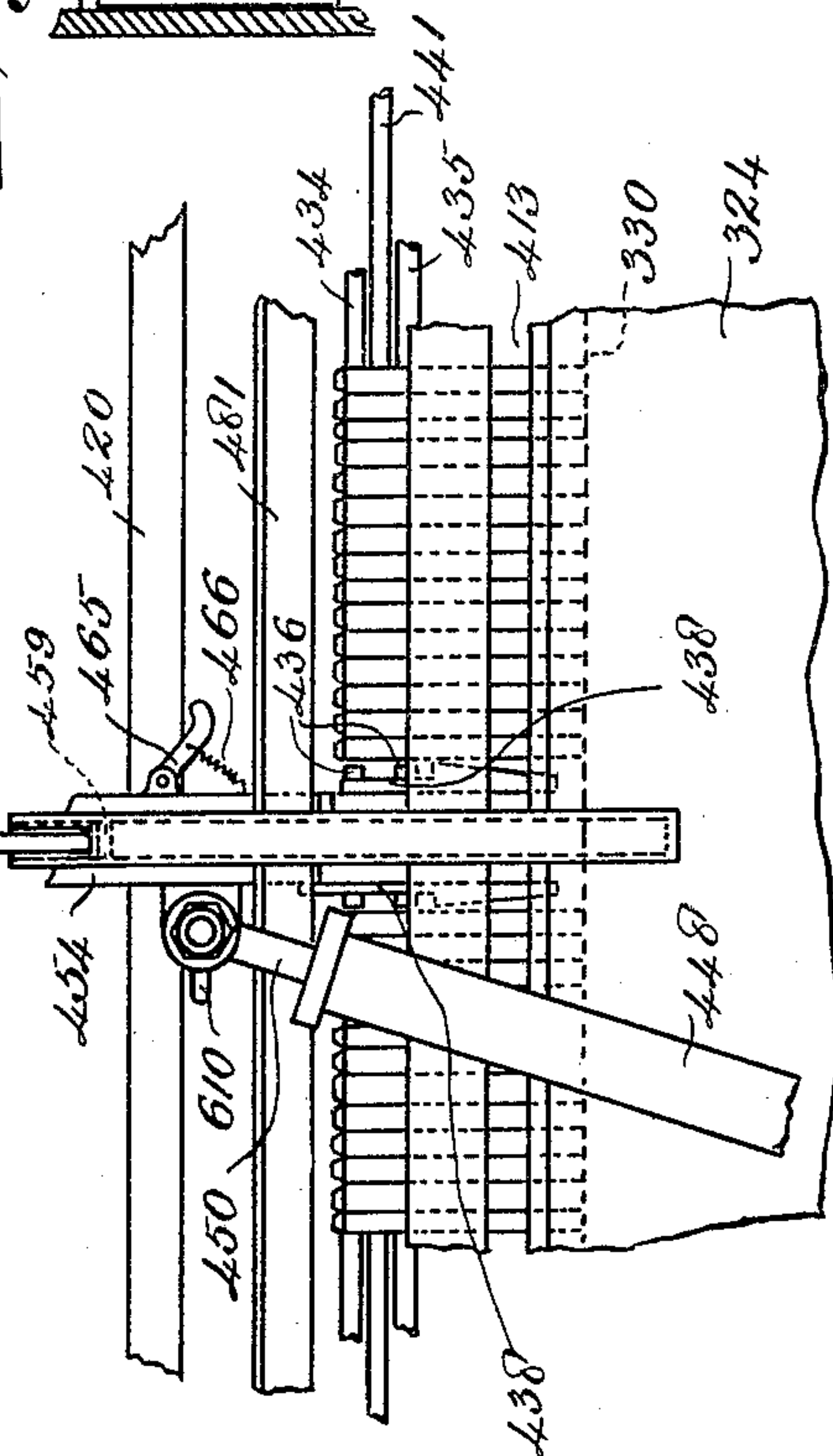


Fig: 27.



Witnesses
Leonard C. Haynes,
Edwin. D. Bartlett

Inventor.
Shanker Abaji Bhisey.
per Herbert Septm. Jones
Attorney.

No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 18.

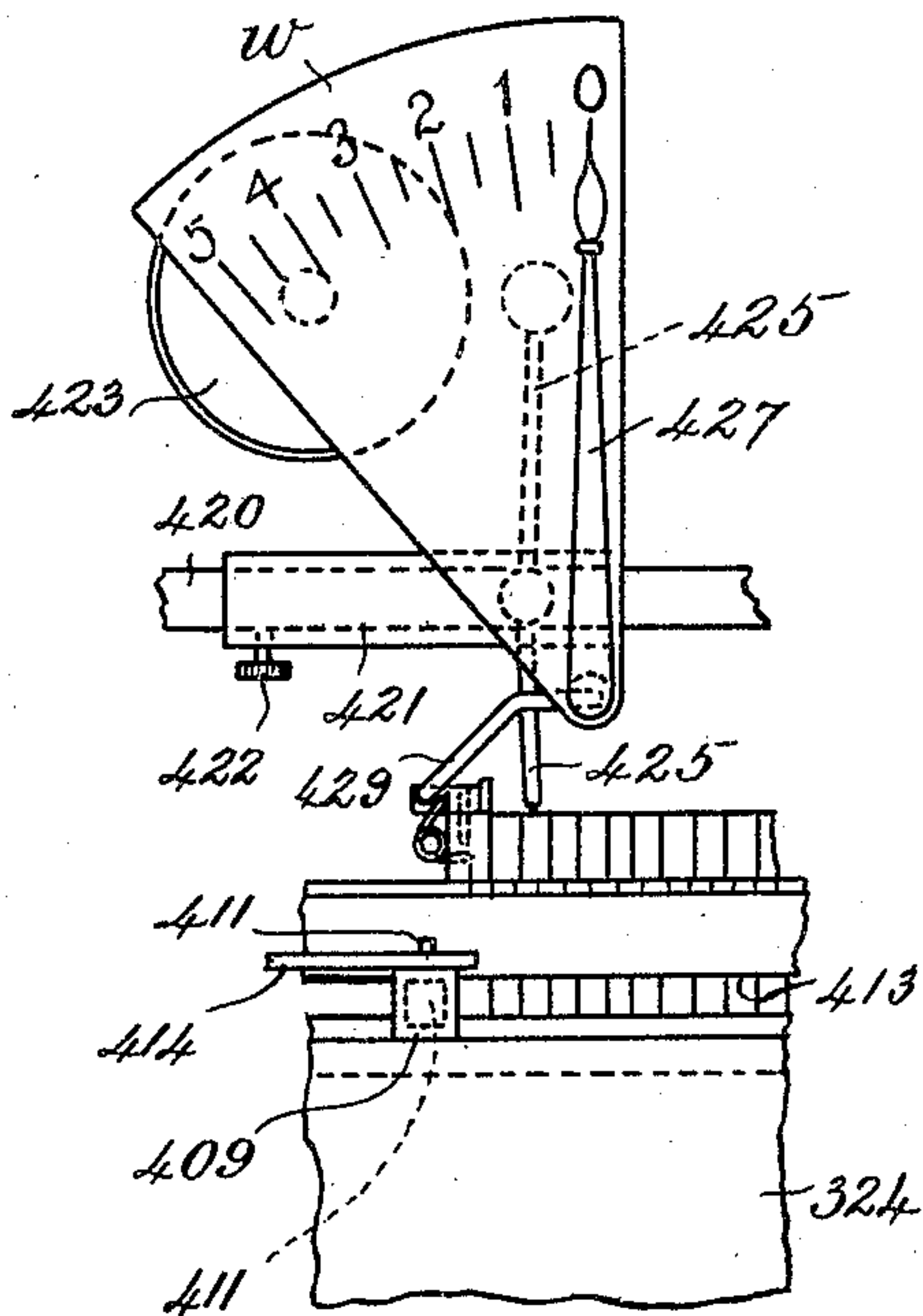


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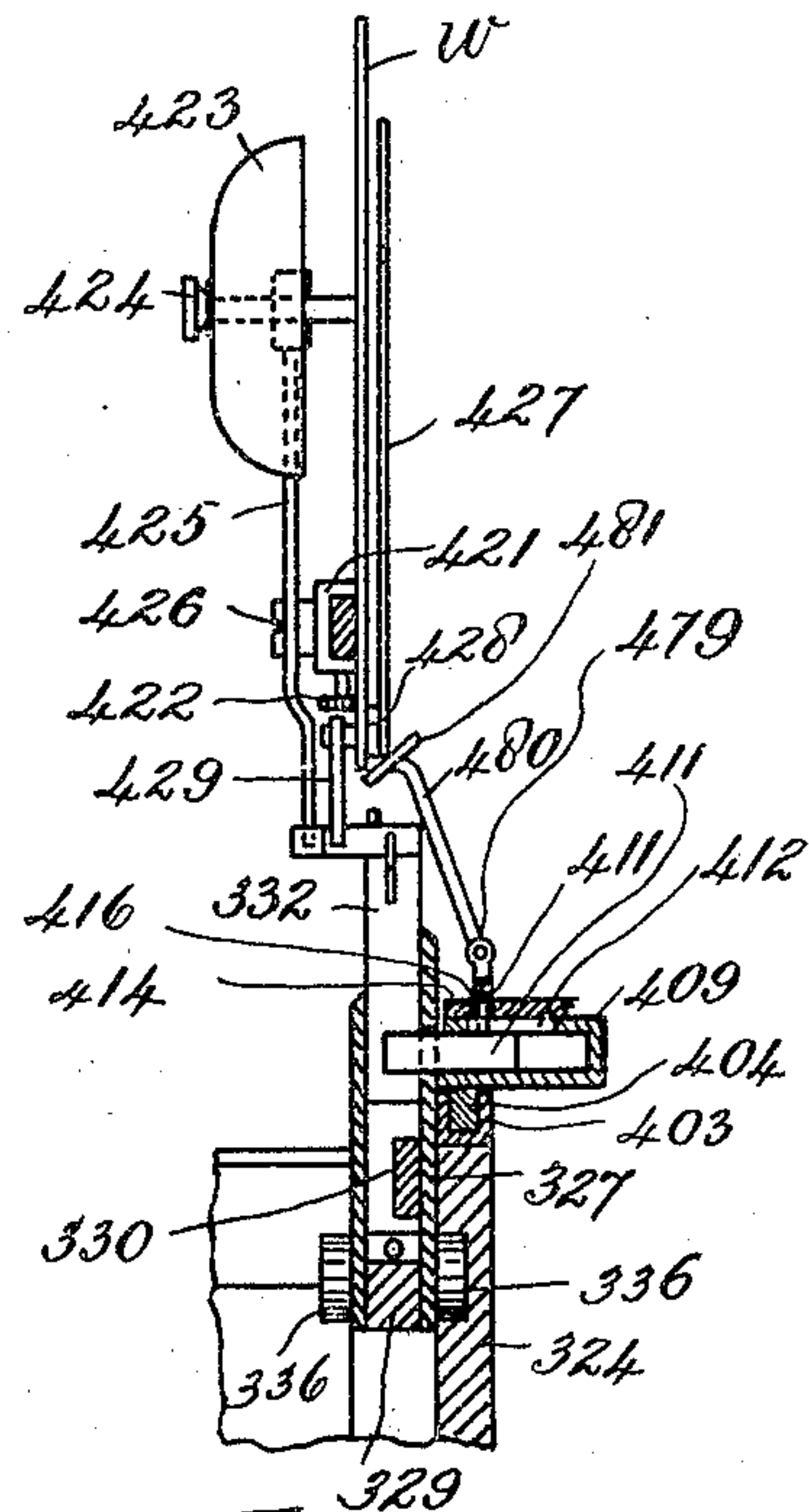


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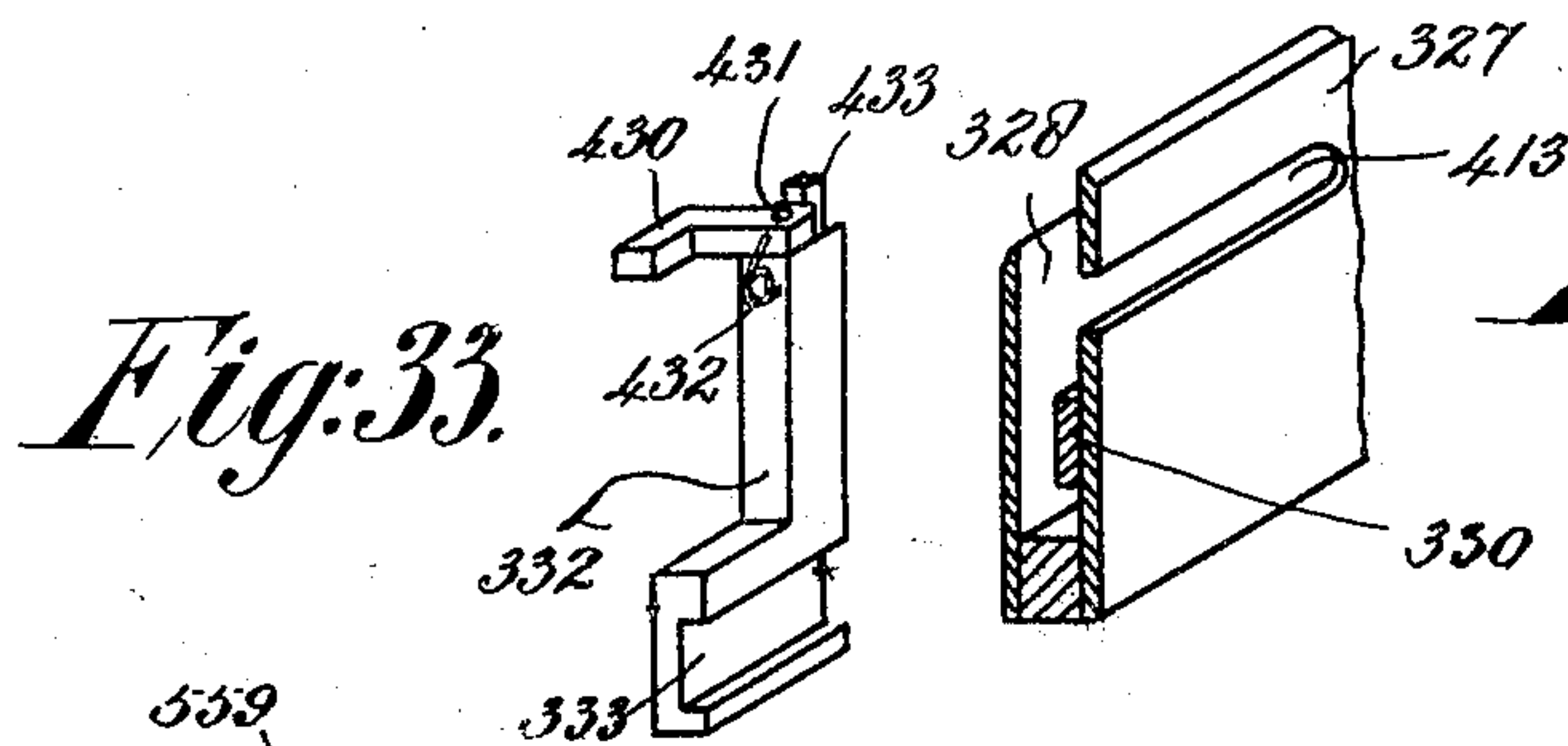


Fig:33.

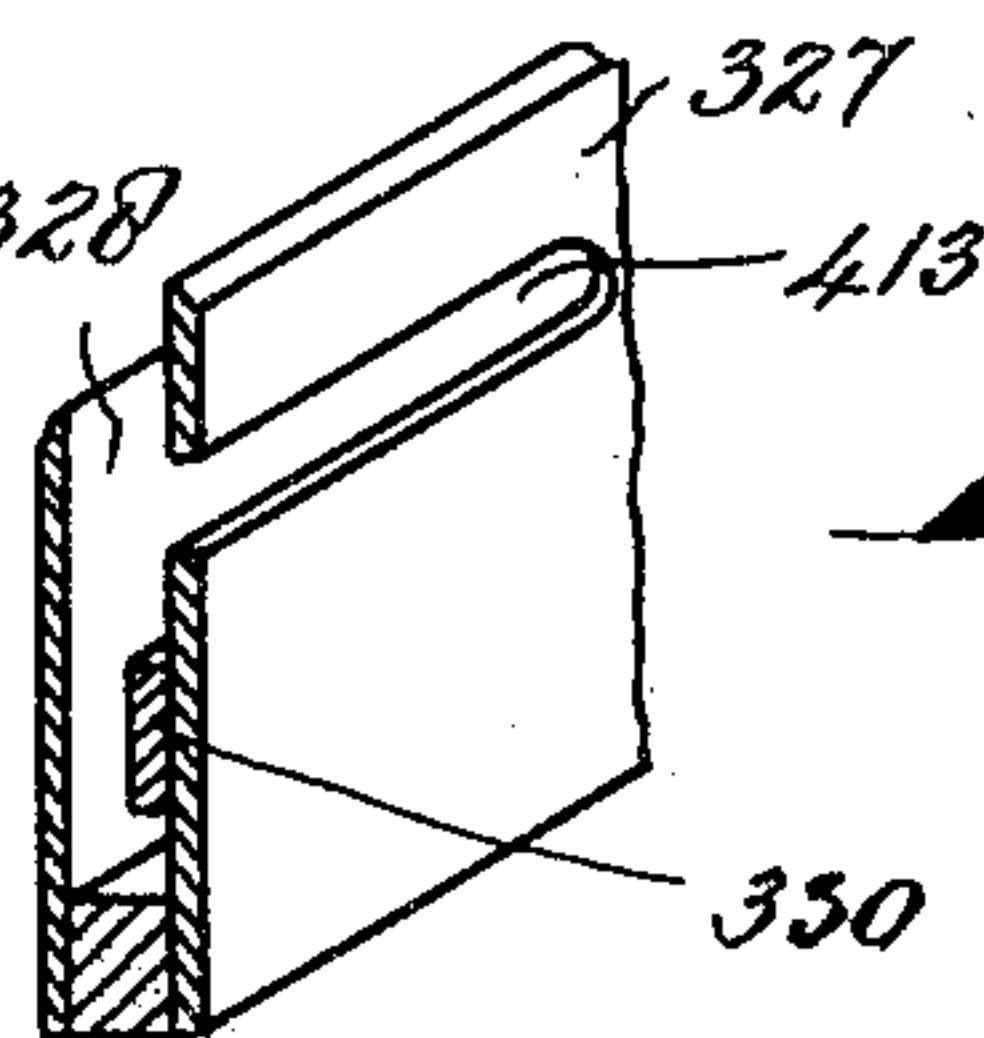


Fig:34

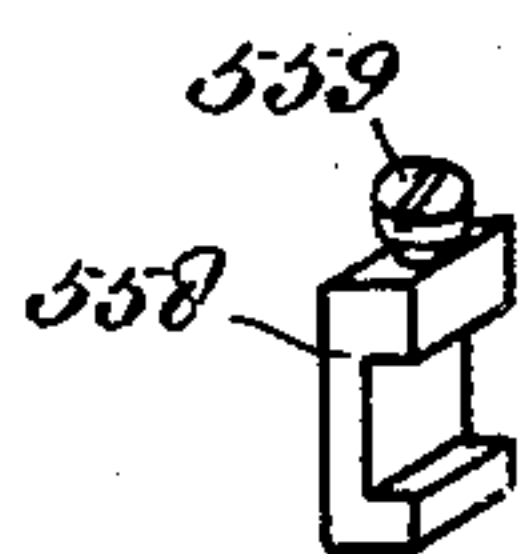


Fig:33^a

Witnesses
Leonard C. Haynes.
Edwin D. Bartlett

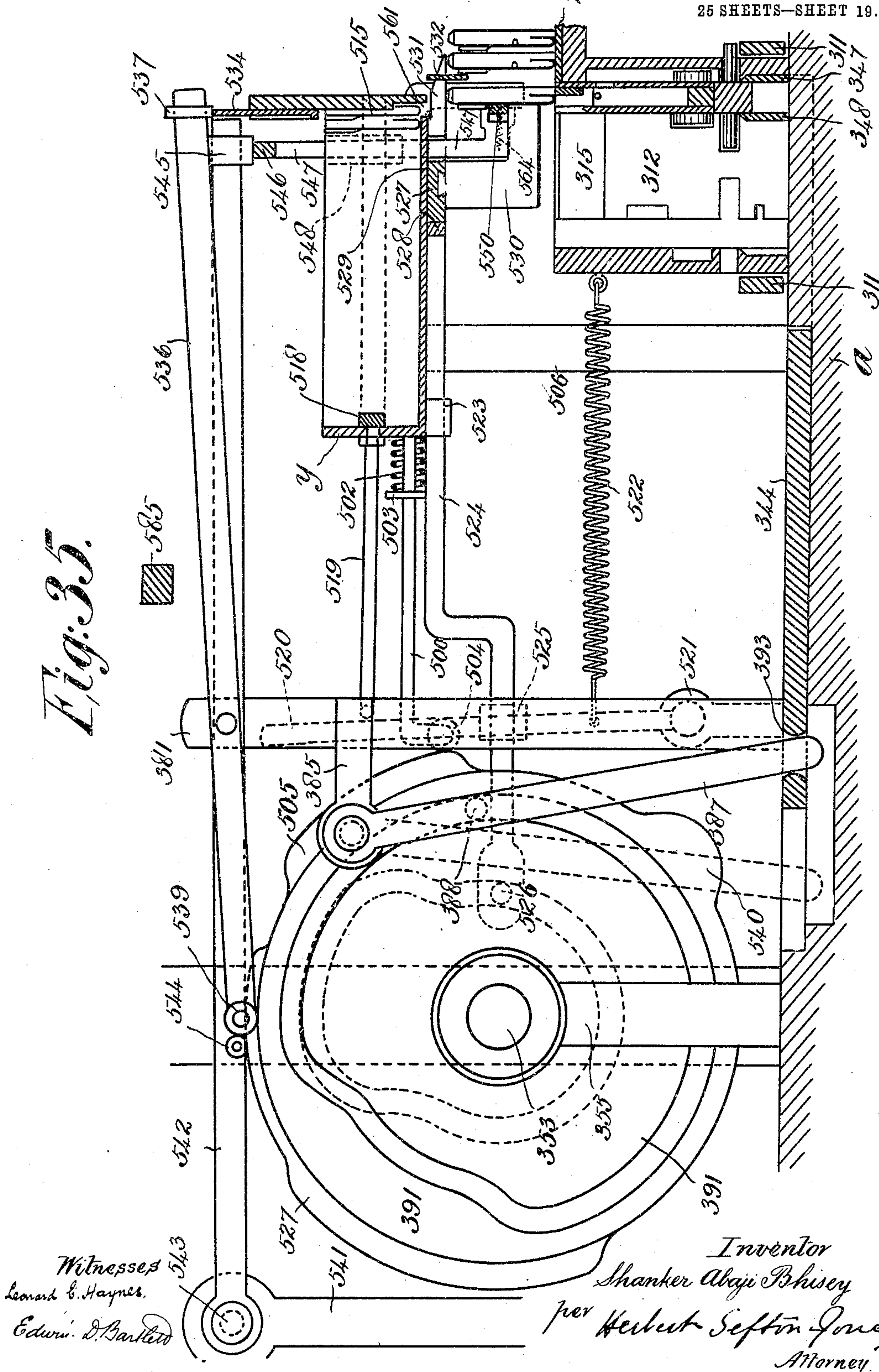
Inventor
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S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 19.

Fig. 35.



Witnesses
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No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 20.

Fig:36.

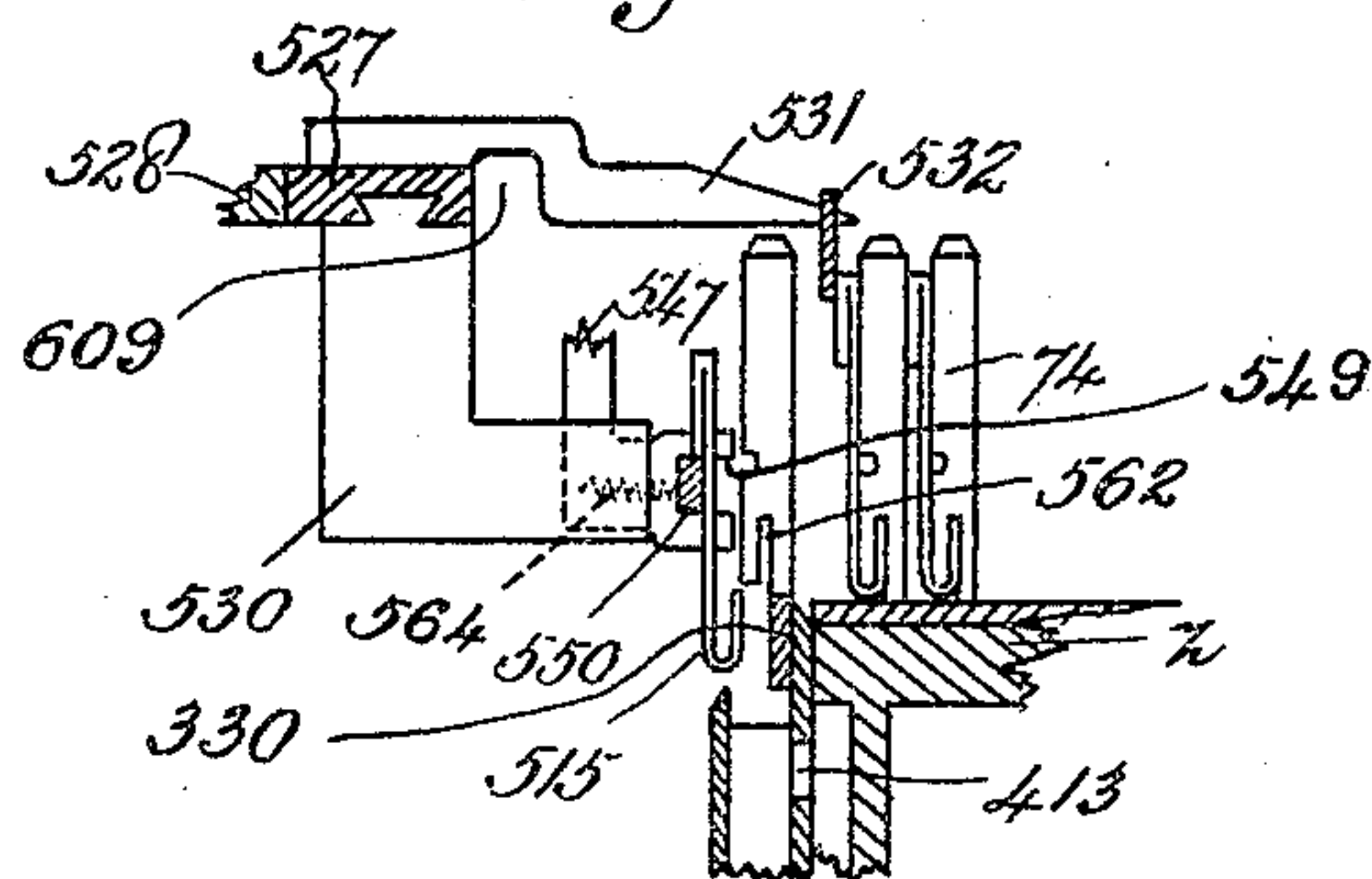


Fig:37.

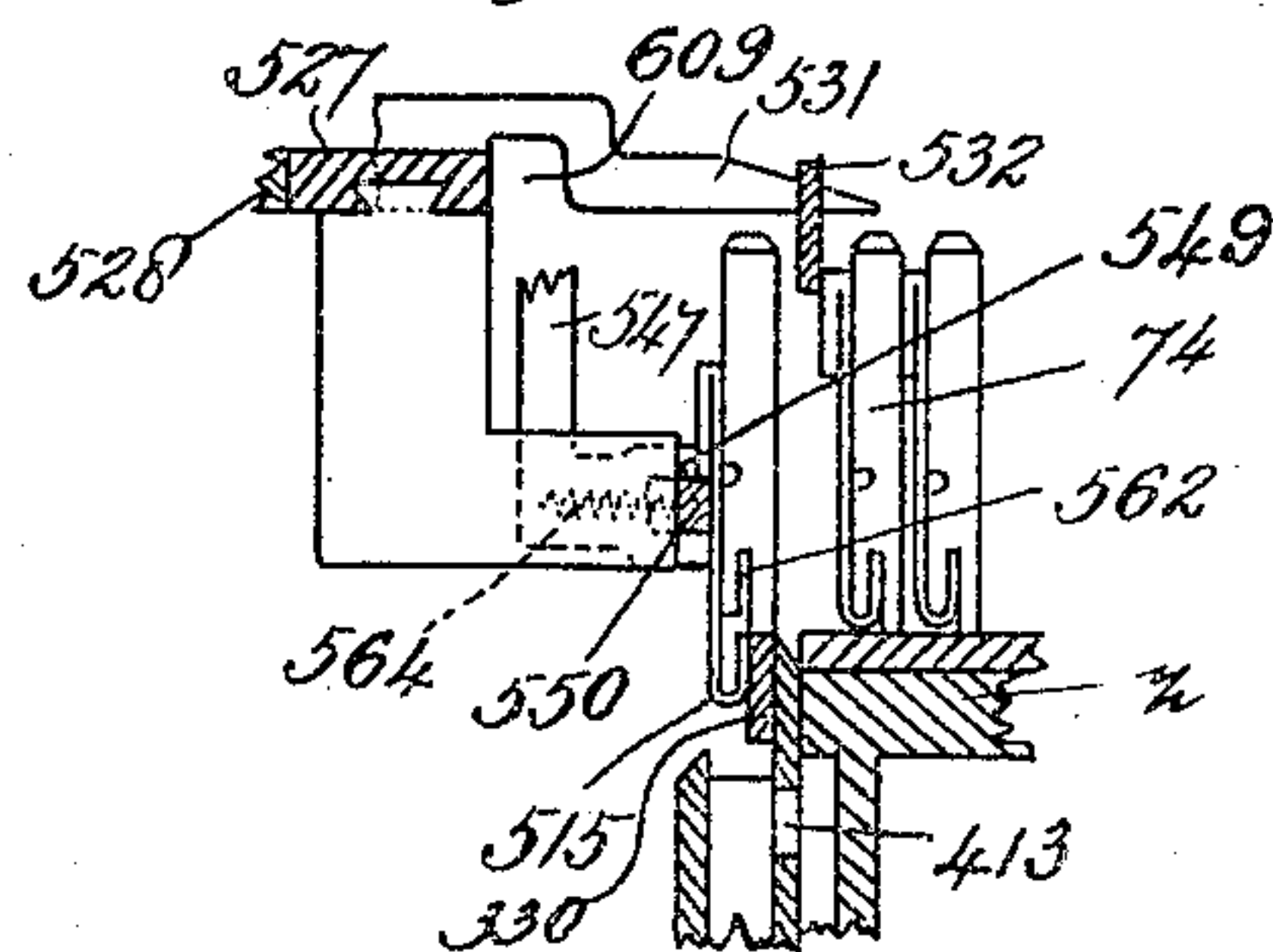


Fig:38.

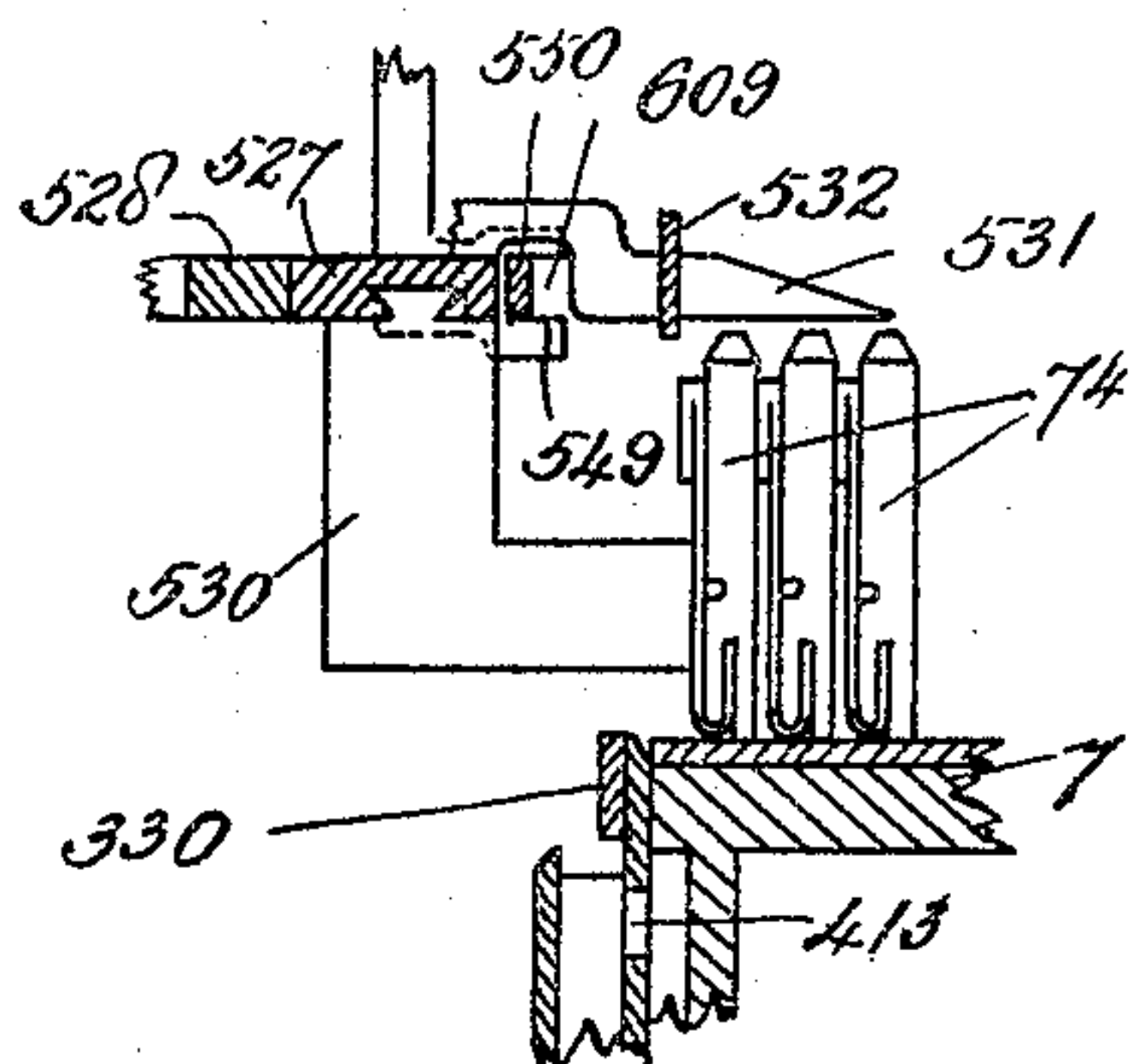


Fig:39.

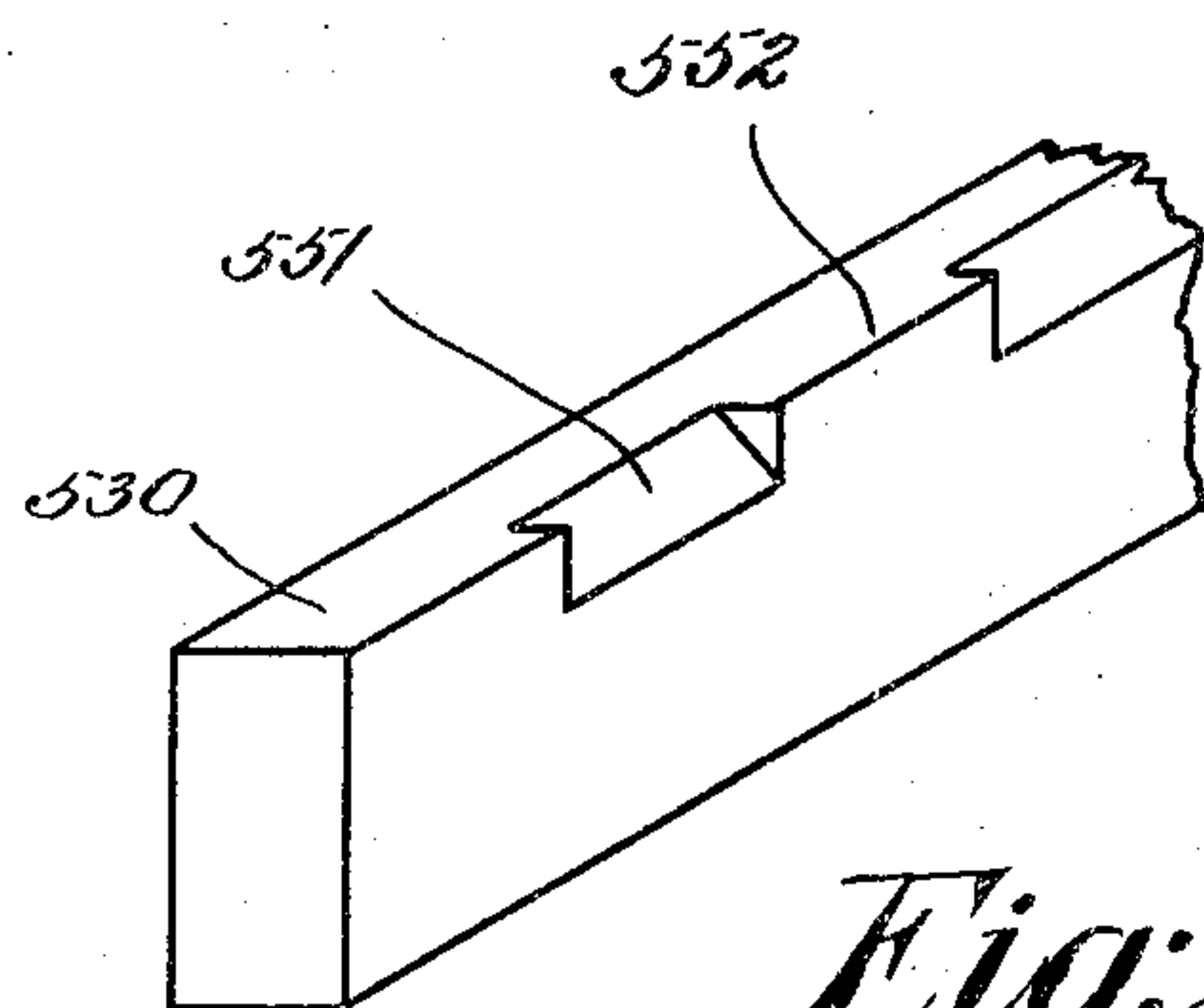
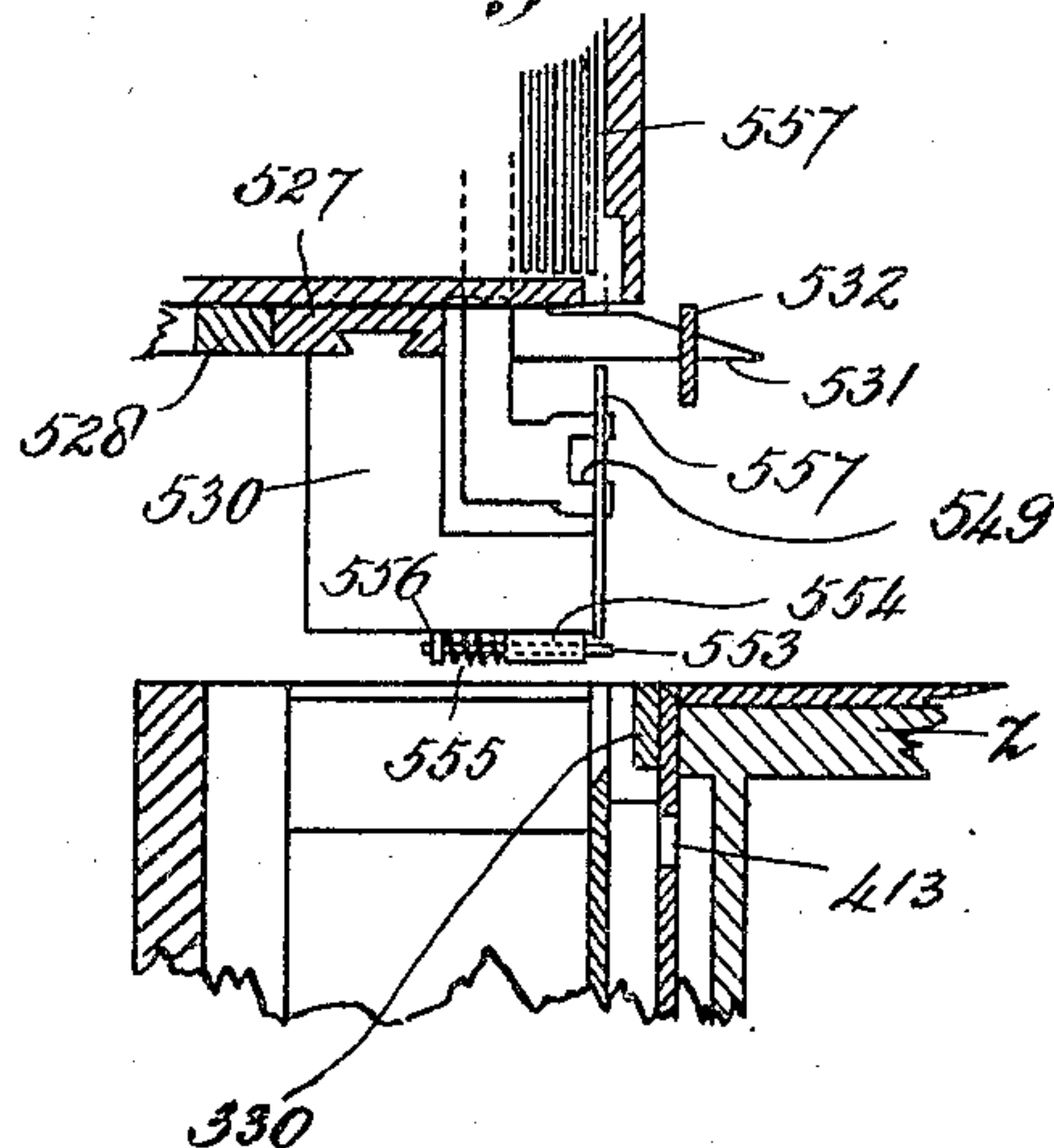


Fig:40.

Witnesses
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No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 21.

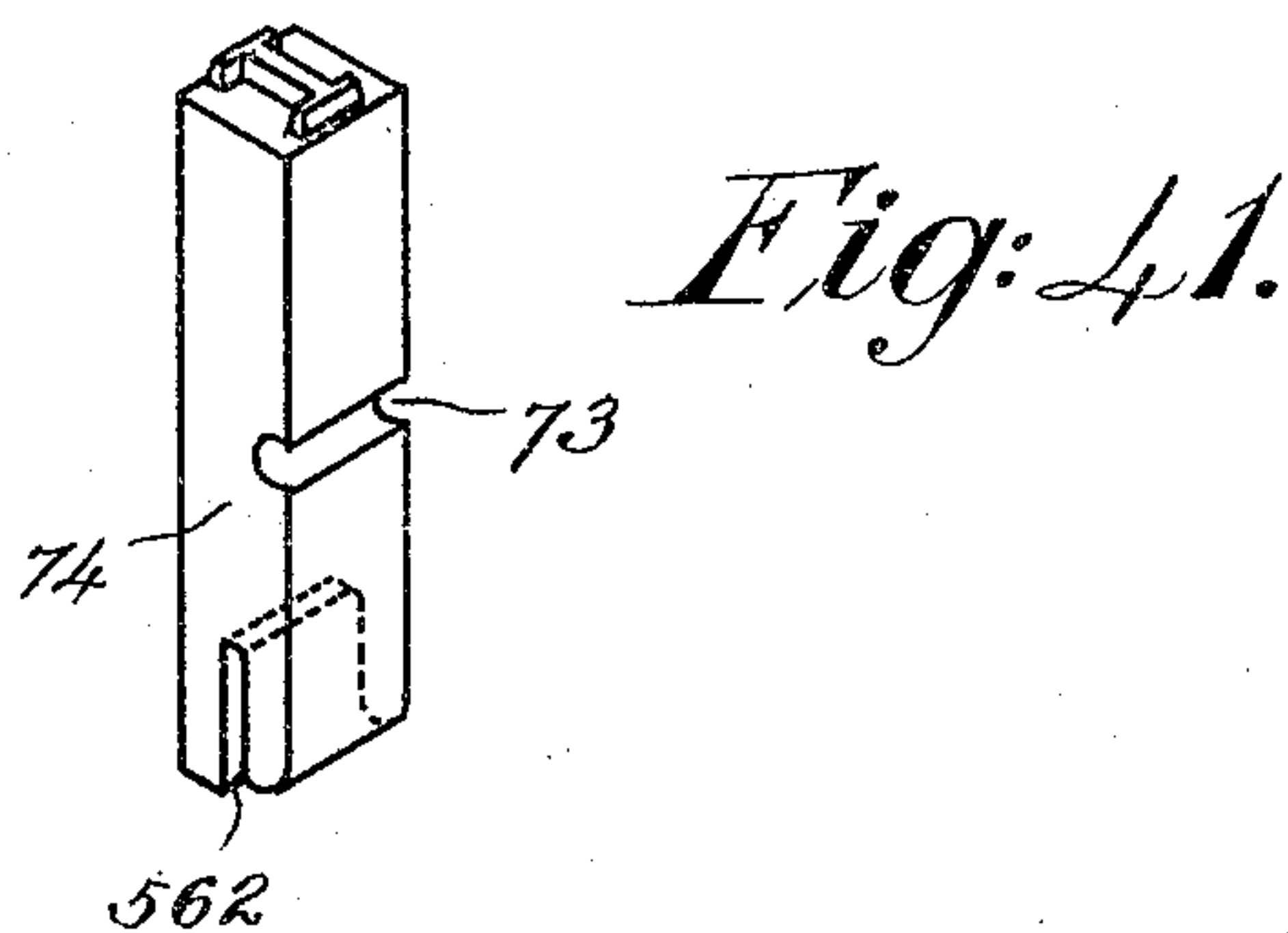


Fig. 41.

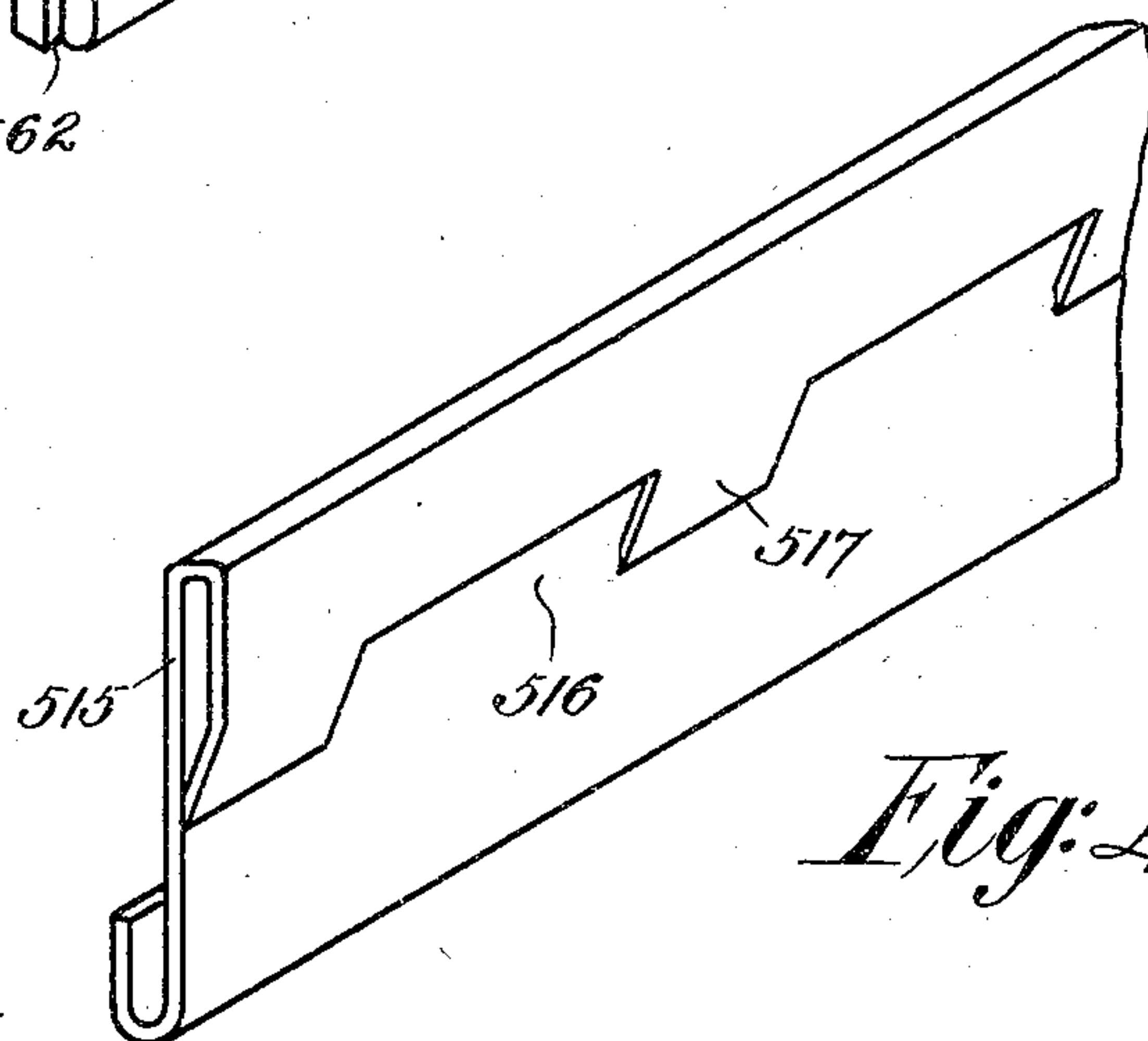


Fig. 42.

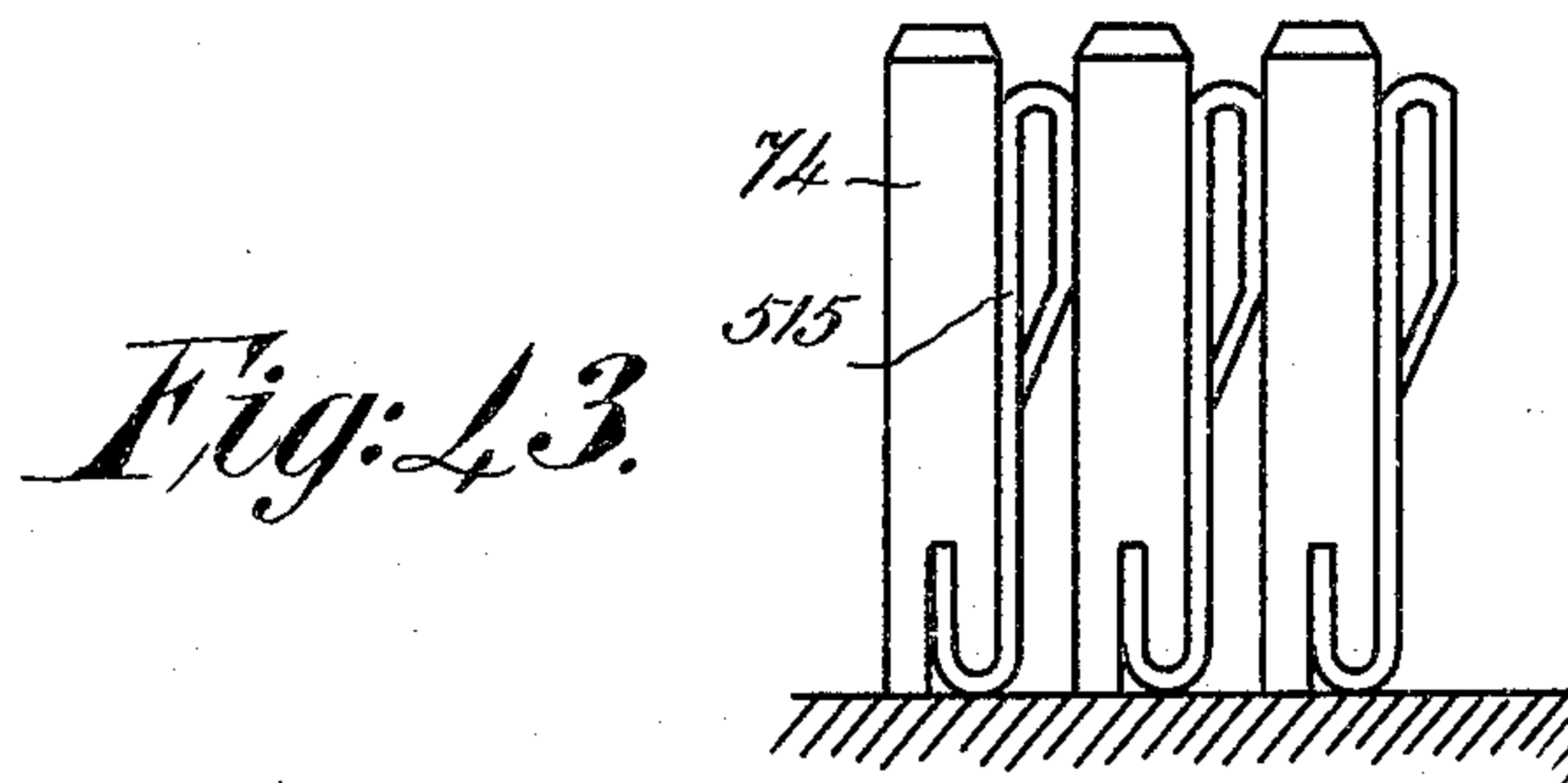


Fig. 43.

Witnesses
Leonard E. Haynes.
Edwin D. Bartlett

Inventor.
Shankar Abaji Bhisey.
per. Herbert Septon Jones
Attorney.

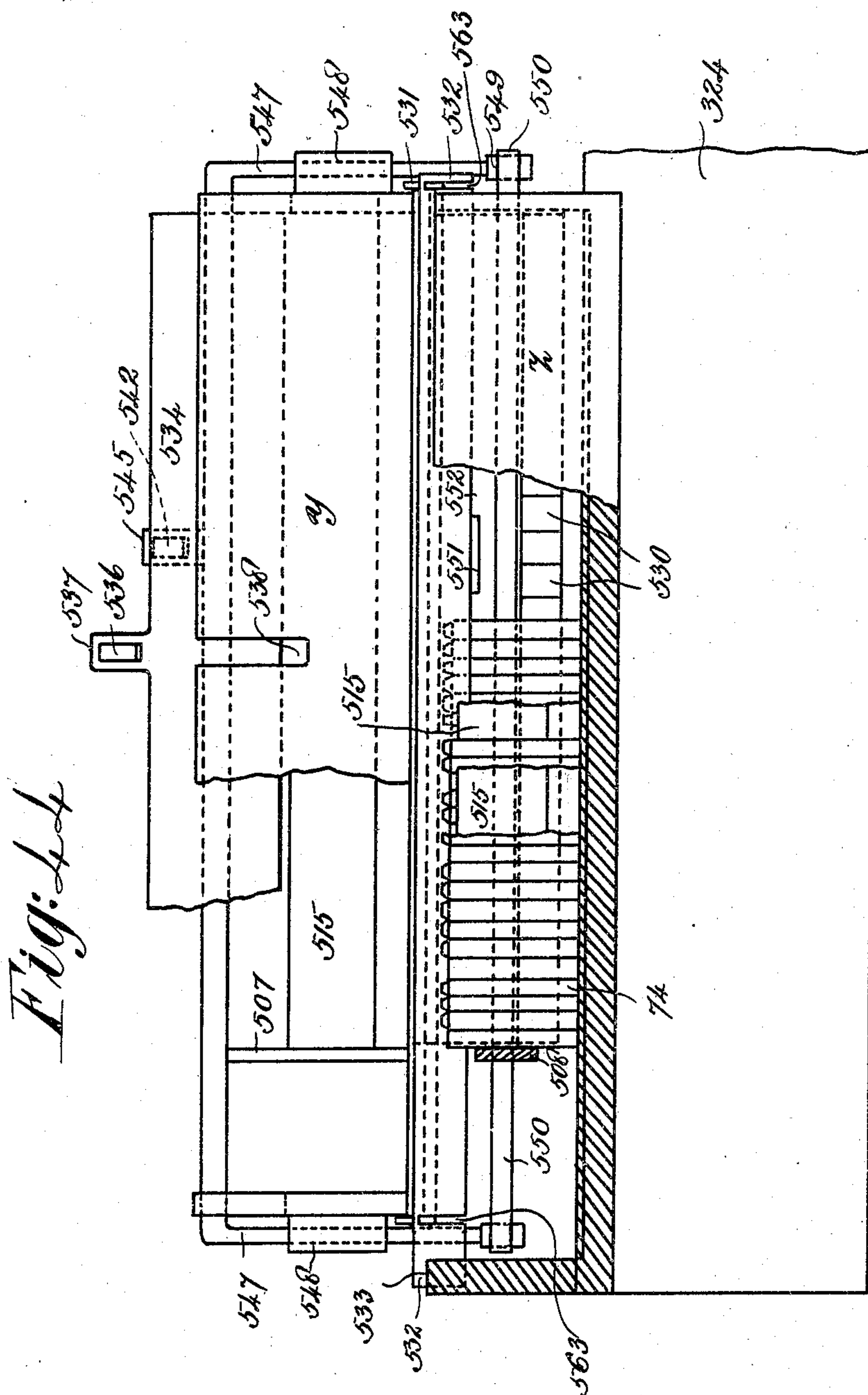
No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 22.



Witnesses
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Inventor.
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Per. Herbert Septon-Jones
Attorney.

No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 23.

Fig: 45.

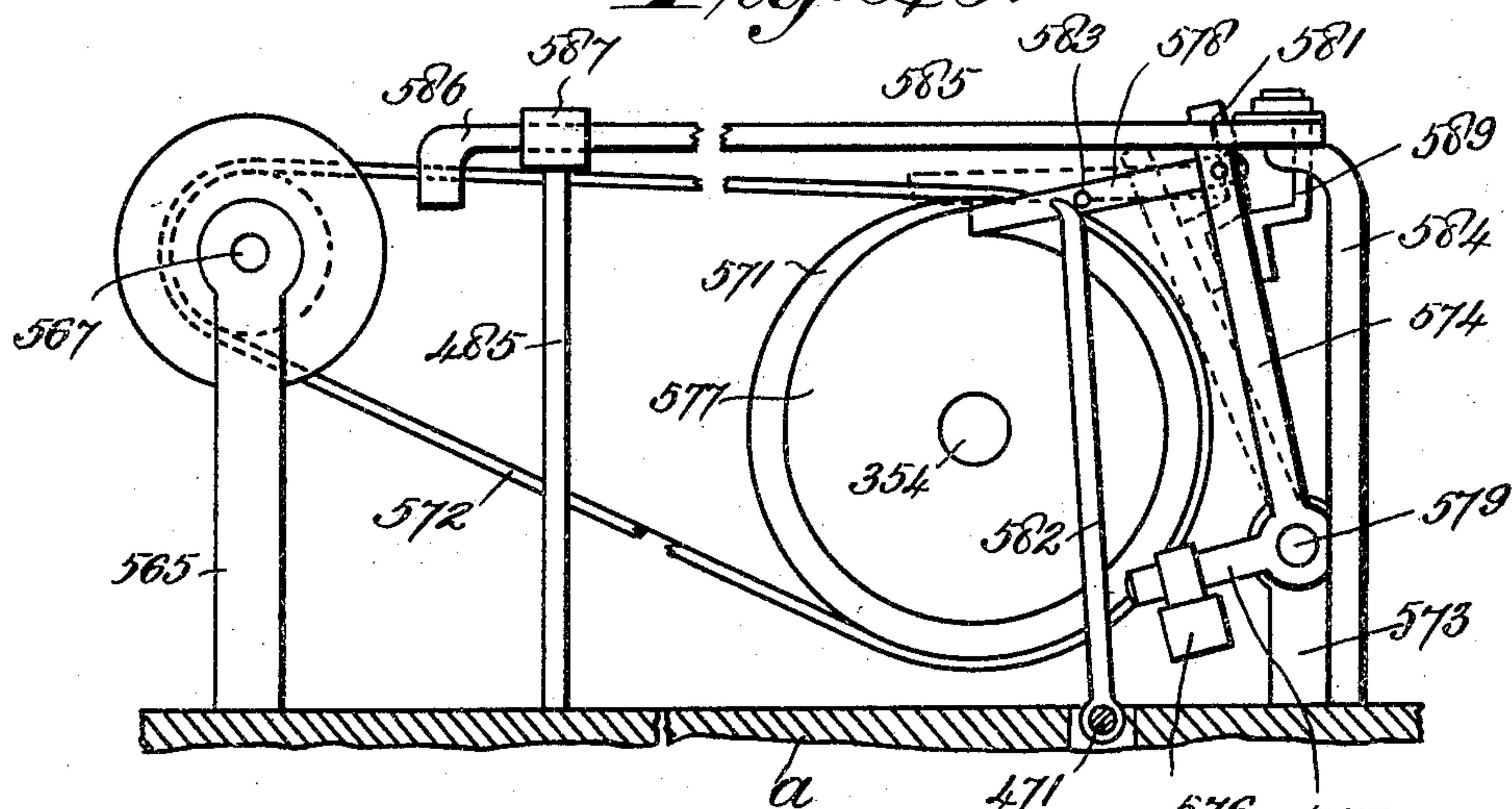


Fig: 46.

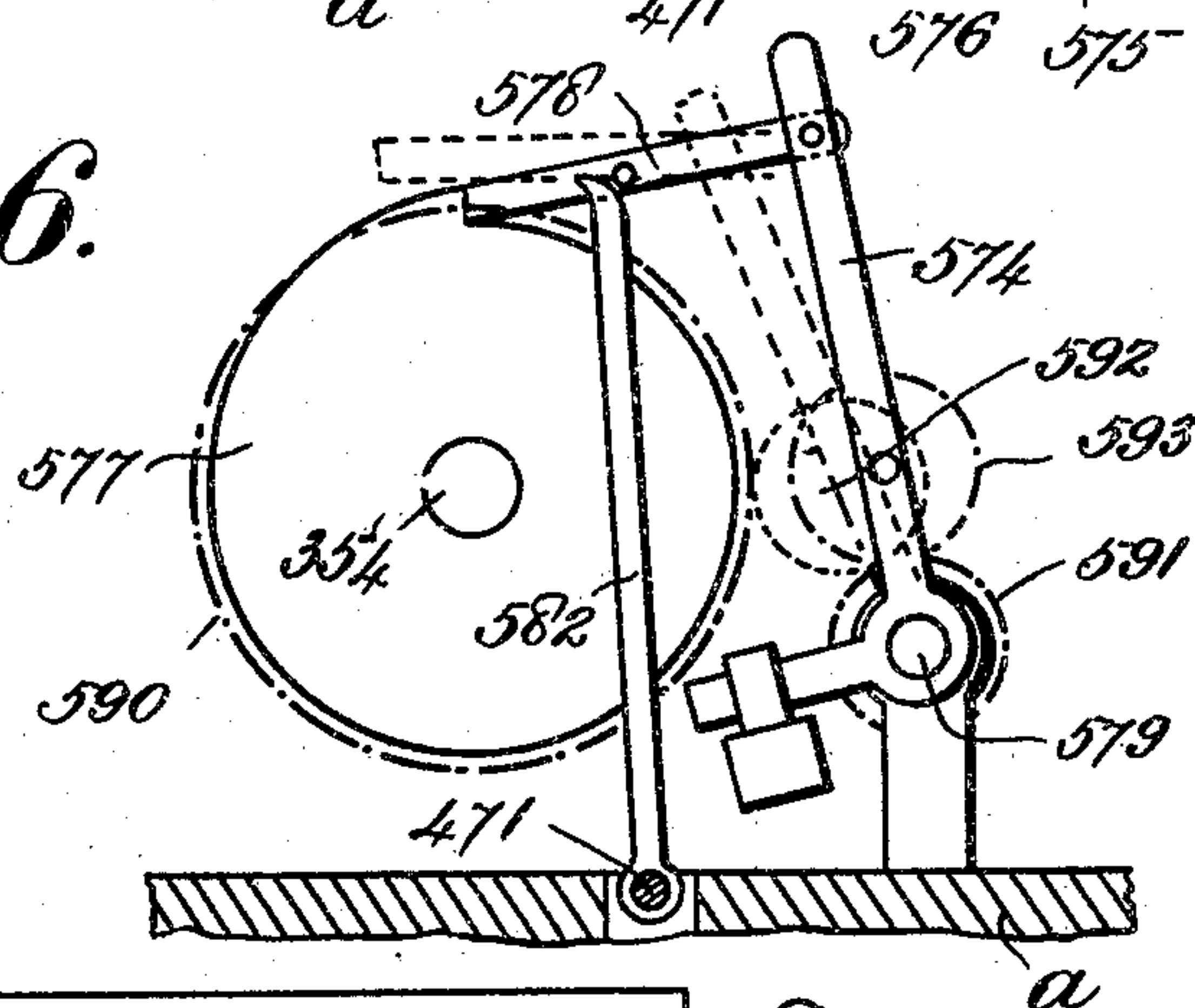
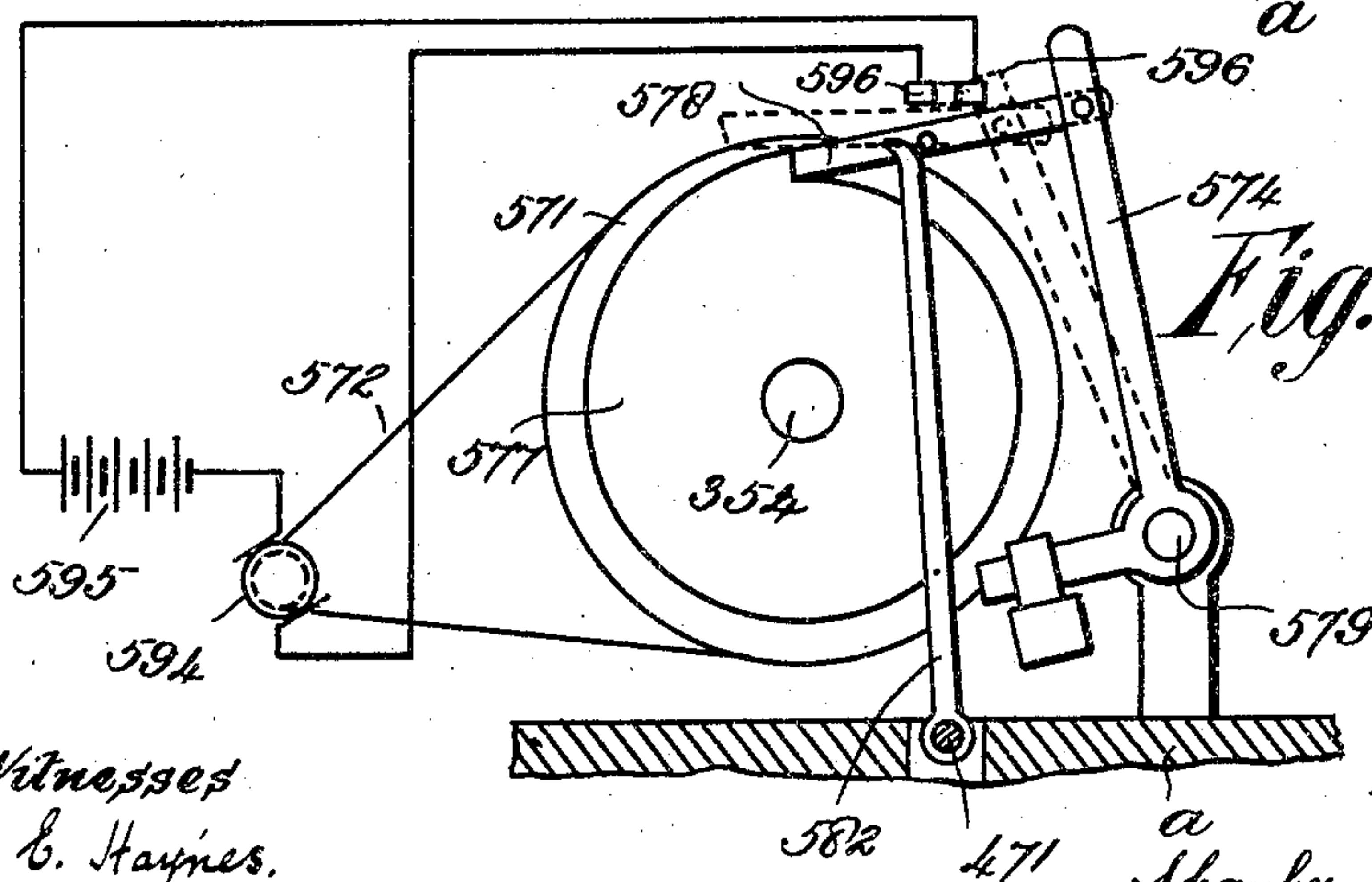


Fig: 47.



Witnesses
Leonard C. Haynes.
Edwin D. Bartlett

471
Per. *Shanker Abaji Bhisey*
Herbert Lepton Jones
Inventor.
Attorney.

S. A. BHISEY.

TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 24.

Fig: 48

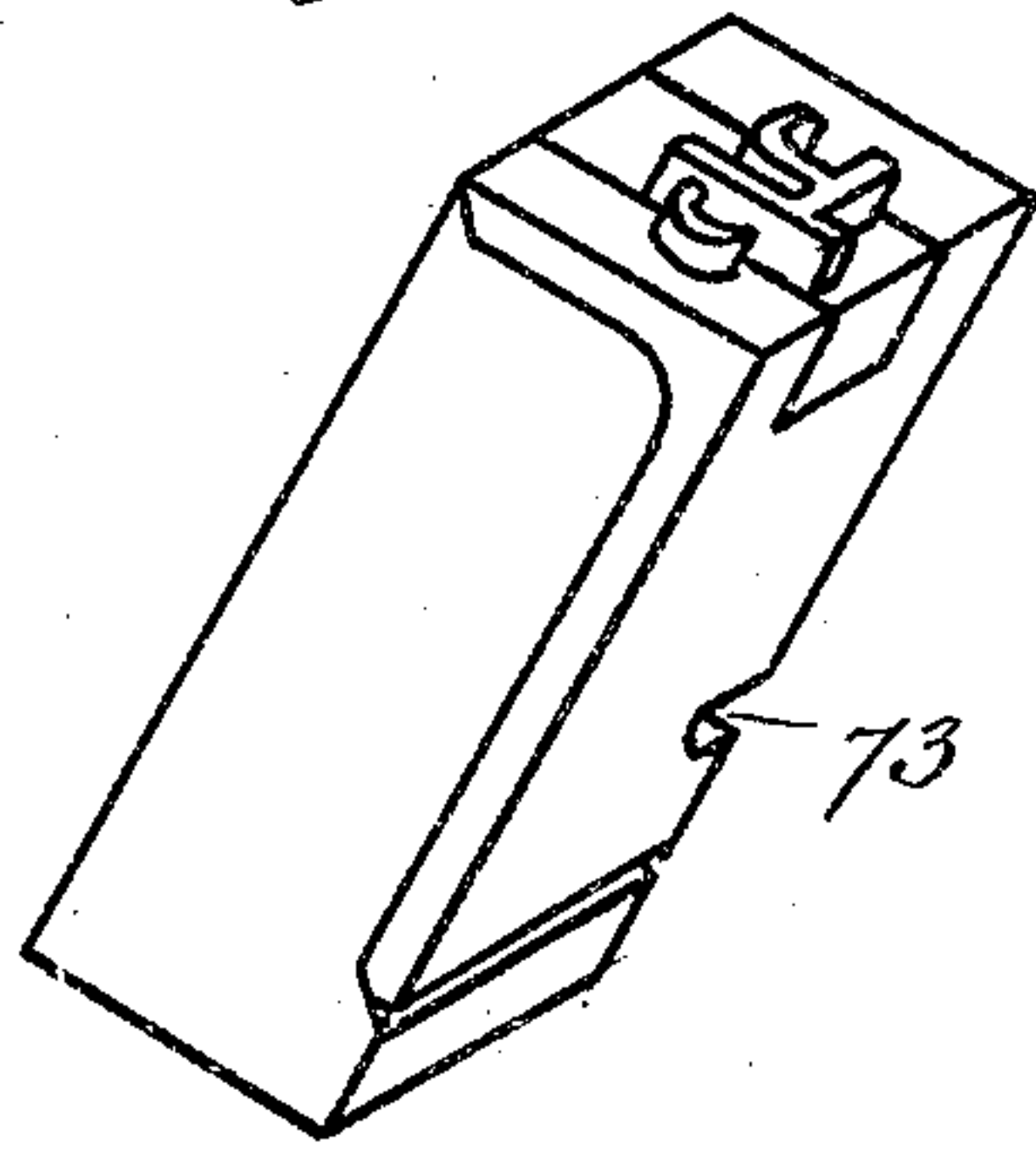


Fig: 49.

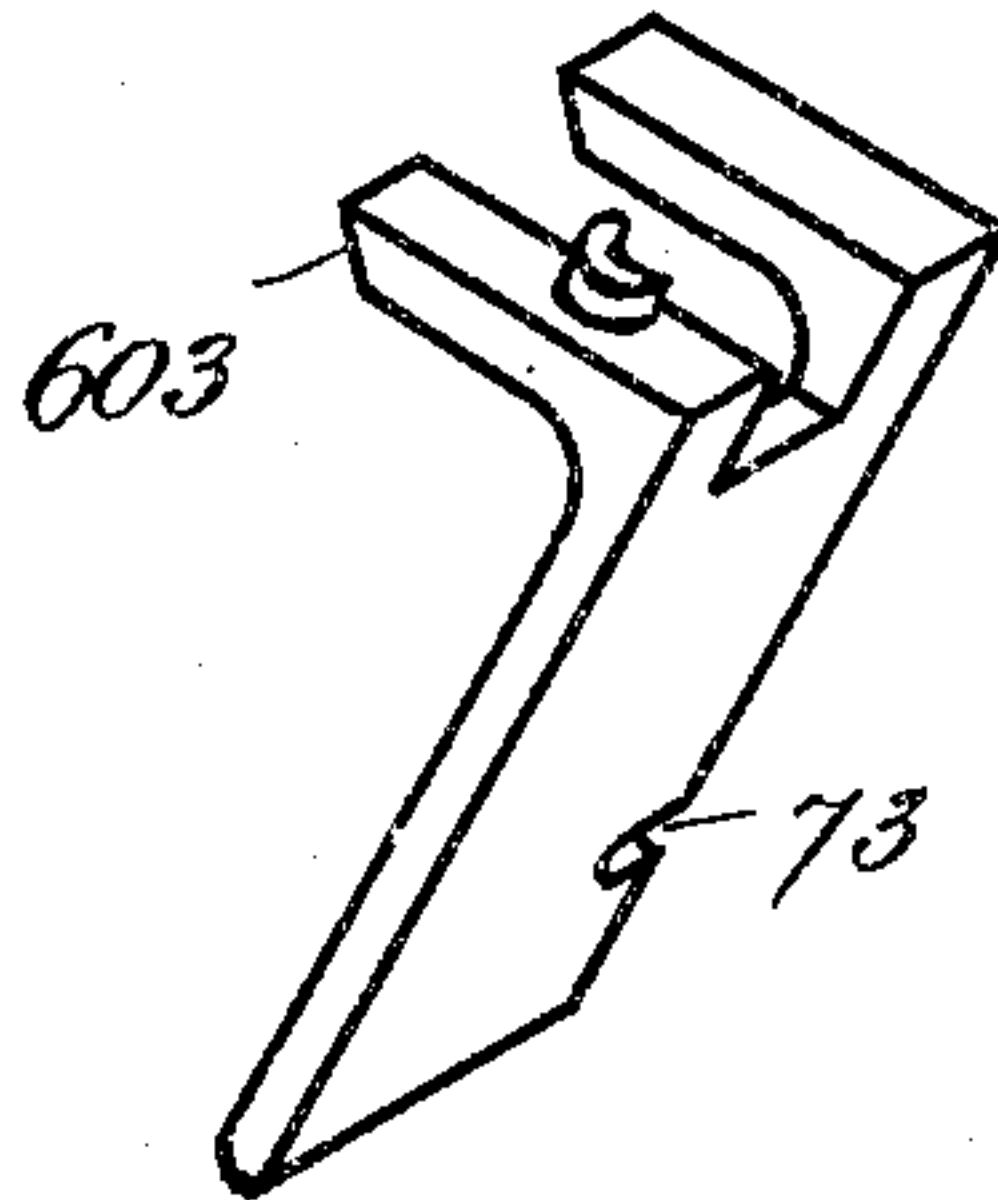


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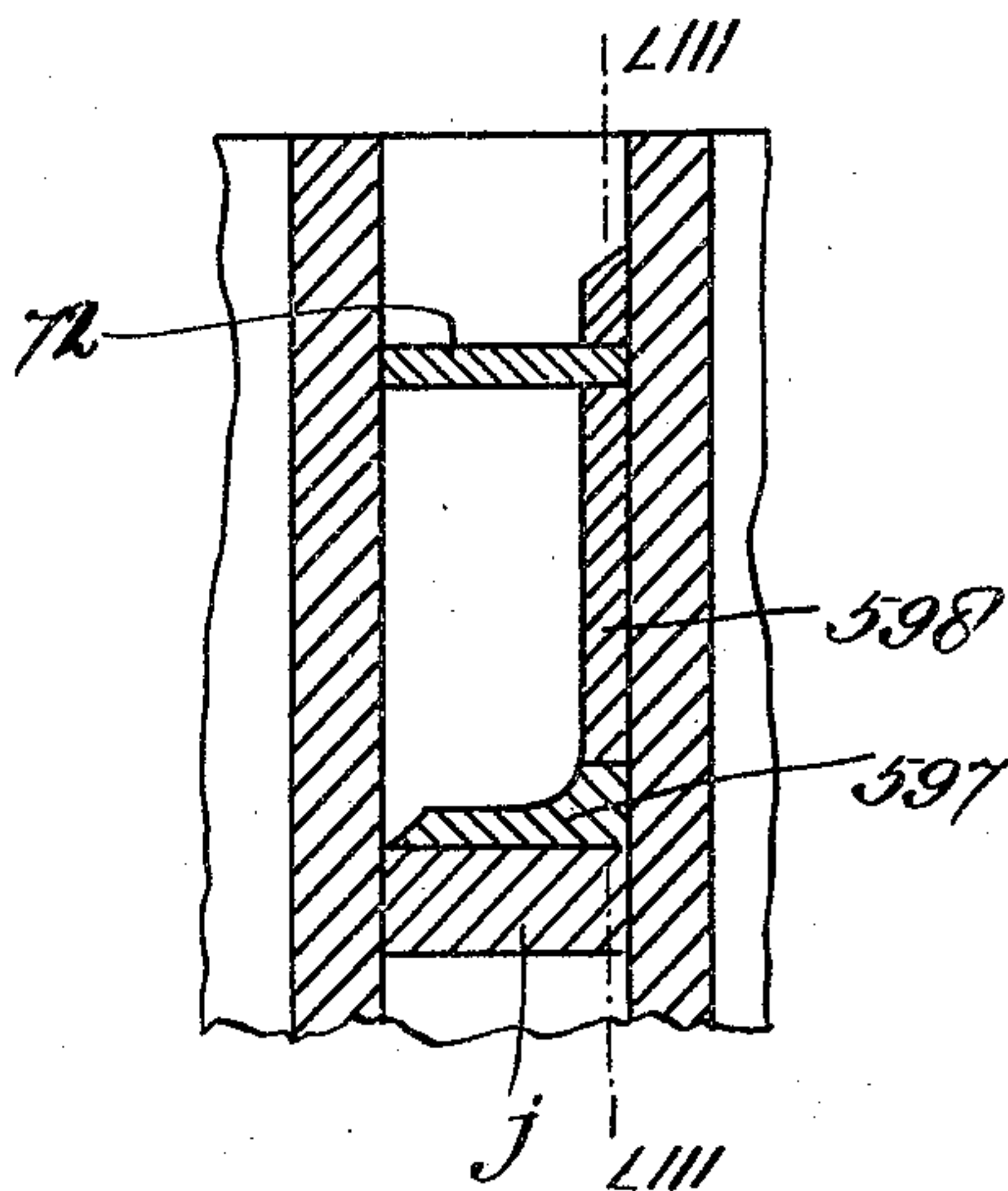


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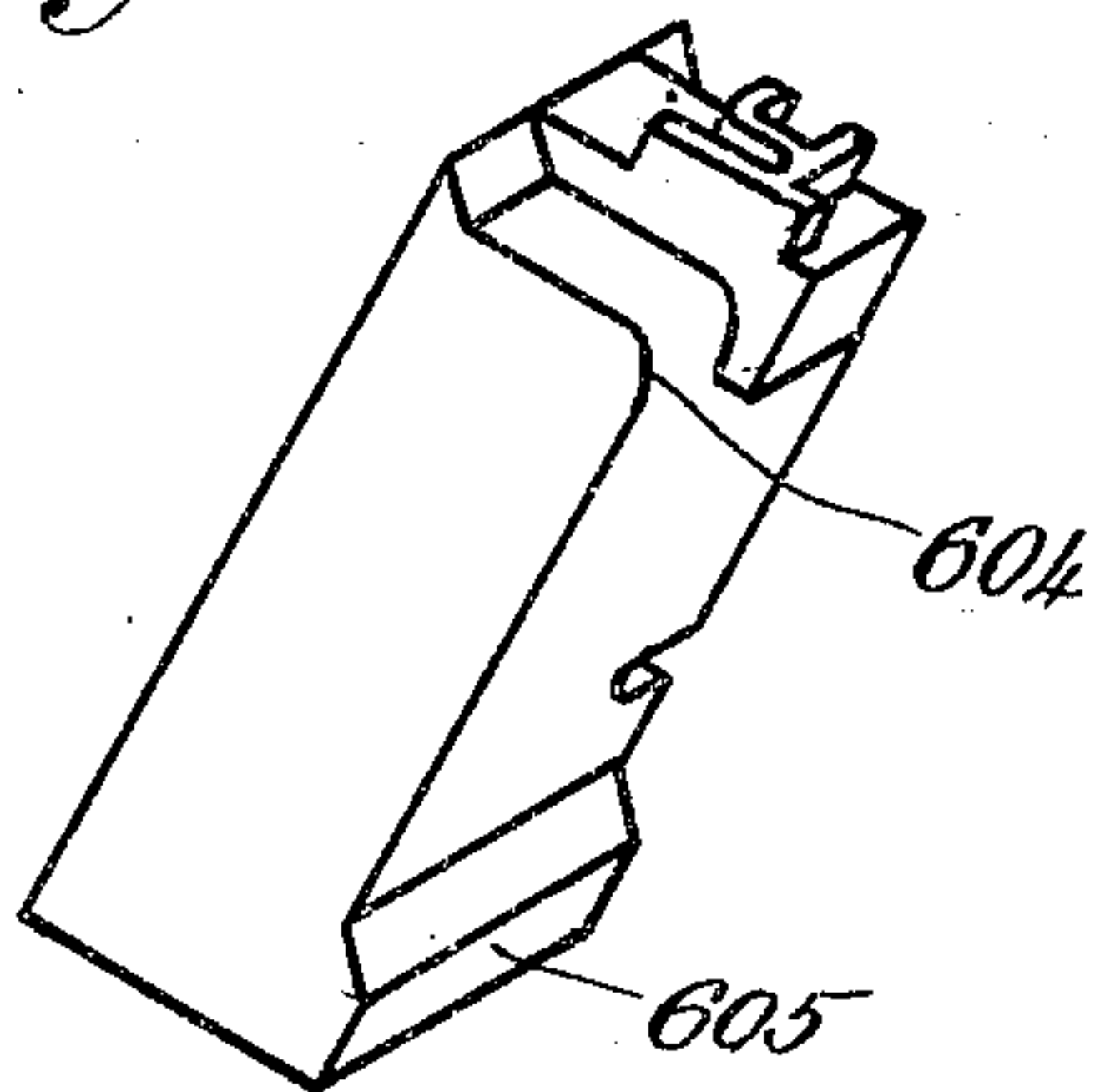


Fig: 52.

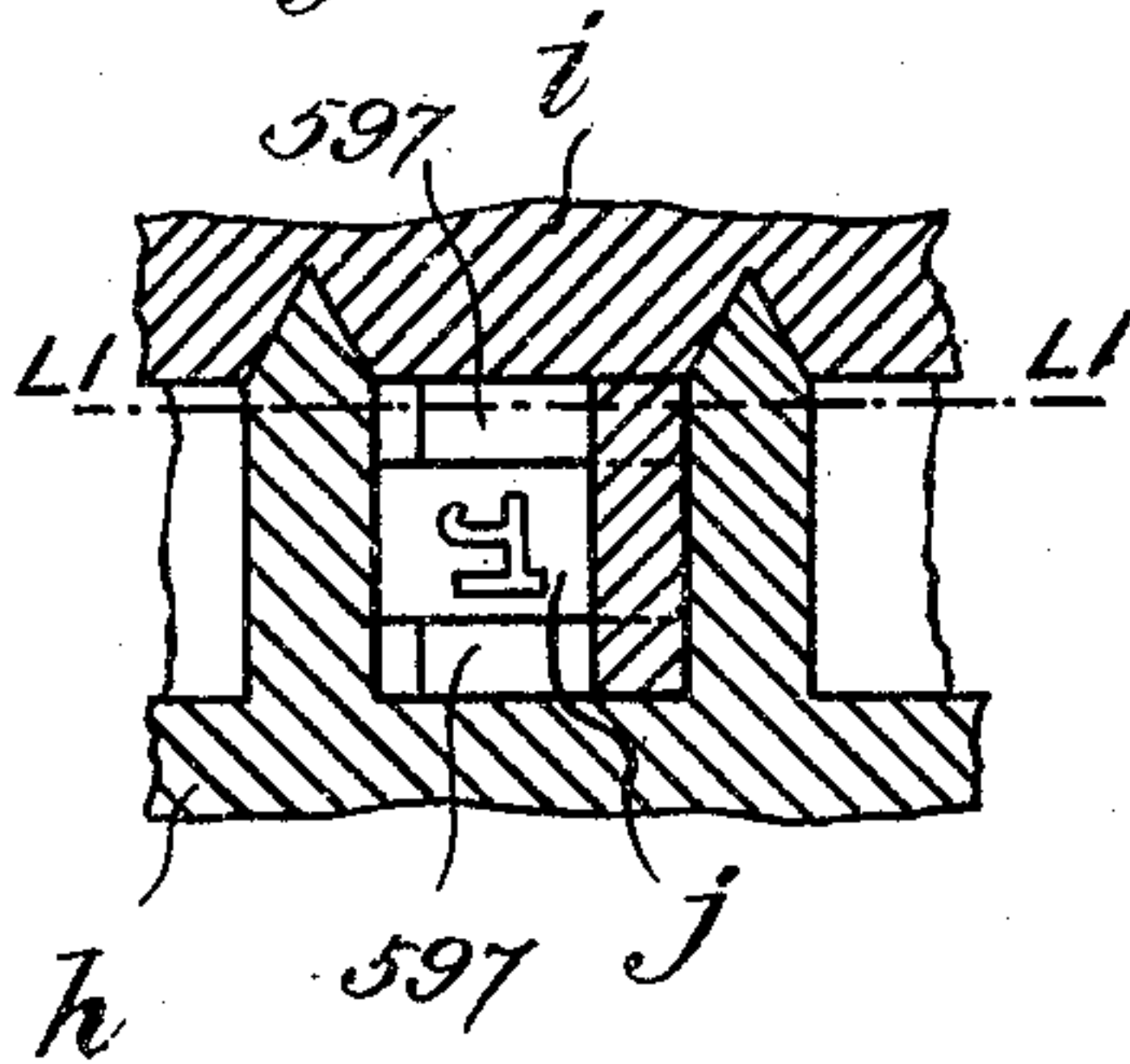
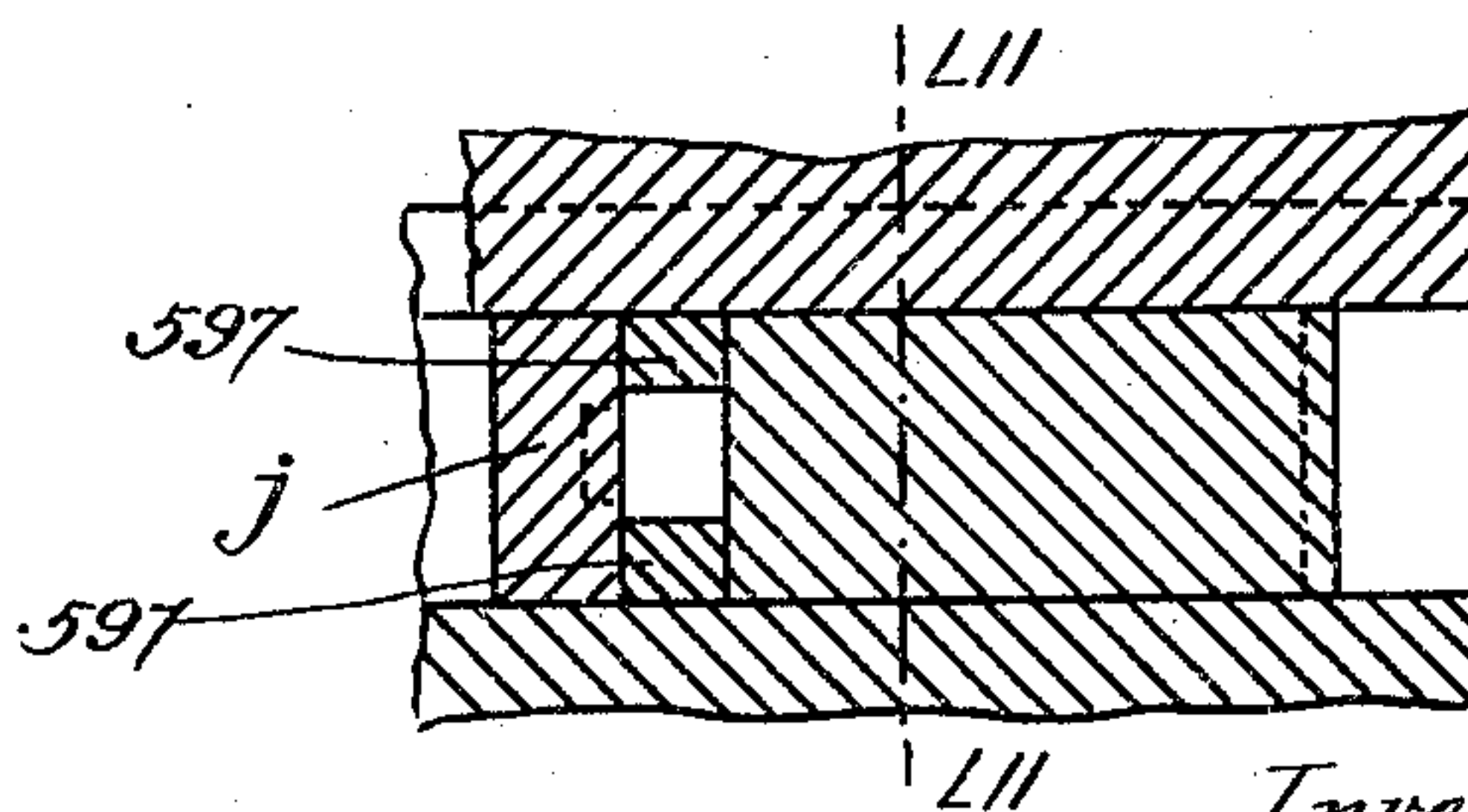


Fig: 53.



Witnesses
 Leonard B. Haynes
 Edwin D. Bartlett

Inventor.
 Shanker Abaji Bhisey
 per Herbert Sefton Jones
 Attorney

No. 789,708.

PATENTED MAY 16, 1905.

S. A. BHISEY.
TYPE MAKING AND SETTING MACHINE.

APPLICATION FILED AUG. 3, 1903.

25 SHEETS—SHEET 25.

Fig: 54.

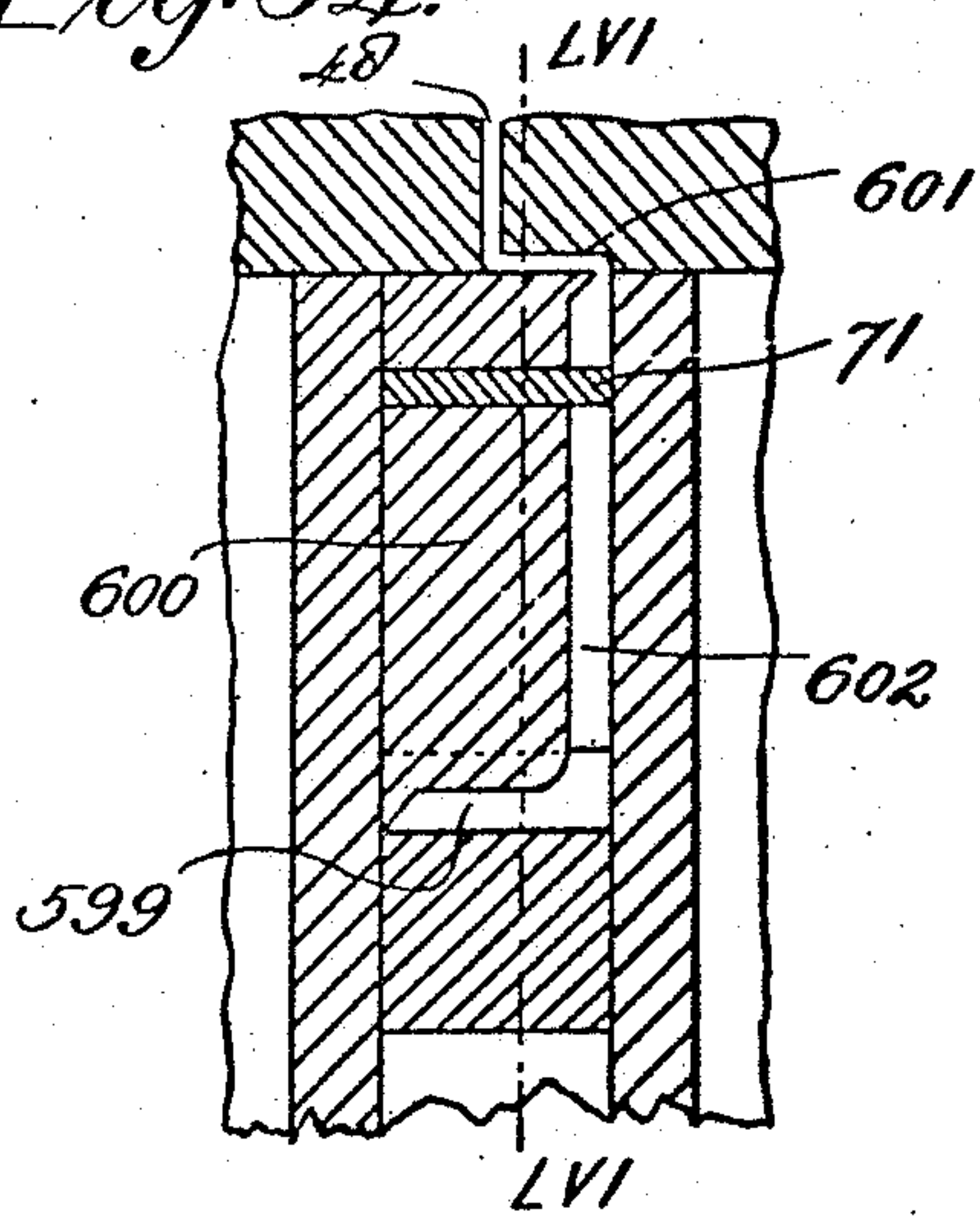


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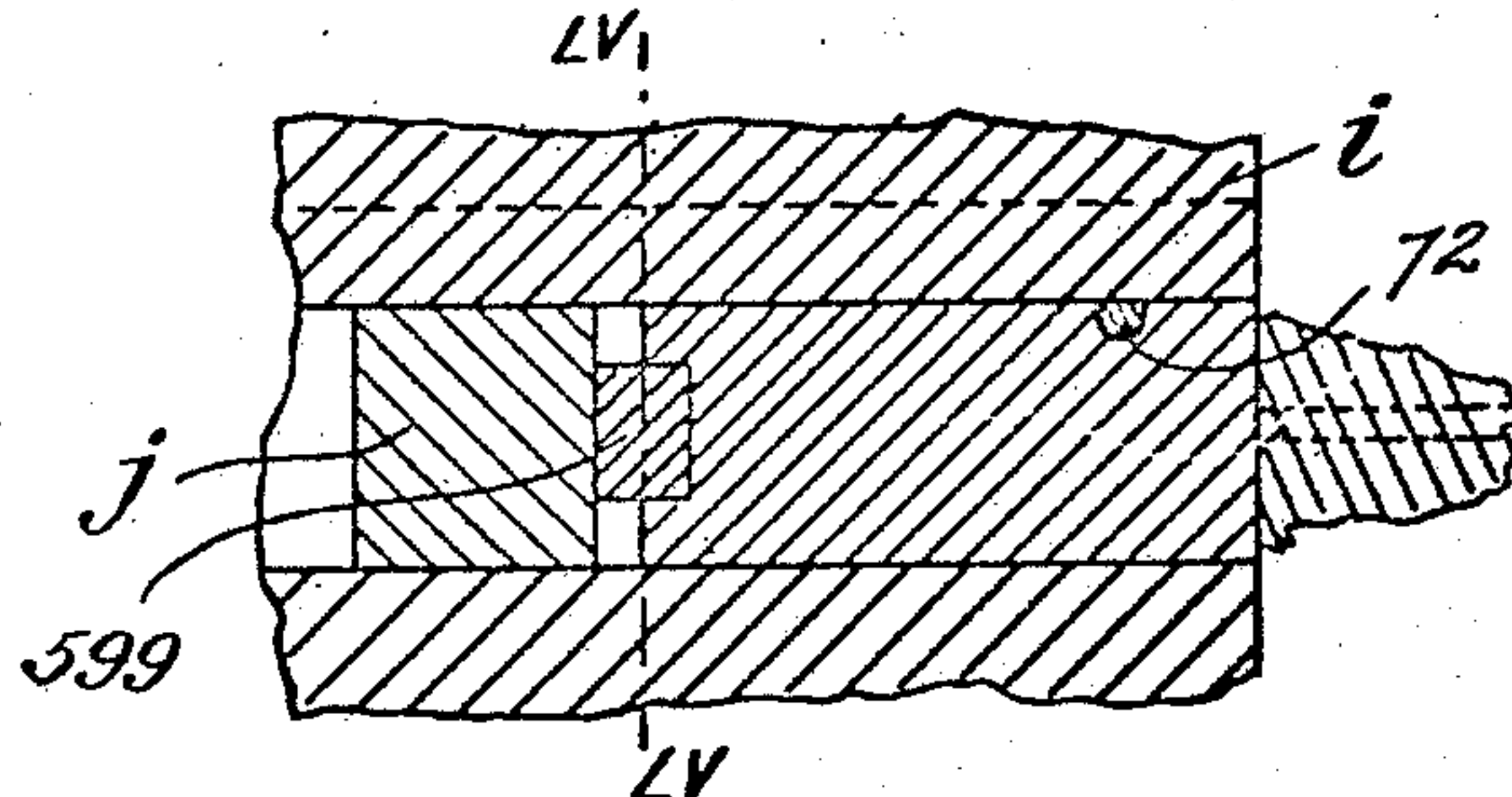
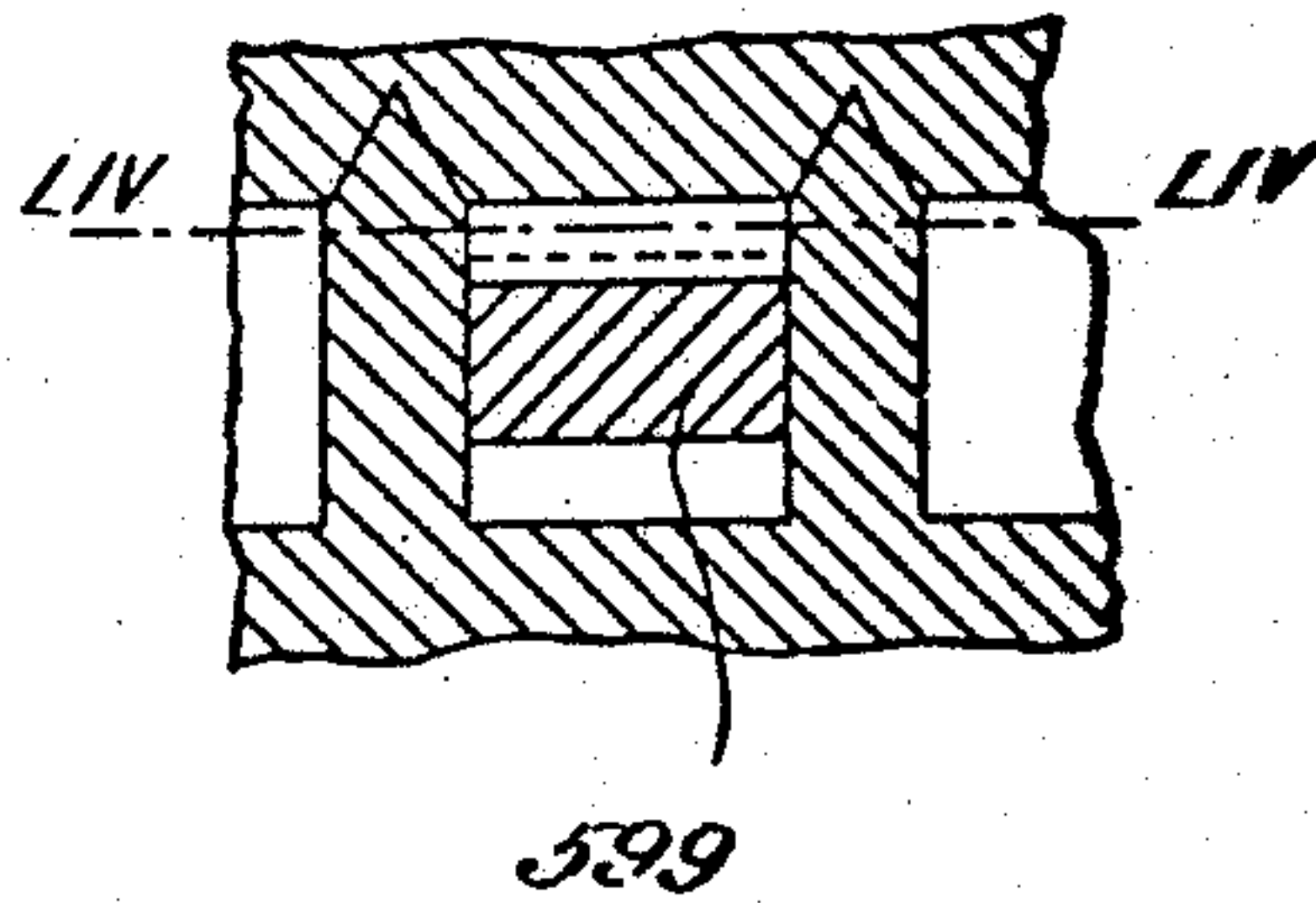


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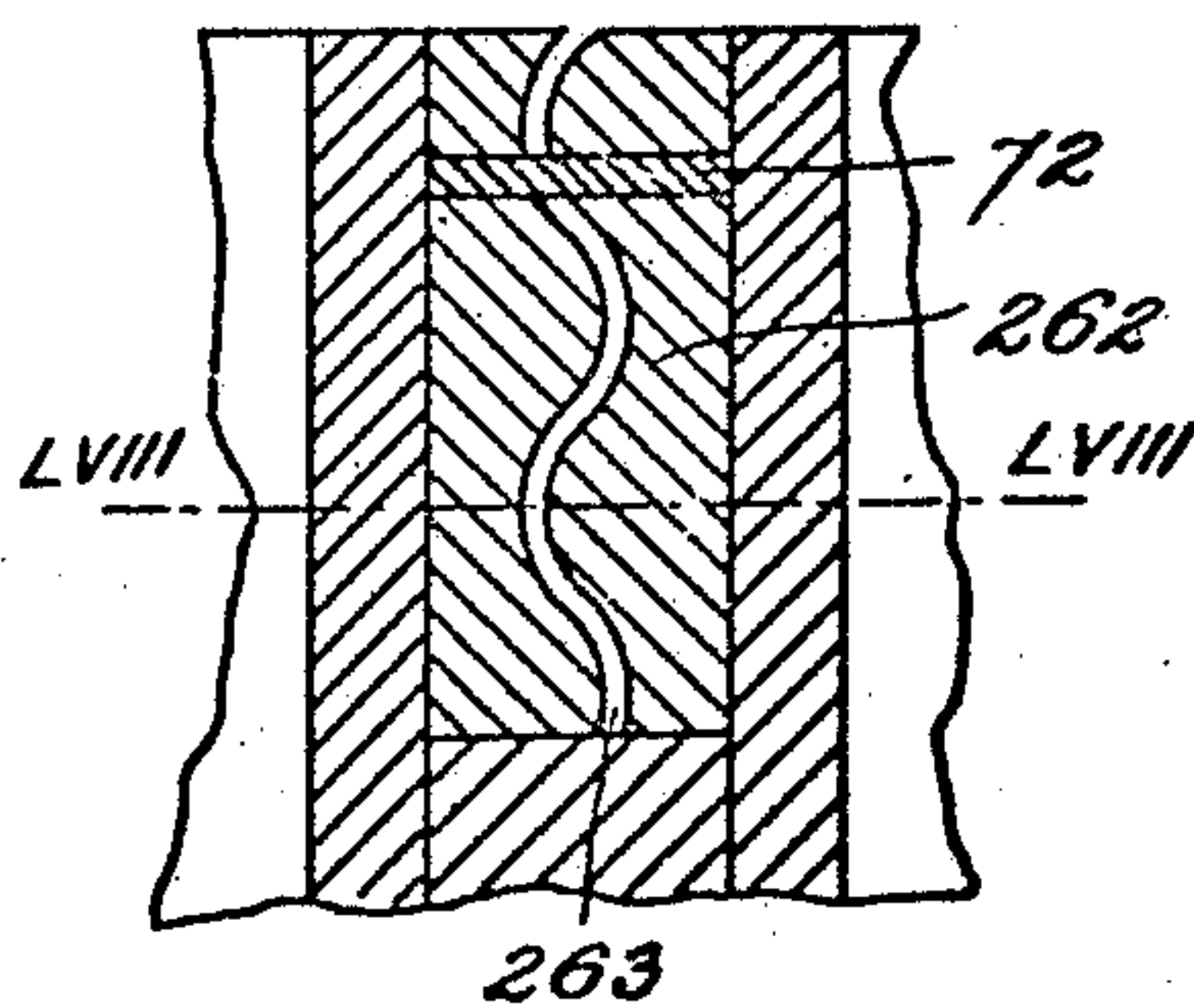


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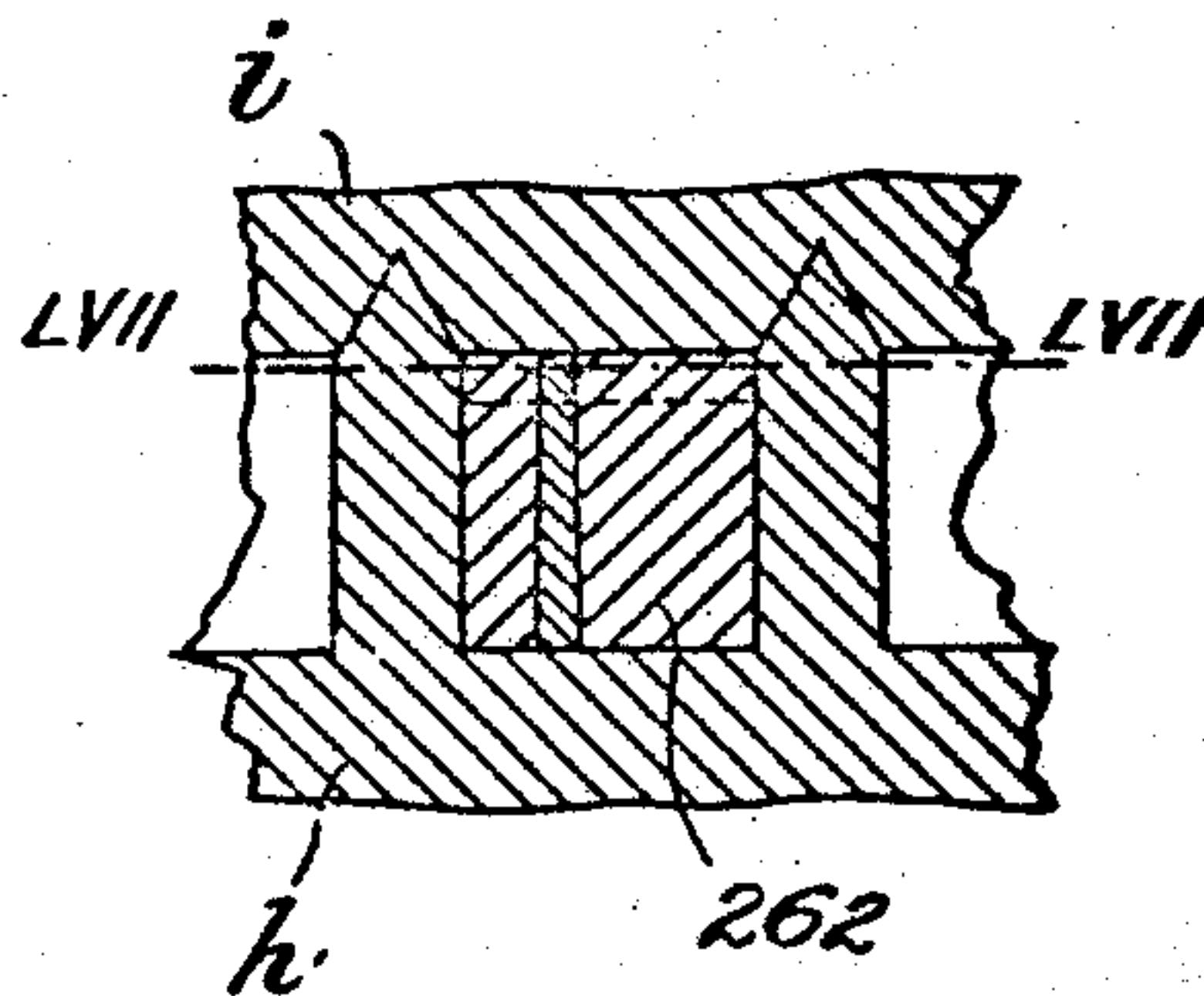


Fig: 58.

Witnesses
Leonard C. Haynes.
Edwin D. Bartlett.

Inventor.
Shankar Abaji Bhisey.
Per. Herbert Sefton-Jones
Attorney.

UNITED STATES PATENT OFFICE.

SHANKER ABAJI BHISEY, OF LONDON, ENGLAND.

TYPE MAKING AND SETTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 789,708, dated May 16, 1905.

Application filed August 3, 1903. Serial No. 168,042.

To all whom it may concern:

Be it known that I, SHANKER ABAJI BHISEY, engineer, a subject of the King of Great Britain, residing at 320 Goswell road, in the city and county of London, England, have invented a new and useful Improved Type Making and Setting Machine, of which the following is a specification.

This invention relates to a machine for composing types and in which as types are taken for composing from a magazine fresh types are automatically cast to fill their places.

The machine comprises devices whereby it is rendered possible to cast clear type with high-relief faces, owing to the use of one fixed matrix for each letter; to cast and readily compose when required the types of oriental or other languages in which each letter is composed of separable parts—such, for instance, as a consonant with part of a vowel above or below it; to use the machine at times when required for producing and for assembling types in lots for a type-font, such as is used in hand composing; to compose selected types into lines of suitable and predetermined lengths; to justify such lines; to bind the lines into line-slugs or back them with lead rules and to transfer them to a galley, ready for the usual printing operations. In this machine also the type-lines are composed from left to right, and a reflector is preferably provided whereby the types are viewed in composing as they will appear when the work is printed, and thus a person who is not accustomed to read reversed types is able to operate the machine and to correct and avoid errors. At the same time the machine comprises comparatively few parts, and all said parts are of comparatively simple construction. Moreover, the whole machine may be made of small dimensions, as the construction is compact, while the parts are such as to require little or no skilled attention.

In the accompanying drawings the machine is shown in the forms of construction most easily calculated to attain the desired ends.

It will be obvious, however, that many parts, such as the driving and moving mechanisms, may be altered or replaced by their mechanical equivalents, as will be well understood by

a competent mechanic, without departing from the scope of the invention.

In the drawings, Figure 1 is a front elevation with portions of the casings and other parts broken away or removed and showing the whole machine on a reduced scale. Fig. 2 is a plan of Fig. 1 to the same scale, certain parts being also broken away or removed. Fig. 3 is a side elevation of the machine, to the same scale, in section on line III III of Fig. 2, the parts of the gear for operating the composing and justifying mechanisms cut by said section-line being omitted. Fig. 4 is a front elevation of the whole machine in section on the lines IV IV of Figs. 2 and 3 to the same reduced scale. Fig. 5 is an elevation, partly sectional, of a portion of Fig. 3 drawn to the normal scale. Fig. 6 is an elevation of a modified detail of part of Fig. 5. Fig. 7 is a section of a part of the spout, showing the means for controlling the feed of molten metal for casting. Fig. 8 is a section of part of a mold and the end of the spout, the latter being somewhat modified as compared with Fig. 5. Fig. 9 is a sectional elevation of part of the mold-plate with its appurtenances and the casing, the section being taken on the line IX IX of Fig. 5. Fig. 10 is an isometric view, on an enlarged scale, of one end of the mold-plate, showing one method of inserting and adjusting the matrix-blocks. Fig. 11 is a similar view, to the same scale, illustrating a modified arrangement. Figs. 11^a and 11^b illustrate the matrix-bar used in the last-mentioned device as seen from opposite sides. Fig. 12 is a side elevation. Fig. 13 is a rear elevation, and Fig. 14 is a partial plan, of the lower part of the type-magazine with the apparatus connected therewith. Fig. 15 is an enlarged isometric view of a modified form of the device shown in Figs. 12 and 13 for forming compressible types. Fig. 16 is a partial plan view of the table which is brought into use when the machine is employed for founding types in fonts for hand composing. Figs. 17, 18, and 19 are detail views of the cams on the main actuating-shaft of the founding and storing parts of the apparatus. Figs. 19^a and 19^b illustrate two modified ways of arranging

the type-magazine and parts connected therewith and the type-feeding band. Fig. 19^c is a detail view of the cam 627 on shaft 353. Fig. 20 is a general plan view of the type-line
 5 composing and justifying apparatus. Fig. 21 is an elevation of Fig. 20. Fig. 22 is an elevation of the composing and justifying frames and the two sticks, the front plates of the frames being removed and part of one of
 10 the sticks being broken away. Figs. 23 and 24 are cross-sections of the justifying and composing frames, respectively, taken on the lines XXIII XXIII and XXIV XXIV, respectively, of Fig. 22. Fig. 25 is a plan of the stick-
 15 shifting mechanism at bottom of the composing and justifying frames. Fig. 26 is a sectional elevation of the parts shown in Fig. 25, the section being taken on the line XXVI XXVI of Fig. 25. Fig. 27 is an enlarged front elevation
 20 of the make-up type-inserting apparatus. Fig. 27^a is a detail of Fig. 27. Fig. 28 is a side elevation of the parts shown in Fig. 27, portions of the composing-frame being shown in section. Fig. 29 is a detail plan view of the
 25 make-up type-inserting mechanism proper. Fig. 30 is a detail elevation of the line-spacing pieces for the make-up type-inserting mechanism. Figs. 31 and 32 are front and side elevations, respectively, of the indicator for the
 30 composed lines. Figs. 33 and 34 are isometric views, respectively, of a stick end piece and of part of one of the sticks in section. Fig. 33^a shows a stop. Fig. 35 is a section of the justifying-frame, taken on the
 35 line XXXV XXXV of Fig. 20, the parts at the rear of said frame being omitted in order to show more clearly and separately the apparatus for backing the lines of type or forming them into line-slugs by line-binders.
 40 Figs. 36, 37, and 38 are cross-sectional views of the line-binding mechanism, showing the parts in varying positions of action. Fig. 39 shows the same device as adapted for use with plain lead rules for backing lines of type.
 45 Fig. 40 is an enlarged isometric view of part of the line-binder catching and inserting bar. Fig. 41 is an enlarged isometric view of a single type in the form for binding by the line-binder. Fig. 42 is an enlarged isometric
 50 view of part of a line-binder. Fig. 43 is an enlarged end view of three lines of type with line-binders in position thereon. Fig. 44 is a partly-sectional elevation of the justifying-frame with the line-binding attachments and
 55 apparatus thereon. Figs. 45, 46, and 47 are elevations of three forms of apparatus for the application of power to the stick-shifting, justifying, line-binding, and other devices for the composing and justifying frames, Fig. 45
 60 illustrating a belt-operated gear, Fig. 46 a toothed-wheel gear, and Fig. 47 a diagram of the connections of an electric motor which is switched into and out of action by a power-driven arrangement. Figs. 48, 49, and 50 are
 65 isometric views of built-up type for Eastern

languages, Fig. 48 showing the built-up type and Figs. 49 and 50 the separated parts thereof. Figs. 51, 52, and 53 show the molds for forming a consonant type of Eastern languages, Fig. 51 being a sectional plan on line LI LI of
 70 Fig. 52, Fig. 52 a sectional elevation on line LII LII of Fig. 53, and Fig. 53 a sectional elevation on line LIII LIII of Fig. 51. Figs. 54, 55, and 56 show the mold for forming the vowel type of Eastern languages, Fig. 54 be-
 75 ing a sectional plan on the line LIV LIV of Fig. 55, Fig. 55 a sectional elevation on line LV LV of Fig. 56, and Fig. 56 is a sectional elevation on line LVI LVI of Fig. 54. Figs. 57 and 58 show a form of mold for casting
 80 compressible type, Fig. 57 being a sectional plan on line LVII LVII of Fig. 58, and Fig. 58 is a sectional elevation on line LVIII LVIII of Fig. 57.

In the drawings, *a* is a base or foundation
 85 plate, upon which stand two pillars *b c*, which support the metal-melting pot, its appurtenances, and other parts, as hereinafter described, and two pillars *d e*, which carry the
 90 type-casting molds and parts connected therewith.

The principal parts, hereinafter described in detail, are the melting-pot *f*, wherein the type-metal is melted, and a spout *g* for feeding the molten metal to the molds; a mold-
 95 plate *h*, on which the molds are formed; a sliding cover-plate *i* for the molds and the matrices *j* for forming the type-faces; a tank *k* in connection with the mold-plate; a tank *l* in connection with the cover-plate and a
 100 water-supply tank *m*; the type-magazine *n* and a tray *o*, connected therewith, whereby the apparatus may be used when required for supplying type for hand-composing-type
 105 fonts; a keyboard *p* for governing the release of types for composing in the composing-sticks; a continuously-running band *q* for feeding the type when discharged from the magazine *n*; a type-packer *r*, composing-frame *s*,
 110 justifying-frame *t*, sticks *u v*, line-indicator *w*, make-up type-inserters *x*, line-slug or lead-rule box *y*, and galley *z*.

The type-metal melting and feeding apparatus will be first described.

The pot *f* in one piece with the spout *g* has
 115 on its bottom lugs 2, whereby it is fixed on the tops of pillars *b c*, and it contains a cylinder 3, into which the bifurcated ends 4 of the spout *g* lead through openings 5. The pot *f*, cylinder 3, and spout *g* are shown cast in one
 120 piece in the form seen in Figs. 1 to 5. The bottom and sides of the pot are surrounded by a casing 6, formed in any suitable way and connected to the pillars *b c*, which pass through it, by lugs 7. A space is left between the
 125 casing 6 and the pot *f*, as seen in the above-mentioned figures. In the space below the pot is a heating-ring 8, consisting of a ring of gas-burners, spirit or oil lamps, or the like, and the bottom of the casing 6 is provided
 130

with perforations to supply air for combustion.

In the bottom 10 of cylinder 3 is a conical valve-seat, in which rests a hollow plug-valve 12. A pin fixed in the bottom of pot *f* passes into said plug-valve and has a head which prevents the valve from rising too high, as seen in Fig. 3. A plunger 15 fits in cylinder 3, and its rod 16 has a slot 17 at its end. A bracket 18, fixed inside the pot *f* by a foot, serves as pivot for a lever 20, one arm of which works in slot 17. A rod 21 is guided in a bracket 22, fixed on the side of the pot *f*, and in two brackets 23 24, fixed on the pillars *b c*, by feet 25, as seen in dotted lines in the plan view, Fig. 2. The top of rod 21 is slotted at 26, and the rear arm of lever 20 passes through said slot. The bottom of rod 21 has a roller 27 thereon, Fig. 17, which works on the surface of a cam 28, formed between two side plates 29 30, (which are also cams, as mentioned later.) The cams 28, 29, and 30 are fixed on a shaft 31, which is supported in bearings on pillars 33 34 at the back of the apparatus, the said shaft being actuated, as is hereinafter described. A spring 35, attached at one end to bracket 22 and at the other to lever 20, serves to pull this lever and the rod 21 downward, and thereby keep the roller 27 on the bottom of rod 21 in engagement with the cam 28.

The pot *f* and casing 3 have a cover 36, slotted to allow the rod 16 and arm of bracket 18 to pass through it and provided with a flue 37 to lead away the gases of combustion.

The spout *g* becomes shallower and broader until it forms a slit 38, Figs. 3 and 5, and in front of this it is continued as a block with passages 48 bored through it at equal distances apart and leading into the slit 38. The front part of the spout is supported by a frame 39 on the tops of the pillars *d e*. On top of the spout, at two points near the front, are safety-valves, the casings 40 of which are seen in section in Fig. 5 and in plan in Fig. 2. Each valve-casing communicates with the slit 38 in the spout *g* through an opening 41, which has a conical surface within the casing and is bored through at one point for the connection of a pipe 43, which leads directly back to the melting-pot *f*, as seen in Figs. 2 and 3. A conical-faced valve-plug 44 fits on the seating and in the walls of the casing 40, and its rod 45 has a collar 46 thereon, which is pressed downward by a compression-spring 47, for which a bent abutment 42 is provided, fixed to the side of the casing 40. The springs 47 are such as to press the plugs 44 onto their seatings with rather less pressure than that at which the molten metal is fed, in order that surplus metal may raise said plugs and return to the pot *f* through the pipes 43, as hereinafter described. It will be obvious that any desired number of safety-valves such as described above may be fitted on the top of the

spout *g* and connected to the pot *f* by pipes 43 in exactly the same manner. The spout *g* has an enlargement 49 on the top thereof and extending the whole breadth just in front of the safety-valves 40. Into this enlargement 70 holes 50 are drilled from below upward, passing through each passage 48, near the rear end thereof, and a "hair-hole" 51 leads from the top of each hole 50 through the top of the enlargement 49. In each of the holes 50 fits the 75 enlarged end 52 of a rod 53, guided in brackets 54 55, fixed on the frame 39, and having at its lower end a flattened part 56. In the end 52 a hole 57 is bored, which comes into alinement with the passage 48 when the rod 80 53 is raised—*i. e.*, in the position seen in Fig. 5—but comes out of alinement and closes the passage 48, when the rod 53 is allowed to descend into its lower position, in which the bottom of its enlarged part 52 rests on the upper 85 bracket 54. The hair-holes 51 allow of the entrance and escape of air into and from the borings 50 when the rods 53 are lowered and raised.

The number of passages 48, cross-borings 90 50, and rods 53 is the same as that of the molds hereinafter described, each passage corresponding with and supplying casting metal for one mold.

Under the spout *g*, near the front, is suspended a perforated casing 58, Fig. 5, in which 95 is a burner-pipe 59, supplied with any suitable combustible. This burner-pipe serves to keep the spout hot and to prevent metal from solidifying therein when the apparatus is 100 working. The part within which are the passages 48 is heated by an electric current, where such is available, passing through resistance-wires coiled round said part. In Fig. 5 such 105 wires 60 are shown in section coiled around said part, with a suitable insulating layer 61 interposed.

A shelf 62 is supported on brackets 63 from the pillars *d e*. On this shelf are two rails 64. A rectangular tank *k*, having wheels 65 110 at its corners, runs on the rails 64. The top of the tank is the mold-plate *h*, which has a series of walls 66 on its upper surface, forming the sides of the molds. The walls 66 are equal in height and length, but of different 115 thicknesses, as seen in Fig. 9, because the widths of type to be cast vary; but the passages 48 are equidistant—that is to say, the breadth of each mold is determined by the thickness of its walls—and the centers of all the 120 molds between the walls 66 are equidistant. The walls 66 are beveled at the top, as seen at 67. The matrices *j*, Fig. 10, for forming the type-faces are metal blocks which fit in the ends of the molds and reach up to the beginning 125 of the bevelings 67. The walls 66 are slotted through near the rear of the mold-plate from one side thereof to the other, the slot being just large enough for a rail 68 to be slipped through. This rail extends the 130

whole breadth of the plate through the rear of the molds, and in each mold a set-screw 69 passes through the plate and presses against the back of the matrix *j* in said mold for accurately adjusting the position of the matrix in the mold. The intaglio impression for forming a single letter is formed on the face of each matrix which lies within the mold, one matrix and one mold thus serving for producing each type. The number of molds is sufficient for all the letters, figures, stops, signs, and the like and block or make-up spacing-type to be formed in this single row of molds.

In a modification illustrated in Fig. 11 the walls 66 are cut away at the rear of the plate *h*, thus leaving a plane surface. The matrices are then formed on the side of a bar 80, which thus carries the matrices for making all the required type. The bar 80 is fixed in position at the rear of the plate *h* and against the ends of walls 66 by set-screws 81, passing through threaded holes in a bar or long rail 82, which latter is let into the plate *h* or otherwise suitably fixed thereon. In this construction either a different bar 80, with matrices formed thereon, must be used if a different set of types are to be cast, or if matrices are formed on two or more faces of the bar 80, as shown in Figs. 11^a and 11^b, in which the bar is seen in perspective as viewed from opposite edges, said bar must be turned over to bring a new set of matrices into the molds. It may here be mentioned that the matrices for forming block-type or type of shorter lengths than the printing-type are formed, as is well understood, by matrices of suitable shape or which project a suitable distance into their molds. This is not illustrated in the drawings, as it forms no part of the present invention.

The cover-plate *i* is of the same width as the mold-plate *h*, but of approximately twice the length, measured in the longitudinal direction of the molds. The under side of the cover-plate *i* is formed with wedge-shaped grooves 70 to correspond with and slide along the beveled tops of the walls 66. When the cover-plate rests on the top of the mold-plate walls, its plain under surfaces between the grooves 70 stand at the level of the bottom of the bevelings 67 and the tops of the matrix-blocks *j* and form the tops of the molds. Near the front edge of the plate *i* a rib of metal 71 is inserted in a groove cut completely across the under surface of the plate and in which said rib fits tightly. The rib projects downward in the form seen in Figs. 5 and 8 below the under surface of the plate *i*, but is cut through by the grooves 70, so that a projection 72 only remains at each mold corresponding accurately with the width of said mold, Fig. 9. The projections 72 serve for forming the notches 73 in the type 74, Fig. 41, as will be hereinafter described. The

passages 48 in the spout end in the center of projections 620, Fig. 5, which serve for forming notches in the base of the types. By this arrangement any irregularities on the type ends formed in casting will probably occur in the notch in the type, and trimming may become unnecessary. I have, however, hereinafter described a knife-plate for trimming the type ends. I prefer to use it to insure the formation of clean-ended types; but it is to be understood that its use is not essential. The cover-plate forms the bottom of the second tank *l*, the front and end walls of which are vertical; but the rear wall 75 is inclined. The tank is closed on all sides, except for the pipe connections leading to and from it, as hereinafter described, and it is provided near its top corners with rollers 76, which are adapted to run on rails 77 when the tank and cover-plate are moved forward and backward. The rails are supported at one end by bent ends 78, fixed to two short walls or standards 79, erected on the shelf 62, Fig. 5, and at the other end they are bent upward at right angles and attached to the sides of a tank 83. The said tank rests at the front on brackets 84, attached to the edges of the standards 79, and at the rear on brackets 85, attached to the front of the enlargement 49 on the top of the spout *g*.

It will be seen that when the parts occupy the position shown in full lines in Fig. 5 the mold-plate *h*, walls 66, matrices *j*, and cover-plate *i* form a mold closed on five sides, while the sixth is closed by the front of the spout *g*. In order to insure a close and accurate fit between the molds and cover-plate and the spout, the latter is provided with projections 86, Figs. 5 and 8, which fit in corresponding longitudinal slots 87 in the front edges of the plate *h* and cover-plate *i*, respectively, and prevent the escape of molten metal during casting.

A complete system of water circulation for cooling the molds is provided as follows: The tank *m* is closed on all sides and on top and is supported by a plate 88 on an arm 89, projecting from the pillar *b*. The tanks 83, *k*, and *l* have already been mentioned. Water is raised from tank *m* to 83 by an Archimedean-screw tube 90, passing through the walls of said tank near its ends, as seen in Figs. 2 and 5, and supported below in tank *m* by a bracket 91 and a block 92, on which the pointed end of the tube turns. The tube 90 is rotated by gearing from the shaft 31 as follows: A shaft 93 is supported at one end in the top of a pillar 94 and at the other by a bracket 95, extending from the pillar *d*. Close to pillar 94 the shaft has a bevel-wheel 96 fixed on it, and in a side bracket 97 on the pillar 94 is mounted a short shaft 98, having at one end a bevel-wheel 99, which gears with wheel 96, and at the other end a pulley 100, which is connected by a belt 101 to a pulley 102 on the shaft 31.

Hence the shaft 93 is driven by the belt and bevel-wheels from shaft 31. On shaft 93 is a pulley 103, and on the wall of tank *m*, below the point where the screw-tube 90 enters it, are revolubly mounted a pulley 104 with a bevel-wheel 105 thereon. The two pulleys 103 and 104 are connected by a belt 106, and the bevel-wheel 105 gears with a corresponding wheel 107, fixed on the tube 90, whence said tube is rotated. The wall of the tank *m* is recessed at 112 above and around the tube 90, as seen in dotted lines in Fig. 3, in order to leave clearance for the bevel-wheel 107.

Water raised from tank *m* to tank 83 by the screw-tube 90 constantly flows from the latter tank to that, *k*, under the mold-plate by a flexible pipe 108 (broken away in Fig. 5) and from tank *k* to that, *l*, on the cover-plate by a flexible pipe 109, while the water from tank *l* flows back to tank *m* by a flexible pipe (not shown in the drawings) connected to the nozzles 110 and 111 on the tanks *l* and *m*, respectively.

On the sides of the shelf 62 are fixed bent-out walls 113, which inclose the tanks *k*, *l*, and 83 at the sides, Figs. 1, 2, 3, and 9, and a cover-plate 114 is hinged at 115 to the bottom of tank 83 and serves for closing the front of the space containing the mold apparatus.

The mold-plate *h* is provided with a slot 116, reaching from one side to the other of said plate and beveled or narrowed at the top, so as to form a narrow slit in each mold close to the line of the matrices. This slot is preferably covered by a piece of fine gauze 118, rubbed over with black-lead in order to prevent the molten metal from passing through the slot if it should not be properly closed from below at any time during casting. Below the slot in the tank *k* is a long narrow box 119, the sides of which fit into the slot from below. In this box is a bar 120, the top of which is beveled to fit in the narrowed part of the slot 116 and to close it from below.

This bar is connected by two or more rods 121 to a bar 122 below the tank *k*, the rods 121 being carried down the sides of the tank in slots formed therein. A lever 123, pivoted at 124 to the shelf 62 and lying in recesses in said shelf, is spread out at its front end to form a plate 125, (seen in Fig. 2,) and which operates under the bar 122 to raise the bar 120. The rear end of lever 123 after passing through a slot in the type-magazine *n* is bent sidewise, as seen in Fig. 2, and connected to the top of a rod 126. This rod is guided in the ends of bent brackets 127 128, attached to the pillar *c*, and its lower end engages with a lever 129, pivoted at 130 on a bracket 131, extending from pillar *c*, Fig. 4. The rear end of lever 129 has a roller 132 thereon which bears upon the surface of cam 30, (shown separately in Fig. 17,) so that when the projecting part of said cam presses upward the rear end of lever 129, the front end, and rod 126

are lowered, thereby raising the front of lever 123, with its plate 125, and closing the bar 120 in the slot 116. The part of the magazine through which the lever 123 passes does not receive type, the aperture in the spout *g* being closed or omitted and the mold closed or not cut in the plate *h*.

On a bracket 133, attached to pillar *c*, an air-pump 134 is mounted. This pump is connected with the box 119 by a pipe 135 entering said box at the right-hand end, Fig. 2. The pump is operated by a rod 136, connected to its piston and passing through the rear of the pump-casing. It has at the rear a pin 137, working in slots 138 in the forked end of a lever 139. The lever 139 is pivoted at 140 on a bent bracket 141, attached to the pillar 34, and it has an arm 142, projecting at an angle from the arm 139 and carrying a roller 143 thereon, which bears upon the surface of a cam 144, mounted on the shaft 31, whereby the air-pump 134 is operated during the rotation of the shaft 31 to withdraw air from the box 119.

The mold-plate and tank, together with other parts connected therewith, are moved to and from the spout by means of two horizontal levers 146, fixed to the face of the tank *k*, one near each end, provided with pins at the other end engaging in slots in the upper ends of levers 147. These levers are pivoted at their lower ends on brackets 148, attached to pillars 33 and 34, respectively. Near their lower ends the levers 147 are provided with rollers 149, engaging in cam-grooves formed on the inner surfaces of cam-disks 150, mounted near opposite ends of the shaft 31 and shown in detail in Fig. 19.

Between the rods 146 on the side of the tank nearest the spout is fixed a funnel-shaped channel 151, extending the whole length of the mold-plate and divided by vertical walls into partitions corresponding with the molds and with the partitions in the type-magazine *n*. The type-magazine, with its compartments, is seen in plan in Figs. 14 and 16. Pivoted between the two rods 146 behind the channel 151 is a long catch 152. This catch is pressed forward by a spring 153, also fixed to the rods 146, and when the channel is in the rear position (shown in dotted lines in Fig. 5) this catch lies under the bottom of the channel, so closing all the passages therein from below or rather preventing the type from falling out. In the former position (shown in full lines in Fig. 5) the catch 152 is pressed back by pins 154, one of which projects beyond the magazine from the frame 39 at each end of the magazine.

A knife-plate 155, extending the whole length of the mold and cover plates *h* and *i*, is arranged to slide over the front wall of the tank *l* on the latter plate. The lower edge of the knife-plate is sharpened for cutting off or trimming the rough ends of the types. Substantial pins 156 are fixed in each end of

the knife-plate and carry flanged wheels 157. Vertical tracks for guiding said pins are formed by means of two vertical rods 158, fixed one at each end on the rods 146. Two
 5 levers 159, cranked at their ends, are pivoted at 674 on the short walls or standards 79 and are provided with guides 160, forming slots beneath the levers 159, in which the wheels 157 may travel longitudinally. The other ends
 10 of the levers 159 are slotted to engage over pins 161, fixed on the upper ends of vertical rods 162. These rods are guided in brackets 163 164, projecting from the pillars *d* and *e*, and their lower ends are provided with pins
 15 165, engaged by the forked and slotted ends of arms 166, hinged on brackets 167, connected to the pillars 94 and 34, respectively; the bracket 167, attached to the pillar 34, being bent to pass round the cam-wheel 150, as seen
 20 in the plan view, Fig. 2. The arms 166 are provided with rollers 168, traveling in grooves in the groove cam-wheels 150, Figs. 3 and 19. By the motion of the arms 166, owing to their rollers traveling in the cam-grooves, the rods
 25 162 and arms or levers 159 are raised and lowered, together with the knife-plate operated by the last-mentioned levers.

On top of the knife-plate 155 is a plate 169, which is channeled to exactly correspond with
 30 the molds. The length of said plate is slightly less than half that of a single ordinary type. A tray 170 is attached between the tank *k* and rear wall of channel 151 for catching type ends cut off by the knife-plate, as hereinafter
 35 described. Between the two standards 79 and the upper inclined edge thereof a substantial plate 171 (seen in dotted lines in Figs. 1 and 5) is fixed by means of screws or the like 172. This plate forms a stop against which the rear
 40 inclined face 75 of tank *l* butts when said tank reaches its rearmost position. A peg 173, curved at the rear, is fixed at each side of the tank *l*, and two catches 174 are pivoted at 675 on the standards 79. At the rear of the tank
 45 *k* and at each end thereof is fixed a vertical arm 175, and each catch 174 is formed with a projection 176 near its engaging end. The catches are prevented from falling lower than the position shown in full lines in Fig. 5 by
 50 means of tailpieces 177, which engage against pins 178, fixed on the inner sides of the standards 79.

Attached to the front of the machine near the bottom thereof is the keyboard *p*, Figs. 1
 55 and 3. Each key 179 of this keyboard is mounted as a plunger to operate upon the end of levers 180, pivoted at the rear of a rod 181, bent at its ends and attached to the pillars 33 and 34. No invention lies in
 60 the keyboard itself or in the levers thereof, which are similar to those used in the type-writer. This part of the machine, therefore, is not described in greater detail. The levers 180 may be arranged to be drawn upward by
 65 springs in any suitable manner and may be

bent in order to clear pillars which they have to pass. These are details of mechanical construction forming no part of the invention. The key-levers are covered by a plate 9 to shield them from dust and the like, this plate 7 supported by lugs 209 from the pillars *b c*, &c.

The type-magazine *n* contains a series of vertical chambers corresponding in number and relative position with the molds on the plate *h*. A rail 182, fixed between the two
 7 pillars *d e*, has a track in its upper surface in which rollers 183, mounted on the rear of the type-magazine, can travel longitudinally on said rail. By this means the type-magazine,
 8 together with all the parts connected therewith, may be drawn out of the machine endwise when necessary. When in position in the machine, the chambers in the magazine correspond with those in the mold and in the
 8 funnel-shaped channel 151.

Fixed between the two pillars *d* and *e* is a shaft 184, Figs. 3 and 12. On this shaft are pivoted a series of levers having three arms 185, 186, and 187, the arms 187 being connected by wires or rods 188 to the key-levers
 9 180. A second rod 189 extends between pillars *d* and *e* above the rod 184. On the rod 189 are pivoted a series of detents 190, each having two arms, one above and one below, adapted to enter the walls of the magazine *n*
 9 in one chamber thereof through holes or passages provided therein. Each detent 190 has near its lower end at the rear a staple piece or hook 191 attached thereto through a loop, in the end of which the middle arm 186 of the
 1 three-armed lever passes. One detent 190 is provided for each chamber in the magazine, except in the special cases hereinafter mentioned. The distance between the two projecting ends of the detent 190 is such that
 1 when the types are standing one upon another in the magazine and the bottom one is resting on the lower arm of the detent the nick 73 in the second type from the bottom is opposite the upper arm or catch of the detent.
 1 In the normal position of the detent its lower arm projects into the magazine and forms a stop to hold the column of types in the chamber of the magazine in which said detent operates.

An inclined frame 192 is formed beneath the shelf 62. This frame has a series of channels 194 therein, one corresponding to each chamber of the magazine, and the front and rear walls of the magazine are slotted opposite to each channel. The bottom of each channel 194 has a slot 193 therein, and in each channel a long narrow metal plate 195 is arranged to slide. This plate has a projection at its upper end, which works in the slot 193
 1 and limits the movement of said plate in the channel. A frame consisting of two end pieces 197, guided in inclined tracks 198, formed on the sides of the pillars *d e*, and of a cross-rod 199 at the upper end is arranged to slide at
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the same angle relative to the base of the machine as the strips or plates 195 in the channels 194, its rod 199 being adapted to engage with the projections 196 on said strips 195. The rear part of the said frame is completed by a cross-piece 200, to the center of which a rod 201 is connected. This rod passes through brackets 202, attached to the casing 6 of the type-metal pot, and 203, connected to the pillar *b*. At the rear end said rod 201 has a roller 204 thereon, which operates against the upper arm of a bell-cranked lever 205, which is mounted on a bracket 206, attached to the pillar *b*. The other arm of the lever 205 is connected to a rod 207, having a roller 208 on the end thereof, which travels on the edge of the cam-disk 29, hereinbefore mentioned, and is vertically guided in the bracket 24, Fig. 3. The cam-disk 29 is shown in Fig. 18. It will be seen that when this disk rotates its projection will periodically raise the rod 207, whereby the bell-cranked lever will be turned, the rod 201 and the frame on the end thereof forced completely upward, and all the strips 195 raised by the bar 199. As the frame recedes the strips will slide down again, and this action is repeated at each revolution of the shaft 31.

Below the row of rods 53, the heads 52 of which close and open the passages 48 in the spout *g*, is arranged a frame consisting of rods 210, guided vertically in brackets 211, attached to the pillars *d e*, and of top and bottom bars 212 and 213. The top bar lies across the machine beneath the row of flattened feet 56 on the bottom of rods 53. The top rod 212 has also attached to it a frame 226, through the top part 227 of which the rods 53 slide in slots. Pivoted between the pillars *b c* is a rocking frame 214. Its vertical ends lie beneath the bar 213, near each end thereof, and its middle part is bent inward in order that it may be pivoted at 215 between the pillars *b c*. Connected to the rear part of the frame is a rod 216, having a roller 217 on its lower end which travels in the cam-groove made in the outer surface of the cam-disk 29, as seen in Fig. 18.

Below the type-magazine, the bottom of which is horizontal, a series of guide-channels 218 are provided, which form continuations of the chambers of the type-magazine. The walls of these channels are bent to one side slightly at the bottom, as seen in Fig. 1, and below them is arranged the endless band *g*. The walls of the channels 218 are attached to the bottom of the magazine or formed as part thereof. The front of the channels 218 is closed by a glass plate 228, through which said channels are easily seen from the front in order that the passage of the types through said channels and onto the band may be continuously watched from the front. The band *g* runs upon two rollers 219 220, mounted on shafts 221 222 upon the pillars *e d*, respec-

tively. The shaft 222 is driven from the shaft 93 by means of a belt 223, which passes over a pulley 224 on shaft 93 and a pulley 225 on the backwardly-projecting part of shaft 222. The speed of travel and the angle of inclination of the band *g* is such that a type falling from the magazine will reach the discharging end and lower end of said band after the same period of time from whatever part of the magazine it is discharged.

The operation of the type-casting apparatus and the parts connected with the type-magazine is as follows: We will suppose the magazine to be full of types—that is to say, that each channel contains the types standing one upon the other above the detent 190. The operator in composing will operate certain of the keys of the keyboard *p*, and each time that he does so one of the detents 190 will be rocked, as hereinbefore described. The upper arm of the detent will then engage in the notch 73 in the second type from the bottom, and the lower arm of the detent will allow the lowest type in the channel of the magazine to fall. The type so released will pass through one of the channels 218 onto the band *g*, whereby it will be taken downward to the discharging point. In the meantime the type which was second from the bottom will be held up, together with all the types above it, by means of the upper arm of the detent 190. When the key of this detent is released, it will return to the position shown in Fig. 12, when its upper arm will come out of engagement with the notch 73 in the type and the column of type remaining in that chamber of the magazine will fall downward until the bottom type occupies the position of the one which has been released.

The type-casting apparatus completes one cycle of operations at every revolution of the shaft 31. This cycle of operations comprises the forcing of type-metal out of the spout *g* by means of the pump 15, the passage of said metal through the apertures 48 into the molds and the exhaustion of air from said molds, the expulsion of the cast type from the molds, and the falling of said type into the magazine. During each of the said cycles of operations the strips 195 are allowed to fall downward by the drawing back of the frame 197 199. When a type has been taken from any one of the chambers of the magazine *n*, the strip 195 corresponding to said chamber will pass through the slots therein and occupy the position shown in dotted lines in Fig. 5. The strips of magazines which are full will remain in the upper position. (Shown in full lines in said figure.) As soon as the strips have been allowed to fall the frame 210 212 is raised by the rocking lever 214 from the position shown in dotted lines to that shown in full lines. The top bar 212 carries up with it the ends of all the strips which have passed through the magazine, and said strips when nearing the

top position press upward the feet 56 of rods 53. In cases where the magazine-chambers are full and the strips have not passed there-through the rod 212 comes up to the foot 56 of the rod 53, but does not raise the latter, the interposition of a strip 195 being necessary to effect the raising of the rods 53. Consequently only the rods 53 are operated which are opposite to chambers of the magazine which are not full. The upper parts 52 of the rods which are raised when in their upper positions bring their passages 57 into alignment with the holes 48 in the spout, Fig. 7. In the next movement of the piston 15 in the metal-melting pot type-metal expelled into the spout passes through those passages 48 which are thus made open and reaches the molds opposite said passages. Surplus metal not required for casting types returns to the pot through the valves 40 44, &c., and the pipes 43. The moment before the type-metal enters the mold the box 120 is placed under a partial vacuum by the air-pump 134, and consequently the air is largely exhausted from each mold. The exhaustion continues until the type-metal flowing into the mold has nearly reached the slot 116, when the bar 120 is raised to close said slot and the filling of the mold is almost immediately completed. By this method of exhausting the air the formation of bubbles in the type is largely prevented and clearer and better type is the result.

It will be seen that owing to the arrangement of the strips 195 the frames, rods, &c., type-metal will only enter the molds of those letters in which the magazine is deficient.

The rocker 214 falls, together with the frame 210 212, and this latter, by its upper part 227, draws down again rods 53, which have been raised, and by this means the holes 48 in the spout are closed again. During the further fall of the frame 210 212 the strips 195, which have been in operation, resume the forward dotted position and are then forced backward by the return movement of the bar 199 with its frame. As soon as the molds are filled they are run backward by means of the rods 146, the cover-plate *i*, the tanks *k* *l*, and other parts receding with the mold until the rear part 75 of the tank of the cover-plate strikes against the cross-plate 171. At this moment the catch 174 engages over the stud 173 at each side of the tank *l* and holds said tank and the cover-plate fast in the rear position. During the rearward movement of the parts the knife-plate 155 is forced downward by the levers 159, thus trimming the rear ends of the types where necessary. The trimmed-off ends are caught in the tray 170. In moving the knife-plate the levers 159 turn until their lower edges are approximately horizontal when the tray 169 is in line with the molds of the mold-plate *k*. The tank *k*, with the mold-plate, now continues its backward movement,

while the cover-plate remains stationary, and the knife-plate and tray remain at the same level, because the lower edges of the levers 159 are horizontal. This movement continues until the parts occupy the position shown in dotted lines in Fig. 5. During this movement the types that are cast are extruded from their molds by means of the projecting ribs 72, and they slide over the tray 169 on the knife-plate until the rear ends project beyond said tray more than the forward ends. The funnel-shaped channel 151 occupies the position shown in dotted lines, and the catch-plate 152 closes the bottom of the chambers in the channel. The next movement which takes place is a slight falling of the knife-plate with its tray 169. This falling movement allows the type projecting beyond said tray to turn until either notches 73 are clear from the projections 72 below the cover-plate. The tank *k* then commences its forward movement, while the tank *l*, with the cover-plate *i*, is held stationary by the catches 174 until the mold-plate and its tank again approach their normal position under the front of the cover-plate and the knife-plate comes in front of said cover-plate. At this moment the front ends of the types being freed from the cover-plate their rear ends overbalance and they fall into the channel 151, in which they rest upon the catch-plate 152. Just before this moment the rods 175 come in contact with the enlargements 176 below the catches 174 and raise said catches clear of the studs 173, thus freeing the tank *l* and the cover-plate. As the tank *k* moves forward farther the arms 175 then draw forward the cover-plate by pressing against the studs or projections 173. The knife-plate is raised to the position shown in full lines in Fig. 5, and all the parts are returned to their front position. (Shown in full lines.) Just before this position is reached the catch-plate 152 is pressed back by the projecting rods 154, and the newly-cast types standing in the channel 151 are allowed to drop into the magazine. The strip 195 has already been withdrawn from this magazine by the return movement of the frame 197 199, as before described, and the new type takes up the position of the uppermost type in that chamber of the magazine. If this chamber is now full, the strip 195 will not pass through it on the next reciprocation of the parts, and no further types for aforesaid chamber will be cast until such are required.

Of course it is always possible that several types may be withdrawn from one chamber during the interval between the operations of the casting mechanism. In such case a new type for that chamber will be cast at each movement of the parts entering to the passage of the strip 195 through the chamber and until said chamber is filled again. The types of the most important letters are preferably cast as near as possible to the middle

of the machine, and two or more molds, channels, &c., may be devoted to each of said important types. Devices hereinafter described are provided for enabling the auxiliary chambers of the magazine containing said types to be brought into operation when the first chamber is exhausted.

Fig. 6 shows a modification in which the movements of the strips 195 are directly effected from the rods 146 without the necessity of employing the frame 197 199, &c. In this arrangement an arm 229 projects downward from each rod 146, and the lower end of said arm is bent, as shown. A pin 230, supported beneath each bracket 63 at its inner side, carries an elbow-lever 231, having a projecting tailpiece 232 with a pin 233, with which the lower ends of the arm 229 are adapted to engage, as seen in dotted lines in the figure. In this arrangement a rod 234 is mounted below the strips 195 in a slot 235, and its ends projecting from said slot are adapted to be operated by the arms 231 at each end. The rod 234 is raised and lowered in its slot 235 in order to raise and lower the strips 195 by the operation of the rods 146 and the arms 229, projecting therefrom, all the strips 195 being raised when the rods 146 move backward with the tank until the position shown in dotted lines is reached and all the strips being allowed to fall downward while the tanks are moving forward until the position of the tanks and rods shown in full lines is reached. In this arrangement the types when cast will fall onto the top of the strips in the magazine, and a fresh type will be cast on the next reciprocation owing to the projection of the strips through said magazine. When next the strips are withdrawn, the types last cast will fall down into the magazine, thus preventing the strips from passing through again, and the types then being cast in the molds will be expelled into the channel 151 and will fall thence into the top part of the magazine above the last types which are impeding the passage of the strips through the magazine. It will be seen that with this arrangement no types will be cast for any chamber until two types have been withdrawn therefrom, but that as soon as one type is cast it will always be followed by a second type, owing to the fact that the strip 195 returns to the position in which it passes through the magazine before the first new type reaches said magazine.

Sometimes it may be required to employ the machine for casting types for use in hand-composing. In such case the whole set of molds will be continuously employed at each cycle of operations of the machine and a complete set of types will be cast at each operation. For this purpose a part of the wall of the magazine is mounted on a hinge. It consists of a plate 236, hinged at 237. When in its normal position, this plate lies as is shown in dotted lines in Fig. 5. When used for

type-founding, the plate is dropped into the position shown in full lines in that figure, in which it lies flush upon the tray *o*, and its tail-piece 238 projects into the magazine, all the walls of which are cut away or notched at that point to allow of the entrance of the tail-piece. Types falling down in the chambers of the magazine are arrested by said tailpiece and ejected onto the tray, as hereinafter described. The tray is supported by brackets 239, Fig. 3, from the pillars *d e*. In the center of each chamber of the magazine behind the tray *o* a slot is formed, through which the teeth of a comb 240, Figs. 5 and 16, are adapted to pass. Each of the teeth of this comb thus corresponds to one chamber of the magazine. The comb is guided at its ends in guide-plates 241, attached to the pillars *d e*, the end pieces of the comb being formed to fit in the slot in each guide-piece. Extending between the pillars *d e* is an angle-metal shelf 242. On this shelf at two points each about a quarter of the length of the shelf from its end are mounted slides 243. Each slide has a pin 244, which passes through a slot in the bottom of the shelf and limits the movement of the slide along said shelf. On a shaft 250, which connects the two slides, two-armed levers 245 246 are mounted, one close to each slide 243. The lower arm 246 of each lever has a flanged roller 247 at its end, and these rollers can be made either to rest and work upon the upper edges of the rocking frame 214, as in Fig. 4, or they can be displaced relative to said frame by moving the slides 243 longitudinally until the rollers stand clear of the frame. This latter is the position of the parts when the machine is used in its entirety for casting, composing, and justifying, and the form of position in which the rollers work upon the frame is the position for operating the parts to expel the type upon the tray *o*. On the back of the comb 240 are two projecting pieces 248, one of which is seen in plan in Fig. 16. Between these projecting pieces extends a rod 249, and the heads of the arms 245 are threaded upon this rod. At the front of the shelf *o* and at the sides thereof are vertical walls 251. The row of type produced by the machine is required to be divided into several blocks. In the example shown it is assumed that the row of type is to be divided into four parts. To effect this division, walls 252 are provided, connected at the front and where possible also at the sides to the walls 251 of the shelf. These walls are formed into V shape at the end nearest the magazine, as seen in Fig. 16. The walls are of less depth than the type 74 and stand at a certain distance above the plate *o*. Across said plate two bars 253 254 extend, one above and one below the walls 252. These bars are connected by vertical pieces 255 in the spaces formed by the partition-walls 252. The upper bar 253 has also at each end a foot 256, which projects and engages over the

side wall 251 (see Fig. 3) in order to provide a better guidance for the rods 253 and 254. The walls 251, the partitions 252, and the bars 253 and 254 are preferably all made removable from the shelf *o*, to which they are attached by fixing the side and end walls 251 securely to said shelf by suitable means when required. A guide 257 is attached to each bracket 239 below the ends of the shelf *o*, and in said guides work vertical rods 258. Across between the tops of the rods 258 extends a rod 259. The walls 251 are slotted at each side to allow the rod 259 to fall below the tops of the types 74 until it occupies the position shown in dotted lines in Fig. 5. The bottoms 213 of the rods 210 are provided with forwardly-projecting arms 260, which are adapted to engage with the enlarged feet 261 of the rods 258. The operation of this device is as follows: Supposing the slides 243 to be placed in such a position that the rollers 247 work upon the arms of the rocking frame 214, the double-armed levers 245 246 will be rocked at each movement of said frame. Owing to the action of the arms 245 with the comb 240, said comb will also be moved forward when the arms 214 are raised. The rollers 247 are heavy enough to bring back the arms and the comb when the frame 214 falls again. At each forward movement of the comb 240 a row of types is forced outward from the magazine onto the turned-down plate 236 and in front of the bar 259, the teeth of the comb being of such a length that the type will be moved this distance at each operation. During the expulsion of a row of type the bar 259 is raised by the frame 214 and the arms 258, thus allowing the row of type to pass under it. As the comb recedes the cross-piece 259 is allowed to fall behind the row of types last forced onto the tray, thus preventing said types from falling out backward. As each row of types is pressed out it forces the rows in front of it one type width forward. It will be seen that the V-shaped walls 252 will force the type together toward the center as they are advanced upon the tray *o*, and by the time the type reach the straight part of said walls the space between them caused by the thickness of the walls on the mold-plate and in the magazine will have been eliminated and the type will stand in compact rows upon the tray. As the type advance the bars 253 and 254 serve to keep their front faces in proper alinement and prevent the type from turning, owing to the combined pressure from the rear and to the side pressure of the walls 252. As the tray becomes full the compact rows of type may be removed from the front by hand and the bars 253 254 pushed back in order to guide the further rows of type as they are produced.

If the machine is to be used again for composing and justifying, &c., after it has been used for founding type, the slides 243 must be moved until the rollers 247 are no longer

operated by the arms of the rocking frame 214, the walls of the receiving-tray must be removed, and the plate 236 turned until it again falls in the wall of the magazine.

Of course the matrices can always be altered as is required either in the arrangement shown in Fig. 10 or in that shown in Fig. 11, the latter being the one which is preferable when there is likelihood of the machine being used in the manner last described, because with this arrangement it is most easy to have a single bar upon which the matrices for all the desired types on a font are formed.

In making up lines of type it is necessary to have one or more compressible space-types in order to allow a certain amount of latitude in the length of the lines. Such compressible types may be directly cast together with the ordinary types by the use of a mold, such as is shown in Figs. 57 and 58. In this case a block 262, having a serpentine slot therein, is attached to the cover-plate of the mold for forming a compressible space-type. The serpentine slot 203 receives type-metal at its forward end in the usual manner, and it is made slightly wider at the bottom than at the top in order that the type when cast will readily fall out when the cover-plate *i* is moved away from the mold-plate, as before described. In Fig. 57, 72 is the rib under the cover-plate for forming the notch in the types, as before described.

Another method of forming compressible types is illustrated in Figs. 12 and 13. A long channel 264, preferably extending the whole length between the two pillars *d e*, as indicated in dotted lines in Fig. 1, is attached to said pillars, and its end projects beyond the pillar *d*, at which point a cross frame or box 265 is fixed. Strips of flexible metal 266 of the exact width of a type are placed side by side in the channel 264, with a spring or pressing arrangement of any suitable known type at the rear of said strips nearest the pillar *e* for pressing them forward toward the pillar *d*. The width of the track in the crossing-box 265 is such as to allow one of the thin strips to lie therein, while the others remain in the channel 264. A channel 267, similar to those in the type-magazine, is mounted in line with the magazine below the end of the cross-frame 265. It is provided with a separate detent 268, Fig. 3, exactly similar to those in the type-magazine and connected to one of the key-levers 180 by a rod 269. The operation of this detent is exactly similar to that of the detents before mentioned. At the top of the channel 267 are mounted two corrugating-wheels 270 271. Of these the wheel 270 is directly mounted by a pin 272 in the pillar *d*, and the wheel 271 is formed on the end of the shaft 93, hereinbefore mentioned. The side of the pulley 224 is provided with a projecting piece 273, having an inclined outer edge. On a bracket 274, at-

tached to the pillar *d*, is mounted a lever 275, Fig. 3. The upper part of this lever is shown in Figs. 12 and 13. The lever has a pin 276 projecting from its side and adapted to enter the channel 267 for the compressible space-types through a slot 277 formed in its wall. The lever 275 is drawn toward the channel 267 by a spiral spring 282, Fig. 3. The top of the lever 275 has a fork 278 attached to it and provided with slots in its sides. A plunger 279 of the width of one of the strips 266 is mounted to slide in the crossing-box 265, and its rod 280, which projects through a slot in the rear wall of said box, engages in the slotted fork 278 by means of pins 281. The operation of this device is as follows: We will suppose the channel 267 to be full of corrugated types. At each rotation of the shaft 93 the projection 273 presses back the lever 275, and said lever cannot come forward again because its pin 276 will strike against the edge of a corrugated type in the channel 267. Should a type be required for composing and be discharged from said channel by the detent 268, the lever 275 will be able to swing forward at the next rotation of the shaft 93 under the tension of the spring 282, because its pin 276 will now pass through the channel 267. In the forward movement a strip 266 will be pressed from the box 265 into the channel above the corrugating-wheels 270 271 by the plunger 279, which is moved forward by the lever 275. When the strip comes in position over the corrugating-wheels, it falls between the latter, which are constantly rotating, and is pressed into the form of a corrugated type in passing between them. If the channel 267 is filled by the new type, the pin 276 will strike against the latter on the next movement and no more corrugated types will be formed until they are required. The lever 275 will, however, be forced back by the projection 273, and another strip 266 will be brought forward in front of the plunger 279 ready for forming the next corrugated type.

Fig. 15 shows a modified arrangement for forming compressible types when required. In this arrangement a coil of suitable metal strip is mounted in a box 283 above the corrugated wheels 270 271, and these latter are in this case formed somewhat differently, as shown—that is to say, they are provided with corrugations over a part only of their surfaces and have at the rear of the last corrugation corresponding knife-edges 284. The box 283 is mounted on the end of the sliding arm 280 by a bar 285 and has a door 286 hinged at 288 and held by a catch 287, through which the coils of strip metal 289 are inserted. The end of the arm 285 has a slot therein through which the strip 289 is passed toward the rollers 270 271.

When a new corrugated type is required, the pin 276, Fig. 12, will enter the channel 267,

as before, and the arm 280 will slide forward the bar 285 with the coil of strip metal. The downwardly-projecting end of the strip will be caught between the rollers, corrugated thereby, and the piece so formed cut off by the knife-edges 284. The plain parts of the rollers do not engage with the strip, and this latter is moved sidewise away from the rollers, owing to the movement of the arm 280, before the corrugations come into position for operating upon it again unless a further strip is required.

There is one further device connected with the magazine remaining to be described. This is the device for bringing into operation duplicate columns of types or for releasing block-types in the place of types of exhausted letters, which block-types must be afterward replaced in their lines by the proper letter-types. The use of block-types of one standard size in this manner in place of exhausted letter-types is well known in type composition; but the novelty here consists in the mechanism whereby block-types of the exact thickness required are automatically released when the letter-types in any column of the magazine are exhausted. Figs. 12, 13, and 14 show the arrangement.

The types used in printing are of varying thicknesses or grades, according to the width of the letters required. In the drawings it is assumed that there are only two grades; but the devices illustrated can obviously be duplicated or triplicated, according to the number of grades, as may be required. Certain of the molds of the magazine are arranged to cast block-types of the required thicknesses. The channel for such a block-type is seen at the top of Fig. 12, the channel shown below with the ordinary detent being broken away above said detent. A rod 291 is fixed at the rear of the magazine between the pillars *d* and *e*. On this rod, behind each block-type channel in the magazine, is pivoted a detent 290, substantially similar to the detent 190, but adapted to be operated by a projection 293 at the rear of its pivoted point on the rod 291. Three guide-bars 292 294 295 are also mounted between the pillars *d* and *e*. Through the guide-bar 294 pass rods 296, each of which is connected to one of the projections 293 of the detent 290 and is bent inward toward the magazine at its lower end. The inwardly-bent ends of the rods 296 are attached to rods 297, which extend completely across the magazine and are guided in slots 299 in the pillars *d* and *e* at their ends. One rod, 297, is nearer to the magazine than the other, and the rods 296 for operating the detents are connected, respectively, to the rods 297 nearer or farther from the magazine, according as they operate upon channels containing thicker or thinner grades of block-type. Guided in the cross-piece 292 are a series of pins 298. Any type in the maga-

zine having a letter of one of the two grades has the pin 298 near the magazine, while the types of the other grades have their pins farther away from the magazine, as seen in Figs. 12 and 14. The tops of all the pins 298 are adapted to bear, respectively, on the under sides of the rods 297, which extend across the magazine and are connected to the rods 296, which operate the detents 290, as described above. The rod 300 extends across the front of the magazine between the two brackets 239. On this rod a strip of metal 301 is pivoted opposite to all the chambers of the magazine, the detents 190 of which are under the direct control of keys 179. Each strip 301 is counterbalanced at the rear by a weight 302. The rod 300, the strips, and counterweights are all inclosed in a box 608, Fig. 3. The walls of the magazine opposite to the strips are slotted to allow the ends of said strips to pass therethrough if there are no types in the magazine to impede this movement. In the guide-piece 295 is mounted a double-headed pin 303 behind each common type-chamber of the magazine. This pin is adapted to be raised by the arm 185 whenever the three-armed lever 185 186 187 is rocked in depressing a key to release a type. Now supposing one of the channels of the magazine to be exhausted of types, the end of its strip 301 will pass through the lowest space in the channel when the last type is released and will occupy the position shown in dotted lines in Fig. 12. The next time that a type is required from the exhausted chamber of the magazine the strip will be pressed upward by the pin 303, which is raised when the key-lever 179 corresponding to the required type is operated. The projecting end of the strip will raise the pin 298 opposite to that chamber of the magazine and according as the pin is in the first or second row the first or second of the cross-bars 297 will be raised, and a block-type of one or other thickness or grade will be automatically released from its channel by its particular detent 290. The block-types so released will pass onto the band and will be composed in place of the letter-type, and it must be replaced subsequently by the proper type.

When a new letter-type is formed for the exhausted channel, it will press back the strip 301 in falling to the bottom of that channel, and this mechanism will be automatically thrown out of operation for that particular type.

In some cases, where letters are very frequently used, duplicate columns of such letters may be provided in the magazine. For bringing into operation these duplicate columns when the original column is exhausted of types a somewhat similar arrangement to the block-type mechanism is used. The duplicate column has no operating-key or three-armed lever to it, but has a detent 304, Figs. 13 and 14, exactly like detent 190, except that

its operating-pin 191 is omitted and a cranked projection 305 provided instead. This cranked projection overlies the rear of the ordinary type-channel, as seen in Fig. 14, and this channel instead of having a strip 301 has a somewhat longer strip 306 of similar construction.

Supposing the type in the principal channel to be exhausted, the strip 306 will project through said channel and will operate upon the cranked projection 305 when the pin 303 rises. By this means the detent 304 of the duplicate type-column will be turned and a type automatically released therefrom. The casting of types for the duplicate columns and all other operations connected therewith take place exactly in the same manner as has been already described for the ordinary type-columns.

Below the band *g* in the arrangement shown in Fig. 1 are a series of exposed pigeonhole-boxes 307. These serve for the storing of types of uncommon letters or signs which are not so frequently required as to make it worth while to cast them in this machine.

Figs. 19^a and 19^b show two suggested modified arrangements of the feeding-belt *g* and apparatus connected therewith. In Fig. 19^a it is assumed that the whole of the right-hand part of the machine is moved through half its length toward the left and two bands *g* are provided instead of one, said bands converging toward the center. This arrangement will only require modifications in certain mechanical details not affecting the subject-matter of the invention.

Fig. 19^b shows an arrangement in which the band *g* runs horizontally. In this case the type-magazine channels are of varying lengths, those toward the right-hand end of the magazine *n* being longer than the others, and consequently being capable of holding a larger number of types. The detents in this case would of course be arranged on an inclined line instead of being horizontal; but this would only necessitate the employment of rods 188 of varying lengths, and the other parts of the apparatus would remain substantially the same, the details of construction being in this case also such as could be worked out by any competent mechanic from the description hereinbefore given. This last-mentioned arrangement has a considerable advantage in the provision of longer chambers at one end of the magazine, whereby greater numbers of the more important types can be kept in store at one time without inconvenience.

308, Figs. 1 and 3, is a copy-holder of suitable construction for holding the material to be set up in type, the matter being read a line at a time through the slot 309 in the front of the copy-holder. This detail is not further described here, as it forms no part of the present invention, although it is part of this in-

vention to apply a copy-holder in this convenient position to the front of the machine described herein.

At the left-hand end of the apparatus in line with the top of the band *q* is a discharge-chute 310, Fig. 1, from which the type fed by the band *q* or discharged from the corrugated type-channel 267 are directed into the type-packer *r* for composing.

The apparatus actuated by the shaft 31 has been described in connection with each mechanism which it operates. The shaft 31 is itself driven by a belt from any suitable source of power. (Not shown.) The shaft carries fast and loose pulleys 11 13, respectively, Figs. 2 and 4. A shaft 14, pivoted in the front wall of the machine near the bottom thereof, carries an arm 19, with a fork 32 on the upper end thereof adapted to engage with the belt, as seen in Fig. 4. On the front end of the shaft 14 is a finger-lever 42.

When the machine is running, the parts stand in the position shown; but when it is required to stop the machine the arm 42 is depressed, whereby the belt is shifted to the loose pulley 13 and the machine is stopped.

The composing-frame *s* and the justifying-frame *t* stand on the left-hand side of the base *a*. These frames consist of vertical rectangular walls, 324 in the front, 325 at the back, and 313 314 at the ends. The frame is divided into two parts by the central division-block 312, Figs. 25 and 26. The two end walls 313 314 of the frames *s t* and the division-block 312 are provided near the top with horizontal slots 315, extending from back to front. The division-block 312 is also slotted in its front and rear surfaces, as seen in the sections, to allow of the passage past said block of the pins 334 and 321 and the rollers 336 upon the sides of the sticks, as hereinafter described. There are, as before mentioned, two sticks *u v*. Each of these consists of a frame, Figs. 22, 23, and 24, having a solid bottom bar 316, with two end pieces 317 318 and inwardly-projecting webs 319 on each piece 317 318. In the end piece 317 is a vertical slot in which is fitted a bolt 320. This bolt has a pin 321, which projects through a slot 322 in the front of the end piece 317, as seen at the left-hand side of Fig. 22. The pin 321 projects into a slot 323 in the front walls 324 of the composing and justifying frames, as seen in dotted lines in Fig. 21. The said slot rises from the right-hand end for a short distance and then runs horizontally along the front wall. Each of the end pieces 317 318 has a projection 326, which fits in the slots 315. Each stick has two side walls 327 328, one fitting in the front and one in the rear part thereof, so as to lie flush with the sides of the frame 316 317 318 and to rest against the webs 319. The plates 327 at the front and 328 at the rear are joined by a solid bottom bar 329, which lies between the two

webs 319 and to which the front plate 327 is fixed by countersunk screws 331, which enable said plate to be adjusted slightly in its distance from the plate 328. The plate 327 is slightly higher than 328, as seen in Figs. 23 and 24. Between the two webs 319 at the top extends a bar 330, which is about half the width of the space between the plates 327 and 328. Over the bar 330 fits a sliding piece 332, hereinafter called the "line-rod." This is shown separately in Fig. 33, and the part of the stick with its two walls and the top bar 330 appears in Fig. 34. It will be seen that the foot 333 of the line-rod will fit between the walls 327 328 and will slide longitudinally over the bar 330. On the bar 330 also fits the stop 558 of similar section to the foot 333, as seen in Fig. 33^a. Through the top part of the stop works a set-screw 559, by means of which the stop can be clamped in any required position on the bar 330. A pin 334 projects through the bottom bar 316 of each stick from back to front, and a horizontal slot 335 is formed in the front wall 324 for said pin to pass through. The rear wall 325 is also slotted at 335 in the same manner, Figs. 23 and 24. On each side of the stick are rollers 336, mounted on a pin passing through the plates 327 328 and the bar 329. In the front wall 324 a horizontal slot 337 is formed from the middle of the frame *s* to the middle of the frame *t*, as seen in dotted lines in Fig. 21, and at its end in the frame *t* is a vertical slot 338. The rear wall has a slot 339, Figs. 21 and 26, which runs in an incline from the level of the bottom of slot 338 up to the level of the slot 337 at the right-hand end. The wall 325 is cut back for half its depth and over a large part of its surface, as shown in Figs. 24, 25, and 26, and a plate 340 fits in the cut-out part and is shaped at its left-hand upper edge to form the lower wall of the slot 339, the upper wall of which in the frame *s* is formed by the full thickness of the wall 325. A slight depression 560 is formed at the top of the inclined edge of the wall 339. The plate 340 will thus lie flush with the back wall 325 and complete the slot 339. The plate 340 is mounted on the tops of the arms 341 342 of a forked arm 343, which lies in slots in the base-plate *a*, so that its upper edge is flush with said plate, as seen in dotted lines in Fig. 26 and in side view in Fig. 24. In the justifying-frame a somewhat similar fork 344 is arranged. Across between the ends of the arms 345 346 a channel-piece formed of two walls 347 348 is fixed, Fig. 23. The fork 344 345 346 also lies in a recess in the base *a*, as seen in Figs. 23 and 26. The rear wall 325 and the front wall 324 in the frame *t* is cut back slightly, as shown in Fig. 23, in order to allow the channel-pieces 347 348 to lie with their inner faces flush with said walls when required. The slot 335 in the rear wall is carried through the plate 340, also as shown in Figs. 24 and 26, in order that the pin 334

might pass completely through it. On the base *a* lies a U-shaped frame 311, the front and rear arms of which lie close to the front and rear walls 324 325, respectively, of the composing and justifying frames. The top of said U-piece is on a level with the bottom of the slots 335, through which the pins 334 project. On the front arm of the frame 311 a rocking catch 349 is mounted in a slot 350, Figs. 21 and 25, in which it is pivoted by a pin 351. The corresponding end to the rear arm of the frame 311 has a fixed projection 352 thereon. At the rear of the frames *s* *t* are mounted two shaft 353 and 354, supported in standards 355 356 and 357 and 358, respectively. Two shafts stand at right angles to one another on the same level and are geared together by bevel-wheels 359 477. On the shaft 354, near the front thereof, is a disk 360, provided with a cam-groove in the front thereof, as seen in Fig. 4. The shaft 354 may be driven in several different ways, as will be hereinafter described. Mounted in guides 361 in the cover-plate 9 above the key-levers is a slide 362. At its right-hand end this slide has a slotted head 363, Fig. 4, and at its left-hand end it has a depending arm 364, which engages with the rear arm of the U-shaped piece 311 by a pin 365, Fig. 25. Between the rail 182, which supports the type-magazine, and a bracket 366, attached to the pillar *b*, is a strong shaft 367, upon which is mounted a sleeve 368. From this sleeve at one point an arm 369 projects downward and engages in the slotted part 363 on the slide 362. At another point on the sleeve two short arms 370 project at right angles to the arm 369. The ends of the arms 370 are slotted and between them lies a shaft 371, mounted to slide vertically in two brackets 372 373, connected to the pillar *b*. The top of the shaft 371 engages in the slots of the arms 370 by means of a pin 374, Fig. 4. On the base *a*, near the cam-disk 360, is fixed a pillar 357, to the top of which is pivoted a lever 376, having a forked end 377, which engages with a pin on the lower end of the rod 371. The lever 376 has a pin 379 thereon, which engages in the groove in the cam-disk 360. At each rotation of the shaft 354, as hereinafter described, the lever 376 is once depressed and subsequently raised again, owing to the engagement of pin 379 in the groove in the cam-disk 360, and by this motion the sleeve 368 is turned until the arms thereon occupy the position shown in dotted lines in Fig. 4 and is then brought back to the position shown in full lines. The frame 311, connected to the slide 362, is by this means drawn once to the right along the base under the key-levers and pressed back again to the position shown in Fig. 4. Each of the U-shaped frames 343 344, which lie in the bottoms of the composing and justifying frames, respectively, is moved backward and for-

ward by cams on the shaft 353. The plan view, Fig. 20, and the sectional elevation of the justifying-block, Fig. 35, will explain the action, which is exactly similar for each of the frames, although the movements of said frames take place at different periods. Two substantial posts 380 381 are mounted by feet 382 383, respectively, on the base *a*. From brackets 384 385, projecting, respectively, from these pillars, near the tops thereof, are hung arms 386 387. These arms have rollers 388 389, engaging in grooves in groove-cams 390 391, mounted on the shaft 353. The lower ends of the arms 386 387 project through slots 392 393 in the arms 343 344, respectively, of the stick-shifting forks. By this arrangement when the shaft 353 rotates the arms 386 387 are drawn backward and forward at predetermined intervals, thus moving the forks 343 344 backward and forward.

Referring now again to the apparatus which directly deals with the type as they are fed down the chute 310, on the end wall 313 of the composing-frame is mounted a casing 394, containing the type-packer *r*. This consists in the example shown of a block having two curved arms fixed on a shaft 395, journaled in the walls of the casing and supported beyond the latter in a block 396, fixed on the wall 313. Beyond said block the shaft 395 carries a cylindrical groove-cam 397 and a pulley 398, by which the shaft is continuously driven by a band 399, passed over a pulley 400 on the shaft 222, which carries the lower wheel 220 of the feeding-band *a*. A bolt 401 is mounted to slide in two small bent brackets 402 on the end wall 313. One end of this bolt has a pin 623, Fig. 3, which projects into the groove of the cam 397. The other end of the bolt passes through a slot in the casing of the packer *r*. During the rotation of the shaft 395 the arms of the packer pass in turn under the end of the chute 310 and press any type that would fall down said chute over to the left into the stick, as is hereinafter described. Immediately the arm of the packer passes the end of the bolt 401 this latter is brought forward by the groove-cam 397 and holds the type so fed forward until another type arrives. On top of the front wall 324 of the composing-stick a channel 403 is fixed, as seen in Figs. 24, 28, and 32. In this channel a block 404 is mounted to slide longitudinally, and to said block is attached a band 405, which is wound round a drum 406. The drum 406 is supported by a shaft 407 on a bracket 408, Fig. 21, on the end wall 313 of the frame *s* and is provided with a coiled spring in any known manner, which will always tend to rotate the drum in such a sense that the band 405 will tend to be wound up thereon. On the top of the sliding block 404 is fixed a box 409, having a passage therethrough, in which a bolt 410 is free to slide crosswise to the channel 403.

The movements of the bolt 410 are limited by a pin 411, projecting through a slot 412 in the top of the box 409. The front wall 327 of each stick *u v* has a slot 413 therein, through which the bolt 410 is adapted to project over the space in the stick. 414 is a plate attached to the front wall 324 of the composing-frame beyond the end of the channel 403 by means of a bent-down portion 415. In the top of the plate 414 is a slot 416, Fig. 20, through which the pin 411 is adapted to travel when the block 404 is moved along the channel 403 under the plate 414. Pivoted on a lug 417 on the wall 324 is a rod 418. This rod has a pin 419 thereon, which projects through a hole in the wall 324 of the frame *s* directly in the end of the channel 337, Fig. 24. The farther end of the arm 418, which is formed by springy material, is bent upward, as seen in Fig. 21, and it engages with the box 409 when this latter reaches its farthest position and prevents it from returning for a certain time, as will be hereinafter described. A strong rail 420 of rectangular section and of the shape shown in Fig. 21 is attached at one end to the division-block 312, as seen in the plan, Fig. 20, and at the other end is attached to the pillar *d*. Near the left-hand end of this rail the indicator *w* is mounted by means of a sleeve 421, fixed by a set-screw 422, Figs. 31 and 32. At the rear of the plate *w* of the indicator a bell 423 is fixed by a screw-pin 424, and on the rear of the sleeve a striker 425 is pivoted by means of a pin 426. A pointer 427 is mounted on a pin 428 at the base of the sector-shaped plate *w* and is adapted to be turned, together with said pin, by an arm 429, projecting outward and downward. The line-rod 332 has pivoted at 431, on the top thereof, a catch 430. This catch is normally held in the position shown in Fig. 33 by a spring 432 and a stop 433. The upper edge of the front plate 327 of the stick is beveled, as seen in Figs. 31 and 32, and divided into a scale, according to the unit-divisions in use by compositors in the locality where the machine is to be employed.

The make-up-type-inserting device consists of the following parts: Two bars 434 and 435 extend horizontally one above the other over the top of the composing-frame, Figs. 27 and 28, and their ends are connected to the division-block 312 and the end wall 313 of the frame *s*, respectively. Upon these rods are hinged two pairs of arms 436 of equal length. To one pair of arms a plate 437 is attached and to the other pair a plate 438, the points of attachment on the plates being such that when said plates are raised a parallel movement of the arms 437 will keep said plates vertical and away from the composing-stick. At the rear of each of the lower arms 436 is a projection 439. Each plate 437 is notched at its front edge in order that when in the position shown in Fig. 28 the top part of the

plate may engage over the beveled upper edge of the stick-plate 327. The plate 437 is cut off close above the connection-point of its upper arm 436, as seen in Fig. 30; but the plate 438 projects considerably above this point. Two brackets 440 are mounted on the back wall 325 of the frame *s*, and each of said brackets carries a rectangular frame 441 in lugs 442 and a second frame 443 at the top of said pillars. Hinged on a lug 444 at the back of the wall 325 near the middle of the frame *s* is an arm 445, having a V-shaped point 446, bent under the top bar of the frame 441, as seen in Fig. 28. The lower bar of the frame 441 lies above the tailpieces 439 of the arms 436 in its normal position. (Seen in Fig. 28.) Pivoted on a pin 447 on the base *a* below the frame *s* is a tube 448 and projecting at an angle therefrom a finger-lever 449. In the tube 448 slides a rod 450, having a collar 452 at its end, and a spring 451 in the tube pressing upon said collar tends to draw the rod 450 inward toward the pivot 447. Through the top of the rod 450 passes a pin 453, having an arm 610 projecting from its rear end, and upon the pin 453 above the frame *s* is hinged a box 454. This box has a broad foot 455 at its rear side, which engages over the rail 420. The box 454 is capable of sliding along the rail, upon which it is guided by said foot. In the end position of the frame 448 (shown in dotted lines in Fig. 21) the box 454 forms part of the channel or chute 310, leading to the type-packer *r*. Attached by an arm 456 to the front of the box 454 is a tube 457, having a spring 458 therein, which tends to press upward a block 459, fitting in the tube. The tube is slotted at the front and rear from its upper end downward, as indicated in Fig. 28, and upon the block 459 is hinged a plunger 460, having a large head 461 and an arm 462, projecting at right angles over the box 454. The arm 462 projects through a slot in the front wall of the box 454 and has at its end a cross-plate 463, constituting a plunger, Fig. 29. Pivoted in lugs 464 at the side of the box is a catch 465. The outer arm of this catch is pulled toward the box by a spring 466, and its inner arm carries a springy tongue 467 within the box. In the position shown in Figs. 1 and 21 by dotted lines, in which the box 454 forms a continuation of the channel 310, the tailpiece of the catch 465 is pressed upward by a block 468, whereby the catch will be turned so that its spring 467 lies in a recess 469 in the wall of the box 454, and thus leaves the box open for the passage of type therethrough. When the box is in this latter position, the plunger 460 is turned back until it occupies the position shown in dotted lines, Fig. 28, in order that the arm 462 may be brought out from the box 454.

At the top of the casing 394 of the type-packer is a pin 470, which may be pressed into

the bottom of the channel 310 or drawn out therefrom, as is required.

On a shaft 471, passing through the base *a* below the composing-frame, is a lever 472, which sets into operation the stick-shifting and the justifying and other mechanisms, as will be hereinafter described. On the base near the end of the lever 472 is pivoted a small bell-crank lever 473, Fig. 3, the forwardly-projecting arm of which is adapted to be depressed when the lever 472 is depressed. The right-hand end of the groove 323 in the wall 324 ends in a rectangular recess in which a sliding plate 474 is mounted, Fig. 21. From this plate a pin 475, Fig. 3, projects outward through the wall 324 and is adapted to be raised by the second arm of the bell-cranked lever 473. In the sliding plate 474 is formed a slot which constitutes the endwise continuation of the groove 323, as seen in dotted lines in Fig. 21, and it is into this slot in the bottom of the groove that the pin 321 enters when the stick is brought forward in the frame *s*, as described hereinafter. The plate 474 is guided in its movement by a set-screw 476, passing through a slot in said plate.

On a post 478, mounted on the edge of the channel 403 near the right-hand end, and a post 479, mounted upon a plate 414 at the left-hand end of the frame *s*, is a frame 480, carrying a long plate 481, formed as a mirror on its lower surface. This plate is omitted in the plan view Fig. 20, but is seen in one position in Fig. 28 and in another position in Fig. 32, while it appears as seen from the front in Fig. 21. The frame 480 is capable of turning on the posts 478 479, and in the position shown in Fig. 32 its under surface reflects the image of the line of types in the composing-stick, so that, as seen from the front by the operator, the types appear as letters in the correct order of reading. The operator can thus more readily detect and correct mistakes. When the make-up-type mechanism is in use, the frame 480 is turned into the position shown in Fig. 28, in which it and the mirror are clear of the box 454 and the arms of the make-up-type mechanism generally.

The justifying-frame *t* stands at the left-hand side in direct continuation of the frame *s*. On a bracket 482, fixed on the end wall 314 of the frame *t*, is pivoted a strong lever 483, to the rear end of which is connected by a rod 484, passing through slots in pillars 485 and 375, and having on its further end a roller 486, which engages in a cam-groove formed in the rear surface of the cam-disk 360. A strong bracket or slide 487 is fixed under the front end of the lever 483 to the wall 314. The end of the lever has a depending arm 488, projecting in front of the bracket 487. In a sleeve 489 on the wall 324 is mounted a sliding rod 490, Figs. 21, 23, and 25. A spring 492, pressing on a collar 491 on the

rod and at the other end pressing against the sleeve 489, tends to move the rod to the left and to keep it pressed against the projecting piece 488, with which it is in line. An arm 493 is pivoted on a bracket 494 on the wall 324, and its upper end is bent to the right and then directly backward and is passed through a hole in the front wall 324, as seen in Fig. 23. Its inner end lies in the slot 338 on a level with the bottom of the slot 337. The right-hand end of the rod 490 is provided with an incline 495, which engages behind the vertical part of the arm 493. A spring-tongue 496 tends to press the arm 493 inward toward the wall 324 and against the incline 495. A block 497, with a slot through the center, is mounted to slide on the bracket 487. The end of the lever 483 is provided with a slot corresponding to that in the block 497. A strong bar 498, suitably graduated on its face, fits in the slots in the arm 483 and the block 497 and may be fixed in any desired position in the latter by a set-screw 499.

A strong horizontal rod 500, having a downwardly-projecting end 616, is arranged to slide in brackets 501 on the end of the box *y*, which carries the line-binders or lead-rules, as hereinafter described. A spring 502, engaging with a collar 503 on the rod, tends to press it rearwardly. A roller 504 on the rear end of the rod rolls upon the surface of a cam 505, mounted near the center of the shaft 353. When in its forward position, the end 616 of the rod 500 projects behind the rear end of the stick, which lies in the justifying-frame *t* and supports the line while under compression, as described hereinafter.

The box *y*, which contains the binding-strips or lead-rules for backing the type-lines, is mounted on two pillars 506, whereby it is held above the justifying-frame, as seen in Fig. 35. The box *y* has an opening 561 at its front edge of the form, (seen in Fig. 35,) a slot being cut in the bottom of the box and a recess formed at the bottom of its front wall for forming said opening. The galley *z* projects horizontally from the top of the front wall of the frame *t*. Strong rods or angle-plates 507 508 are adapted to be fixed by clamps 509 510 to the rear wall of the box *y* and the front wall of the galley *z*, respectively, by means of set-screws 511 and 512, the latter of which passes through a slot 513 in the front wall of the galley, Fig. 21. The rods 507 and 508 serve to cut off from said box and galley lengths corresponding to the lines of type which are being composed, as seen in Fig. 20.

When types are to be bound together or backed by line-binders of the special construction about to be described, they are cast with slots 562 extending into their bases, as seen in Fig. 41, and have slightly-rounded corners to the part at the rear side of said slot. Fig. 8 shows how this formation is produced. The end of the spout *g* is provided with a projec-

tion 514 of the shape required, which makes the slot in the type during casting. This projection is deeper and narrower than that (620) which forms the notch in the bases of ordinary types, and the passage 48 in the spout preferably opens below it, as shown. A separate type 74, formed with the slot, is seen in Fig. 41. It may here be mentioned that the bottoms of the strips 266, which form compressible types, should be slotted if line-binders are to be employed in order that the compressible types may not interfere with the engagement of the line-binders in a line of types. Part of a line-binder 515 is shown separately in Fig. 42. It consists of a plate bent into hook form at the top and bottom, the top edge having been previously notched, however, in order that recesses 516 may be formed, between which the remaining portions 517 are bent inward at an angle onto the upright part of the strip. The line-binders 515 are stored one behind another in the box *y*, Fig. 35, in which figure, however, only two are shown. On the end of a rod 519, sliding through the back wall of the box *y*, is a plunger-bar 518, adapted to lie against the rear of the line-binders. The rod 519 is bent to the right at its rear end, as seen in Fig. 20, and an arm 520, pivoted on a support 521 and pulled forward by a tension-spring 522, presses against the rear end of said rod and forces it forward, together with the plunger-bar 518. By this means the binding-plates are kept fed toward the front of the box *y*. Mounted in a bracket 523, below the box *y*, is a rod 524, bent, as shown in Fig. 35, and passed through a bracket 525 on the pillar 381. The rear end of this rod carries a roller 526, which engages in a slot in a groove cam-disk 627, Figs. 19^c, 20, and 35, mounted on the shaft 353. The forward end of the rod 524 carries a cross-piece 527, to which it is connected by a shoulder 528 on the end of the rod. The cross-piece 527 extends completely across the lower surface of the box *y*, and it is provided below with a dovetailed or undercut slot 529. L-shaped plates 530, having dovetailed heads adapted to fit in the slot 529, are slid into said slot from one end. Each plate 530 is preferably of unit-type width or grade, and a number of said plates are placed in position under the cross-piece 527 until an L-shaped bar of the length of the type-line required is built up. At each end of the cross-piece 527 just beyond the ends of the box *y* is a forwardly-projecting rod 531, which is bent upward, as seen in Figs. 35 to 38, in order to form a notch 609, in which the bar 550, described below, lies in one position of the apparatus. The upper edge of this rod is beveled at the front, as seen in Fig. 35. A plate 532 works in vertical slots 533 in the end walls of the galley *z*. It is notched from below at two points 563, and the beveled rods 531 project through said notches. A pusher 534 is mounted to slide

over the front wall of the box *y* and is guided vertically by means of slots 535 in the ends of said box, Fig. 20. An arm 536, pivoted on the top of the pillar 381, passes through a lug 537 on the top of said plate. The front wall of the box *y* is slotted at 538 to allow of the downward movement of the end of the arm 536, as seen in Fig. 21. The rear end of the arm 536 carries a roller 539, which works on the edge of the disk 391. This disk has a cam projection 540 thereon, whereby the roller 539 is raised during the rotation of the shaft 353. The part of the arm 536 behind the pillar 381 is made to overbalance the forward part by forming it of thicker metal or any other suitable means in order to keep the roller 539 in operation on the edge of the disk 391.

A pillar 541 stands on the base *a* at the rear of the cam-disk 627 and carries at its upper end an arm 542, pivoted at 543. This arm has a roller 544, which works on the edge of the disk 627, this disk being also formed as a cam on its edge, as seen in Fig. 35. The forward end of the arm 542 passes through a lug 545, below which a bar 546 extends across the box *y* above the same. The bar 546 has pieces 547 extending vertically downward at its ends and passing through lugs 548 on the ends of the box *y*. The end pieces 547 are bent forward at their lower ends and formed with slots 549. A bar 550 of about half the width of these slots is adapted to lie across between them and is drawn toward the rear of said slots by tension-springs 564, attached to the end pieces 547 and the ends of the bar 550, as seen in the detailed views Figs. 36 and 38. The bar 550 is shown separately in Fig. 40. Its edge is provided with inclined surfaces 551 and rectangular projections 552, as will be seen in said figure, the object of the projections and inclines being to enable the bar to hold a binding-plate 515 falling upon it—that is to say, the projections 552 will engage in the spaces between the parts 517 of the binder.

Fig. 39 illustrates a modification in which two or more of the L-shaped plates 530 are provided with bolts 553, sliding through sleeves 554, fixed beneath the forward end of the L and drawn forward by means of a tension-spring 555, attached at one end to the sleeve and at the other end to a collar 556 on the bolt. The object of the bolts is to support lead rules 557, Fig. 39, if such are used for backing the lines in place of the binders mentioned above. In the frame *s* two spring-catches 615 are provided to support the stick when at the front of said frame and after the wall 340 has receded from it, as hereinafter described. The wall 340 is provided with notches 617 at each side to allow of the passage of said catches. The right-hand part of the apparatus is closed to the front below the keyboard by a plate 607. In this plate is a slot 606, which allows the U-shaped frame 311 freedom for movement.

The operations of the composing, justifying, line-binding, and other mechanisms connected with the frames *s t* are as follows: When a line is being composed, one of the sticks *u* stands at the front of the frame *s* in line with the packer *r* and is held there by the catches 615. Its line-rod 332 is at the end of the stick *u* close to the packer, and it is pressed toward the packer from the rear by the bolt 410, which latter, it will be remembered, is pulled toward the right by a spring-drum and band connected to the slide-block 403. The two plates 437 438 also occupy the position shown in dotted lines in Fig. 28, in which they are held by the pressure of the frame 441, which stands in its lowest position. The plates are in contact with one another and are slid along their bars 434 435 to a position directly behind the end of the stick close to the packer *r*. As the type fall down the chute 310 they are pressed into the space formed between the side plates 327 328 of the stick against the spring-pressure on the line-rod 332, and this latter is moved along in steps as each additional type is packed into the stick. The type stand in a row on the longitudinal rail 330 of the stick. One or more compressible types are preferably inserted in the line in place of solid block-types, and the line is composed a little longer than the final length required.

In composing a line by hand one or more considerable spaces are usually left at suitable points in order that the length of the line may be subsequently readjusted to bring it to the required length with a word or syllable properly terminating at its end. The make-up-type-inserting mechanism is designed, in conjunction with the indicator *w*, to quickly and conveniently effect this adjustment. When starting to work, the indicator is adjusted on the rail 420, so that when the required length of types is composed in the stick the arm 429 of said indicator, which engages with the notched part of the catch 430 on the line-rod 332, will point to zero on the indicator-scale. The stop 558 must also be so fixed on the bar 330 that the line-rod 332 is blocked at this moment. During the composing the plates 437 438 are allowed to drop into the line at some convenient point—after a full stop, for example. This is effected by pushing back the arm 445 until its head 446 releases the frame 441, allowing this frame to rise and the plates 437 438 to fall. The frame is held in this position (shown in Fig. 28) by the head 446. The plates 437 438 then being in the line on the stick, as more types are fed into the line the plates, engaging by their notched front edges over the bevel edge of the front of the plate 327 of the stick, slide along the latter with the types, while their downwardly-projecting points lie between the types in the line. Shortly before the line is made up to its predetermined length the striker-arm 425 is tripped by the catch 430 on the line-rod

and the bell is struck. This may be timed to take place at any desired moment by the suitable bending of the stem 425; but it preferably takes place when the binder 427 indicates "5" on the scale and its arm 429 is just in contact with the projecting end of the catch 430. According then to the next syllables or words which are to be composed the operator determines how many more types he will feed into the stick, and he may find it necessary to end the line when one, two, or more spaces remain to be filled. The graduations on the side of the wall 327 will roughly show the spaces required, and the pointer 427 will show these more accurately. Of course any suitable divisions may be marked on the indicator *w*. During the period of composing the line the box 454 has formed part of the chute 310. The operator now, however, presses in the pin 470, whereby any types which he feeds will be stopped in the box 454. He then operates the keys to release block-types, which will fill up as accurately as possible the space remaining to be filled, allowance having been made already when adjusting the stop 558 for the thickness of the plates 437 438, which are of course a constant quantity. When the required block-types are in the box 454, the operator depresses the arm 449 and the box is swung out from its normal position and slid along the bar 420 until its lower edge strikes the projecting edge of the plate 438. By striking said plate the box forces it along with the type behind it until the movement is stopped by the line-rod 332 being blocked against the stop 558. A gap is thus created in the line the width of which will correspond with the required thickness of block-types to be inserted. When the box 454 commences to move, the rear arm of the catch 465 slides off the block 468 and the spring 466 turns the catch so that its end 467 presses against the types and prevents them from falling downward out of the box. The box is now over the space created between the plates 437 438 in the line—for instance, in the position shown in Fig. 27 and by full lines in Fig. 21—the plunger 460 being turned upward, so that its arm, with the piece 463, lies in the top of the box 454. The head 461 is now pressed down by hand against the resistance of the spring 458 and the type are pressed out from the box by the cross-piece 463. During the depression of the plunger 460 its head 461 presses upon the frame 443, forcing the latter downward, and with it the frame 441, upon which it presses, the catch-piece 446 being forced back, owing to the beveling of its point. The frame 441 bears upon the tailpieces 439 of the arms carrying the plates 437 438, and said plates are raised simultaneously with the movement which forces out the block-types from the box 454. The positions and proportions of the parts are preferably made such that the plates 437 438 are not raised until the block-types

are well down in the line. On releasing the plunger 460 it rises and may be turned back again into the position indicated by dotted lines in Fig. 28. The arm 449 may now be released and the arm 448 swung back, whereby the box 454 is slid along the bar 420 until it again comes into position in the chute 310. During this movement the arm 610 will press against the plate 438 in its raised position, and thereby draw back the plates 437 438 to the right-hand end of the frame ready for composing in the next type-line. The catch 465 will be thrown out of operation as before, and as soon as the pin 470 is drawn back the type may be fed to the packer in ordinary course. During the filling of the line the mirror-plate 481 will have been in the position shown in Fig. 32; but during the operation of the make-up-type mechanism the mirror-plate will have been turned back, with its frame, into the position shown in Fig. 28. The stick *u* being now filled as nearly as possible to the desired length with types which stand on the bar 330 between the walls 327 328, it is required to shift the stick *u* into the justifying-frame *t*. The other stick *v* will at this period be lying at the back of the frame *s*, as will be explained hereinafter, and the forked frame 344 345 346, with its channel-piece 347 348, will be in the front of the frame *t*. The finger-lever 472 is now depressed, whereby the shafts 353 354 are set in motion for one revolution, as will be hereinafter described. The first movement of the lever 472 causes the rocking of the bell-cranked lever 473, whereby the plate 474, with the bolt 320, will be raised a short distance, and said bolt will project behind the last type in the stick *u*. As the shafts rotate the frame 311 on the base will be moved from its right-hand limiting position into the extreme left-hand position (shown in Figs. 21 and 25) by the action of the cam 360 on the arm 376, the rocking of the lever 369, and the sliding of the bar 362, connected to said frame 311. In its movement from right to left the catch 349 on the front arm of the frame will engage with the pin 334 of the stick *u* and will thereby force the stick from the frame *s* to the frame *t*. During this movement certain other actions take place. First, the roller 336 on the front of the stick travels along the horizontal slot 337 and finally comes to rest on top of the inwardly-projecting end of the arm 493 over the vertical slot 338 in the wall of the frame *t*. Secondly, the pin 321, sliding in the slot 323, will raise the bolt 320 until the top of said bolt is on a level with the tops of the type, as seen at the left-hand part of Fig. 22. Thirdly, the bolt 410, which presses by spring-pressure against the end of the line-rod 332, will be moved a short distance to the left during the travel of the stick, but will be withdrawn from the line-rod owing to the engagement of its pin 411 in the slot 416 of the plate 414. The pin 419 of the

spring-rod 418 will have dropped into the space vacated by the front roller 336 immediately after the stick began to move, and its end will have moved inward from the position shown in Fig. 20 to one in which it lies in the path of the bolt-box 409. Consequently while the bolt 410 is being withdrawn from engagement with the line-rod 332 its box 409 will snap over the end of the rod 418, and the box will thereby be held stationary, with the spring-drum 406 under tension and the band 405 fully drawn out. The stick *u* will now occupy the position of the stick *v* (shown in Fig. 22) in the justifying-frame *t*, its base having slid between the channel-plates 347 348 on the ends of the arms 345 346, which are in the position shown at the left-hand side of Fig. 25 at this moment. Immediately the stick *u* has come into position in the frame *t* the other stick, *v*, which is lying at the back of the frame *s*, is pushed forward by the forward movement of the fork 343, which presses forward the plate 340 until the catches 615 hold said stick by snapping outward behind it. The rear roller 336 of the stick rests in a slight depression 560 in the top part of the plate which forms the base of the groove 339 at the back of the frame *s*. The projecting pieces 326 on the frame of the stick *v* slide in the grooves 315 in the wall and the block 312, respectively, during the forward movement, and at the completion of this movement the parts occupy the position shown in Fig. 24—that is to say, the pin 334 of the new stick *v* is made to project through the hole in the wall 324, the front roller 326 is brought into the channel 337 in the front wall, and the pin 321 of the bolt 320 of the stick enters the bottom of the slot in the plate 474 at the end of the frame *s*. Immediately the stick has been safely lodged in this position and is held by the catches 615 the fork 343 moves back, drawing back with it the plate 340 until this latter again lies flush with and forms part of the rear wall 325. The roller 336 in entering the channel 337 as the stick is moved forward will have forced out the pin 419, whereby the other end of the rod 418 will be turned out of engagement with the box 409, whereupon the spring-drum 406 will wind up the band 405, drawing the slide 404 along the groove 403 and causing the bolt 410 to again project through the slot 413 in the new stick. The block 404, with its bolt 410, will be drawn along in this way until the end of said bolt strikes the line-rod 332, and it then carries this latter up to the right-hand end of the new stick ready for commencing the filling of said stick, while the pivoted catch 430 on the line-rod turns in passing the downward projections of the pointer-arm 429 and the striker 425. The position now described for the stick *v* will be seen to exactly correspond with that described for the stick *u* when the filling thereof was commenced.

The operations which the stick *u* undergoes in the frame *t* and its motion from said frame to the back of frame *s* remain to be described. During these operations a fresh line is being
 5 composed in the stick *v*, now brought to position in front of the frame *s*, so that no time is lost during the justifying, binding, and expelling of the composed lines. These latter operations take place as follows: When the
 10 stick with the line to be justified arrives in the position at the left-hand side of Fig. 22, the length by which it exceeds the final length of the line which is to be expelled into the galley is known. The graduated bar 498 before
 15 operations commenced has been adjusted in the block 497 by means of the set-screw 499, the block 497 having been placed at the required distance from the end wall 314 during this adjustment. The strong bar 500 is
 20 now moved forward so that its end 616 lies behind the bolt 320 and supports the latter from the rear. The lever 483 is then turned by the movement of the sliding bar 484, operated by the groove in the cam-disk 360.
 25 The forked front of the lever 483 presses against the block 497 and forces this latter, together with the bar 498, strongly against the end of the line-rod 332, as seen in Fig. 22. The extent of the movement having been pre-
 30 determined, the compressible types in the line are flattened somewhat until said line has exactly the required length. Near the completion of the compression of the line the projection 488 in moving toward the right has
 35 pushed along the bar 490 and the inclined end of this latter has pressed back the arm 493 until its end no longer prevents the falling of the roller 336 at the front of the stick. Immediately, therefore, that the end of the
 40 arm 493 is withdrawn the front roller 336 falls down the slot 338, whereby the front and rear walls of the stick 327 328 are dropped until the front wall does not project above the bar 330. The line of types is still held under
 45 compression by the bar 498. The backing of the line or the binding thereof by a binder 515 now takes place. The expelling-plate 354 is forced downward by its lever 536, operated by the projection 540 on the disk
 50 391, and the front binder 515 is pressed downward and out of the opening 561 in the front of the box *y*. The inclined pieces on the back of the binder enable it to slide over the upwardly-bent part of the next binder in the
 55 box. The expelled binder falls vertically downward until its rear notches 516 engage on the projecting parts 552 of the bar 550. The parts now occupy the position shown in Fig. 36. It will be seen that it was necessary
 60 for the rear plate 328 of the stick to be lower than the front plate in order to allow the binder to come into this position. The rod 524 next slides forward a little way and the L-shaped plates 530 thereon press against the
 65 back of the bar 550 and slide said bar forward

in the slots 549 in the arms 547 which carry it. The parts now occupy the position shown in Fig. 37. The hooked part on the front of the binder is directly beneath the slot 562 in the bottom of the types forming the line, held under pressure between the bar 498 and the rod 500. The arm 542 is now raised by its cam, and the bar 550 is thus raised also until the said bar is above the L-shaped plates 530 and the parts occupy the position shown in Fig. 35. By the raising of the bar 550 the hook of the binder is forced into the slot 562 in the bottoms of the types, and the whole line is bound into one line-slug. The pressure of the bar 498 is now released, and the rod 524 next makes a considerable forward movement, whereby the line, freed from end pressure, is expelled into the galley, and all the lines in front of it in said galley are forced forward to leave a space for the new line. A slide to work in the galley and keep the front line of types therein upright may be formed exactly like the slide 253 254 on the tray *o*, Figs. 5 and 16. It is shown in plan view in Fig. 20 and consists of a lower bar 611 and upper bar 612, with feet 613 at the ends of the latter engaging over the side walls of the galley, the bars 611 612 being connected by vertical rods 614.

The great advantage obtained by using the binders 515 will be obvious to any one skilled in the art. A line bound by a binder can be handled in one piece, if required, as a line-slug; but one or more of the types can be removed and replaced at any time without breaking up the line or disturbing the other types. As soon as the binder 515 is moved off from the bar 550 during the ejection of the line said bar is pulled backward in the slots 549 by the tension-springs 564. (These springs are only powerful enough to move the bar when it is quite free, and consequently while the bar is pulling the binder upward the springs cannot force back the bar.) During the forward movement of the pusher-plates 530 the beveled arms 531, engaging in the slots 563 in the bar 532, raise this latter, as shown in Fig. 38, thereby allowing the type-line to pass under said bar. The frame 547 now rises considerably until the bar 550 is in the notches 609, as close as possible to the bottom of the box *y*, as shown in Fig. 38. The fork 344, carrying the channel 347 348, on the ends of its arms is now moved backward across the frame *t*, carrying with it the stick from which the justified line has been expelled. The belt 320 and line-rod 332 will pass under the bar 550 in its raised position during the backward movement of the stick, and as they are beyond the ends of the row of plates 530 these latter will not impede the movement of the line-rod and bolt. As soon as the pin 321 comes out of the slot 323 during the early part of the backward movement of the stick the bolt 320 will fall to the bottom of its slot. Im-

mediately the stick has moved away the frame 547 will be allowed to fall and the bar 550 and L-shaped plates 530 will again occupy the position shown in Fig. 36 ready for receiving the next line-binder. As the rod 524 moves backward with the plates 530 the bars 531 are also drawn back, allowing the plate 532 to fall behind the line of types last expelled into the galley, thus supporting this line and preventing it from falling out backward. The stick now at the back of the frame *t* is drawn into the back of the frame *s* by the projection 352 on the U-shaped frame 311, which latter is drawn back when the stick reaches the position at the back of the frame *t* with its pin 334 projecting through the slot 335 in the wall 325 and into the path of the projection 352. In its movement from the back of frame *s* to frame *t* the stick is operated upon as follows: Its rear roller 336, traveling in the slot 339, is moved upward, thereby raising the side walls 327 328 of the stick until they occupy the topmost position and the roller 336 rests in the notch 560. The empty stick now occupies the position at the rear of the frame *s* ready for coming forward and into operation when the stick on which a line is being composed is moved out of said frame, and it will be seen that the parts now occupy the initial position again. It should be mentioned, however, that during the sliding backward of the frame 311 its catch 349 being free to rock slips under the pin 334 of the stick now in the front of the frame *s*, and consequently the catch is in a position to move forward the latter stick when its line is completed.

In the modification shown in Fig. 39 plain lead rules are to be used for backing the lines without binding them together. The types may be formed without the slot 562—*i. e.*, the projection 514 on the spout *g* may be dispensed with in such case. When the lead rules 557 are used, the bar 550 must be removed and, as described before, some of the plates 530 are provided with spring-held bolts 553. The movements of the parts take place exactly as before; but the lead rules 557 when expelled are caught on the bolts 553, and the plates 530 then moving forward force the line of types, with the lead rules, out onto the galley, the bolts 553 being pressed backward by the types during this action, as the other movements of the parts take place as before and need no further description here.

It may be mentioned here that in some cases compressible types are not included in the lines. In such cases the bar 498 will be adjusted so that it only grips the line tightly when moved into its compressing position and holds said line for the insertion of a line-binder or the backing by a lead rule.

The device for setting the shafts 353 354 in rotation when required may be made in certain different ways. One of these is shown

in Figs. 4 and 20 and also in Fig. 45. Two pillars 565 566 support between them a shaft 567, which carries a driving-pulley 568 and fast and loose pulleys 569 570. A belt from any suitable continuously-running power-motor is to be passed over the pulley 568. On the shaft 354 is mounted a large pulley 571 capable of receiving the belt 572, which runs on the fast and loose pulleys 569 570. A shaft 579 is pivoted behind the frame *s*, between two supports 573 and 580, and it carries a two-armed lever 574 575. The arm 575 has a weight 576, tending to turn the arm 574 over toward the left. On the shaft 354 next to the pulley 571 is a single-notched snail-cam 577, and an arm or catch 578, pivoted at 581 near the top of the arm 574, is adapted to rest upon the surface of the snail-cam 577. The shaft 471, hereinbefore mentioned and which carries the operating-arm 472 in front of the machine, has an arm 582 fixed on it at the rear and in line with the two-armed lever 574 575. The top of the arm 582 is bent to one side slightly, as seen in Fig. 45, and is adapted to engage with a pin 583, projecting from the pivoted catch-arm 578. On the top of a pillar 584, mounted on the base *a*, is pivoted a horizontal lever 585, Figs. 20 and 45. At its farther end this lever has a fork 586, which engages with the belt 572, and close to said fork the lever slides in a double-jawed bracket 587, fixed to the top of the pillar 485. The lever 585 has a second arm 588, projecting backward from its pivot-point on the pillar 584, and this arm presses against the rear of the arm 574 and is held against the latter by a projecting piece 589, attached to the rear of the arm 574. The operation of this device is as follows: When the arm 472 is depressed, the shaft 471 and the arm 582 are turned, the pin 583 is knocked upward, and the catch-arm 578 released from the notch of the snail-cam. The arm 574, counterbalanced by the weight 576, now turns over toward the left, moving the arm 588, whereby the belt-shifting arm 585 is moved to shift the belt onto the fast pulley 569. The shaft 354 is now driven through one complete rotation until its snail-cam again strikes the end of the catch-arm 578 and moves back the lever 574, thereby turning the lever 585 and shifting the belt onto the loose pulley 570 again.

The device shown in Fig. 46 is a modification of that shown in Fig. 45, employing tooth-gearing instead of belting for driving the shaft 354. The snail-cam 577, counterbalanced lever 574, catch 578, and arm 582 are the same as before. In this case, however, the pulley 571 is replaced by a toothed wheel 590, (indicated by chain-dotted lines) The power is applied by suitable means to a wheel-block running on the shaft 579, which wheel-block carries a toothed wheel 591. Mounted on a pin 592 on the arm 574 is a toothed wheel 593, which is constantly in gear

with the wheel 591. These latter wheels therefore driven by the source of power are in constant rotation. In this case when the arm 574 falls over the wheel 593 is brought into gear with the toothed wheel 590, whereby the shaft 354 is driven, and the wheel 593 is moved out of engagement again when the arm 574 is turned back again by its catch 578 engaging in the notch of the snail-cam.

The other modification of the driving-gear is illustrated in Fig. 47. The snail-cam, counterbalanced lever, catch, &c., are again the same as in Fig. 45. In this case, however, the pulley 571 is driven by a belt 572 from an electromotor 594. The circuit of this motor comprises a source of energy 595 and two contacts 596, all of which parts are indicated diagrammatically in Fig. 47. When the parts are in the stationary position, the contacts 596 are just clear of the catch 578. During the time said catch is raised, however, it completes the circuit through the contacts to the motor 594, and this latter drives the pulley 571 through the belt 572. Just before the catch 578 reaches the notch of the snail-cam it breaks the circuit between the contacts 596, and the motor is allowed to stop. It will be seen that in all these cases the depression of the arm 472 will enable the shafts 354 and 353 to make one complete rotation, by which the movement of the sticks, the compressing of the line, the binding thereof, and the expulsion into the galley are effected.

As mentioned in the preamble of this specification, the machine is peculiarly adapted for forming the types of oriental languages. In these languages each consonant may have a vowel or a part of a vowel above or below it in the line. By the use of suitable molds and matrices I am able to cast consonant and vowel types which will afterward fit together to make one composite letter, such as is required in the languages in question. In Fig. 50 is shown a consonant-type and in Fig. 49 a vowel-type, the two being shown composed together in Fig. 48.

To form consonant-type, (shown in Fig. 50,) the mold is constructed as shown in Figs. 51, 52, and 53. The matrix of the consonant is in a block *j*, as in the molds first described. Above and below said matrix are fixed cross-bars 597 of the shape seen in Fig. 51. Attached to the cover-plate *i* at the side of the mold is a vertical wall 598. The rib 71 exists, as before. When the type-metal enters this mold, it fills the central space, the intaglio impression in the matrix, and the corner beyond the plate 598 and between the cross-pieces 597, fixed to the matrix-block *j*. When the mold-plate *h* moves away from beneath the cover-plate *i*, the cast type is extruded, as before, and its end being freed from the stationary cross-pieces 597 it will fall as an ordinary type into the channel of the maga-

zine. The vowel-type, Fig. 49, is cast in the mold shown in Figs. 54, 55, and 56. The intaglio impression of the vowels are formed in the matrix-block *j*, at the top or bottom thereof. The cross-bar 599 of the form seen in Fig. 54 is attached across the center of the matrix-block *j*. To the cover-plate *i* is attached a block 600, cut at its forward end to fit against and partly over the fixed piece 599, which projects forward somewhat, as seen in Figs. 54 and 56. For feeding the type-metal into the narrow slot remaining at the side of the block 600 a side passage 601 must be cut in the face of the spout *g* and leading from the usual hole 48.

In casting a vowel-type the metal enters the narrow space 602 through the passage 601 and flows above and below the fixed piece 599, taking from the matrix-block *j* the impression of any vowel formed therein either above or below or both above and below. When the mold-plate *h* moves backward from under the cover-plate *i* to extrude the type, the block 600, being attached to the plate *i*, remains stationary, and the type is free to fall in ordinary course, being drawn out by the rail 71.

In composing in an oriental language the consonant-type is released first and this passes down into the stick. The vowel-type follows the consonant-type, and when packed into the stick its beveled forward edges 603 slide over the rounded edges 604 of the consonant-type, and the vowel-type rises upward and moves forward until it lies against the consonant-type, as in Fig. 48. The two types will then operate as one in the stick and galley and print as one type.

In some cases no vowel is required to a consonant. The square-cornered piece 605 of the consonant-type then enables this latter to be packed with the other types without having a vowel-type supplied to it.

It will be seen that types of oriental languages so constructed may be formed with slots in their bases for the reception of a line-binder and, in fact, will function in the machine in exactly the same way as the types of European languages, as applied to which the machine has been described in the first instance.

The use of composite types or types made up of parts which fit together is not confined to oriental languages. Such types may be of use in European languages for adding index-numerals or the like to letters or for forming arithmetical and algebraical signs. The composite types may therefore be employed in any language where their use is convenient.

While thus describing my invention I desire again to point out that I do not limit myself to the exact details of construction of the operating parts, as any part may be replaced by its known mechanical equivalent—i. e., by

a part which will produce substantially the same result—without departing from the scope of this invention.

What I claim is—

1. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine for receiving and storing said types, means for releasing required types from said magazine, a composing-frame, a justifying-frame, a composing-stick, means for feeding forward the released types to said composing-stick, means for moving the stick from the composing-frame to the justifying-frame, and means for justifying the line in the stick in the latter frame.

2. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine for receiving and storing said types, means for releasing required types from said magazine, a composing-frame, a justifying-frame, a composing-stick, means for feeding forward the released types to said composing-stick, means for moving the stick from the composing-frame to the justifying-frame, and means for justifying the line in the stick in the latter frame, means for gripping the composed line on the stick and means for backing the line of types.

3. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine for receiving and storing said types, means for releasing required types from said magazine, a composing-frame, a justifying-frame, a composing-stick, means for feeding forward the released types to said composing-stick, means for moving the stick from the composing-frame to the justifying-frame, means for justifying and gripping the line on the stick in the justifying-frame, means for backing the line, a galley in proximity to said justifying-frame, and means for expelling the backed line of types into said galley.

4. In a machine the combination of means for melting type-metal, a spout for feeding the type-metal, means for casting a set of types from the molten metal, a magazine for receiving and storing said types, means for releasing required types from said magazine, a composing-stick, and means for feeding forward the released types to said stick, a composing-frame, a justifying-frame, means for moving the stick from the composing-frame to the justifying-frame, means for justifying the line on the stick in said justifying-frame, and means for expelling the line from said stick.

5. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a cover-plate, and a set of matrices together adapted to form molds for casting a set of types from said metal, said mold and said cover-plate adapted to move together and

also separately, and means for receiving and storing the set of types.

6. In a machine the combination of means for melting and a spout for feeding type-metal, a mold-plate, a cover-plate and a set of matrices together adapted to constitute molds for casting a set of types from the molten metal, means for receiving and storing the types so cast, and means for traversing the mold-plate and the cover-plate and for moving one of said parts relatively to the other whereby the types are extruded into the receiving and storing means.

7. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices and a cover-plate together adapted to form molds for casting a set of types from the molten metal, means for cooling the mold-plate and the cover-plate, means for receiving and storing the types from the molds and means for moving the mold-plate and the cover-plate together and separately in such manner that the types cast in the molds are extruded therefrom and received in the receiving and storing means.

8. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a bar upon the side of which a set of matrices for type-casting are formed, means for fixing said bar in position on the mold-plate, a cover-plate adapted to form with the mold-plate and matrices molds for casting a set of types, means for receiving and storing types from said molds and means for moving the mold-plate and cover-plate relatively to one another whereby the types cast in the molds are extruded and directed into the receiving and storing means.

9. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices of types to be cast, a cover-plate adapted to form with the mold-plate and matrices molds for casting a set of types, means for exhausting air from said molds, means for operating the air-exhausting means during the period before the casting of types in said molds, means for receiving and storing the cast types and means for moving the mold-plate and cover-plate the one relatively to the other whereby the cast types are extruded and passed to the receiving and storing means.

10. In a machine the combination of means for melting and feeding type-metal and a mold-plate, a cover-plate and a set of matrices, together adapted to form molds for casting a set of types from said metal, said mold-plate and cover-plate adapted to move together and also separately, a knife-plate, means for moving said knife-plate over the rear of the mold-plate and cover-plate, and means for expelling the cast types from the molds.

11. In a machine the combination of means for melting and feeding type-metal, a mold-

plate, a set of matrices, a cover-plate adapted to form with the mold-plate and matrices molds for casting a set of types, a knife-plate, a tray connected to said knife-plate, means
 5 for moving the mold-plate and cover-plate together and also relatively to one another whereby the cast type are extruded from the mold-plate upon the tray connected to the knife-plate, means for receiving and storing
 10 the cast types and means for operating the knife-plate whereby the type ends are trimmed and the cast types are discharged from the tray connected to said knife-plate into the receiving means.

15 12. In a machine the combination of means for melting and feeding type-metal and a mold-plate, a cover-plate and a set of matrices, together adapted to form molds for casting a set of types from said metal, said mold-plate
 20 and cover-plate adapted to move together and also separately, a knife-plate, a receiving-channel, means for storing the types and means for moving the mold-plate and cover-plate, knife-plate and channel, whereby the type
 25 ends are trimmed and the types are extruded from the molds into the receiving-channel and into the storing means.

13. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices, and a cover-plate together adapted to form molds for casting a set of types, a receiving-channel, a catch-plate for holding type in said channel, means for
 30 storing the types, means for moving the mold-plate and cover-plate relatively to one another whereby the type are extruded from the molds into the receiving-channel, and means whereby the catch-plate is operated to allow the
 35 type to pass from the receiving-channel into the storing means on the completion of the relative movement of the mold-plate and cover-plate.

14. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices fixed on said mold-plate, a cover-plate adapted to form with the mold-plate and matrices the molds for casting
 45 types, blocks attached to the matrices and cover-plate whereby types having stems adapted to fit together to form a composite type may be cast in the molds, means for receiving and storing the types cast in the molds and means for moving the mold-plate relatively to the cover-plate whereby the cast
 50 types are extruded from the molds into the receiving and storing means.

15. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices fixed to said mold-plate and a cover-plate adapted to form with the mold-plate and matrices molds for casting
 60 types, blocks attached to the matrices and to the cover-plate whereby types having partial stems adapted to fit together to form compos-

ite types may be cast in the molds, means for
 6 trimming the type ends, means for receiving and storing the cast types, means for operating the end-trimming device and means for moving the mold-plate and cover-plate together and the one relatively to the other
 7 whereby the types cast in the molds are extruded into the receiving and storing means.

16. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine for receiving and storing said types,
 7 means for releasing required types from said magazine, a composing-stick, means for feeding forward the released types to said composing-stick, a tray and means attached to
 8 said magazine and adapted to be brought into operation when required for deflecting the types from said magazine onto said tray.

17. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices attached to said mold-plate and a cover-plate adapted to form with the mold-plate and matrices molds for casting a set of types, means for moving the mold-plate and cover-plate relatively to one another whereby the types are extruded from the molds, a magazine for receiving the types, means for releasing required types from said magazine and for composing said types into a line, a tray and means for expelling the
 9 types from the magazine onto the tray whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

18. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices attached to said mold-plate, a cover-plate adapted to form with the mold-plate and matrices molds for casting a set of types, means for trimming the type ends, and means for operating said trimming means, means for moving the mold-plate and cover-plate together and the one relatively to the other whereby the trimmed types are extruded from the molds, a magazine for receiving the cast types, means for releasing required types from said magazine and for composing said types into a line, a tray, means for expelling the types from said magazine onto the tray and means attached to said tray whereby as the types are expelled they are divided into convenient and compact lots whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

19. Means for casting sets of types, a magazine for receiving the cast types, means for releasing required types from said magazine and for composing the types into a line, a tray, means for feeding lines of types from the magazine onto said tray, and a plurality of wedge-shaped pieces upon said tray adapted to pack together into convenient lots the types fed

thereto whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

20. Means for casting sets of types, a magazine for receiving the cast types, means for releasing required types, from said magazine and for composing the types into a line, a tray, means for feeding lines of types from the magazine onto said tray, and a plurality of wedge-shaped pieces upon said tray adapted to pack together into convenient lots the types fed thereto, and a slide adapted to lie against the foremost types on the tray whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

21. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine for receiving and storing said types, said magazine comprising a series of chambers having slots through their walls near the tops thereof, and each adapted to receive types of one kind, means for releasing required types from said magazine, a plate corresponding to each chamber, a valve adapted to admit molten metal to each mold of the casting apparatus, and means for operating the casting apparatus and moving the plates at continuously-recurring periods whereby the plates are moved to the slots into the magazine and plates corresponding to chambers from which one or more types have been removed are caused to pass through the slots in said chambers, and means whereby the valves which feed metal to the molds corresponding to said chambers are opened when the plates pass through the slots in said chambers.

22. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine comprising a series of chambers each adapted to receive the types of one kind, means for releasing required types from each chamber of said magazine, a valve adapted to govern the feed of type-metal to each mold corresponding to a chamber of the magazine, means connected to each chamber for operating said valve when one or more types have been withdrawn from the chamber and means for operating the casting apparatus which means is also adapted to operate the valve-operating means before mentioned.

23. In a machine the combination of means for melting and feeding type-metal, molds for casting a set of types from said metal, a magazine comprising a series of chambers each adapted to receive types of one kind, a detent connected to each chamber at the bottom thereof and adapted when rocked to release one type from said chamber, means for operating the detent, means for operating the type-casting apparatus at constantly-recurring intervals, and means connected with the top of each

chamber of the magazine and with the type-metal-feeding apparatus adapted to cause the feeding of type-metal to the mold of the casting apparatus corresponding to each chamber of the magazine from which one or more types have been withdrawn.

24. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of a particular kind, a detent at the bottom of each chamber adapted when rocked to release one type from said chamber, operating means connected to certain of the detents, a plate adapted to pass through each of the latter chambers when the types therein are exhausted and means operating in conjunction with said plate to move the detent of one of the remaining chambers of the magazine when said plate passes through its chamber.

25. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of a particular kind, a detent at the bottom of each chamber adapted when rocked to release one type from said chamber, operating means connected to certain of the detents, a plate adapted to pass through each of the latter chambers when the type therein are exhausted, means operating in conjunction with said plate to move the detent of one of the remaining chambers of the magazine when said plate passes through its chamber, a composing-stick and means for feeding the types released from the magazine to said composing-stick.

26. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine comprising a series of chambers each adapted to receive types of a particular kind, a detent at the bottom of each chamber adapted when rocked to release one type from said chamber, operating means connected to certain of the detents, a plate adapted to pass through each of the latter chambers when the type therein are exhausted means operating in conjunction with said plate to move the detent of one of the remaining chambers of the magazine when said plate passes through its chamber, a composing-stick and means for feeding the types released from the magazine to said composing-stick.

27. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine comprising a series of chambers each adapted to receive types of one kind, a detent connected to each chamber and adapted when rocked to release one type therefrom, means for operating by hand certain of said detents, a plate adapted to project through the chamber corresponding to said certain detents when the type in said chamber are exhausted, a plurality of bars each connected to one of the detents which have not hand operating means

applied to them and means adapted to be operated by the hand-operated detent working in conjunction with a plate when this latter projects through its chamber to operate the bar of a particular detent.

28. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of one kind, a detent connected to each chamber and adapted when rocked to release one type therefrom, means for operating by hand certain of said detents, a plate adapted to project through the chamber corresponding to said certain detents when the type in said chamber are exhausted, a plurality of bars each connected to one of the detents which have not hand operating means applied to them and means adapted to be operated by the hand-operated detent working in conjunction with a plate when this latter projects through its chamber to operate the bar of a particular detent.

29. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of one kind, a detent connected to each chamber and adapted when rocked to release one type therefrom, means for operating by hand certain of said detents, a plate adapted to project through the chamber corresponding to said certain detents when the type in said chamber are exhausted, a plurality of bars each connected to one of the detents which have not hand operating means applied to them, means adapted to be operated by the hand-operated detent working in conjunction with a plate when this latter projects through its chamber to operate the bar of a particular detent, a composing-stick and means for feeding forward types released from the magazine to said composing-stick.

30. In a machine the combination of means for melting and feeding type-metal, means for casting a set of types from said metal, a magazine comprising a series of chambers each adapted to receive and store types of one particular kind cast in the type-casting means, a channel, a pair of interacting corrugating-wheels at the top of said channel, continuously-running means for operating said corrugating-wheels, means for feeding a strip of metal to said corrugating-wheels when the channel is not full of strips corrugated by said wheels, means adapted to be operated by hand for releasing types when required from said magazine and said corrugated strip, a receiving-channel, a composing-stick, means for feeding forward the released types to said composing-stick and means for justifying the line in the stick.

31. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of one particular kind, cast in the type-casting means, a channel, a pair of interacting corrugating-wheels at the top of said channel, continuously-run-

ning means for operating said corrugating-wheels, means for feeding a strip of metal to said corrugating-wheels when the channel is not full of strips corrugated by said wheels, means adapted to be operated by hand for releasing types when required from said magazine and said corrugating-strip, a receiving-channel, a composing-stick, means for feeding forward the released types to said composing-stick and means for justifying the line in the stick.

32. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of one particular kind, a channel, a pair of interacting corrugating and cutting wheels mounted above said channel, means for continuously rotating said corrugating and cutting wheels, means adapted to feed a strip of metal to said wheels only when a vacancy occurs in the channel below said wheels, means for releasing required types from the magazine and said channel, a composing-stick, means for feeding forward the released types to said composing-stick and means for justifying the line in said stick.

33. In a machine the combination of means for making the types, a series of chambers each adapted to receive the types of one particular kind, means for feeding the types as they are made to said chambers, means for releasing required types from said chambers, a composing-stick, a type-packer, means for feeding the types released from the chambers to said type-packer, a bolt operatively connected with the type-packer in such manner that it will project to hold the types pushed forward by said packer but will be withdrawn to allow the next type to be packed into the stick and means for driving the type making, feeding and packing devices above mentioned.

34. In a machine the combination of a series of chambers each adapted to receive types of one particular kind, means for releasing required types from said chambers, a composing-stick, a type-packer adapted to feed types into said stick, a bolt operatively connected with the packer in such manner that said bolt will project to support the packed types but will be withdrawn to allow of the packing of each fresh type, means for feeding forward to the packer the types released from the chambers and operating means for actuating the feeding and packing devices.

35. In a machine the combination of means for making types, a series of chambers each adapted to receive types of one particular kind, means for feeding types as they are made to said chambers, means for releasing required types from said chambers, a composing-stick, a line-rod adapted to slide longitudinally of said stick, means adapted to draw said line-rod with convenient pressure toward one end of the stick, a type-packer adapted to feed types onto said stick against the pressure of the line-rod, means for feeding forward the

types released from the chambers to the type-packer, and means for operating the type making and feeding apparatus and the type-packer.

36. In a machine the combination of a series of chambers each adapted to receive types of one particular kind, means for releasing required types from said chambers, a composing-stick, a line-rod adapted to slide longitudinally of said stick, means adapted to draw said line-rod with convenient pressure toward one end of the stick, a type-packer adapted to feed types onto said stick against the pressure of the line-rod, means for feeding forward the types released from the chambers to the type-packer and means for operating the type making and feeding apparatus and the type-packer.

37. In a machine the combination of a series of chambers each adapted to receive types of one particular kind, means for releasing required types from said chambers, a composing-stick, a line-rod adapted to slide longitudinally of said stick, a tension device adapted to draw said line-rod toward one end of the stick, a type-packer adapted to feed types onto said stick against the tension of the line-rod, means for feeding forward to said packer the types released from the chambers and a reflector adapted to lie above the types as they are composed in the stick and in which the types can be seen and read in natural order during the composing.

38. In a machine the combination of a frame, a composing-stick in said frame, means for feeding required types to said stick, an indicator adapted to show when the required number of types have been composed in the stick or the spaces remaining to be filled therein, means for compressing the type on said stick, means for backing the line of types, and operating means for actuating the compressing and backing devices.

39. In a machine the combination of a frame, a composing-stick in said frame, means for feeding required types to said stick, an indicator adapted to show when the required number of types have been composed in the stick or the spaces remaining to be filled therein, means for compressing the types on said stick, means for backing the line of types, a galley, means for expelling the backed line of types onto said galley, and means for operating the compressing, backing and expelling devices,

40. In a machine the combination of two frames, a composing-stick comprising a framework and two side plates adapted to slide at the sides on the top bar of said framework, a projection connected to said plates, a groove in the wall of the two frames in which said projection is adapted to slide, means for feeding required types into the stick upon the top bar of its framework and between the side plates, means for moving the stick longitudinally from the first frame to the second, a com-

pressing device in the second frame, means for adjusting said compressing device in such manner that it may be made to compress the line of types to a predetermined length, means operated by the compressing apparatus adapted to allow the side plates of the stick to fall, a galley, means for expelling the line of types into the galley and operating means for the stick-moving and the compressing and expelling devices.

41. In a machine the combination of two frames, a composing-stick adapted to slide from one frame to the other, said stick comprising a framework and two side plates with connecting means adapted to slide vertically in the sides of the framework, a line-rod, adapted to slide on the top bar of the said framework, means tending to press said line-rod toward one end of the stick, means for feeding required types onto the top bar of the stick, against the pressure of said line-rod, a bolt adapted to slide vertically in one end of the stick, means for moving the stick from the first frame to the second frame, means for withdrawing the pressure on the line-rod and for raising said bolt during the movement, a line-compressing device in the second frame, means adapted to be operated simultaneously with the line-compressing device to allow the side plates of the stick to fall, a galley, means for expelling a compressed line of types into the galley and operating means for the stick-moving and line-of-type compressing and expelling devices.

42. In a machine the combination of two frames called the composing and justifying frame respectively, a composing-stick adapted to lie in said frames, means for feeding type to the stick at the front of the composing-frame, means for moving said stick into the justifying-frame, a galley, means for compressing the line of types on the stick in the justifying-frame, means for backing the line of types and for expelling it into the galley and means for moving said stick across the justifying-frame and into the back of the composing-frame.

43. In a machine the combination of two frames hereinafter called the composing and justifying frames respectively, a galley attached to the composing-frame, two composing-sticks adapted to lie in said frames, means for feeding types into the composing-stick at the front of the composing-frame, means adapted to operate simultaneously to compress the line of types on the second stick in the justifying-frame, means for backing said line of type and for expelling it from the stick into the galley and means for moving said stick to the back of the justifying-frame and into the back of the composing-frame, means for moving said second stick to the front of the composing-frame when the stick lying at the front of said frame has been filled and moved into the justifying-frame and

means for operating the stick-moving and line justifying and expelling devices.

44. In a machine the combination of two frames hereinafter called the composing and justifying frames, two composing-sticks each comprising a framework and two side plates adapted to slide in the sides of said framework, means for feeding type to the stick at the front of the composing-frame, means adapted to apply tension to the line of types fed onto said stick, means for moving the stick from the composing to the justifying frame, means for withdrawing the tension device from the end of the stick when said stick begins to move, a catch adapted to hold said tension device stationary, means for moving the sticks from one framework to the other and from the back of the composing-frame to the front thereof, said catch device being adapted to be released by the advancing of the second stick in the composing-frame whereby it is brought to bear upon the new line of types composed in said second stick and operating means for moving the sticks in the frames and feeding the types.

45. In a machine the combination of two frames hereinafter called the composing and justifying frames, a composing-stick adapted to lie in said frames, means for feeding type onto said stick at the front of the composing-frame, a line-rod adapted to slide on said stick and to be advanced by the types composed thereon, an indicator and means for adjusting the position thereon, an operating-arm connected to said indicator, an arm on the line-rod adapted to operate said indicator when a predetermined length of types has been fed onto said indicator, means for moving the stick from the composing to the justifying frame, means for backing the line of types on said stick, and means for expelling the backed line of types from said stick.

46. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, means for feeding types to said composing-stick, a device adapted to indicate the length of types composed in said stick, a stop adapted to limit to a predetermined amount the length of types which can be fed onto said stick, two plates mounted in such manner that they may be composed at any desired point in the line on the said stick, a box adapted to contain a few types, a guide upon which said box is adapted to travel longitudinally of the stick, means for sliding the box along said guide over the stick and for separating the plates by the amount required to complete the predetermined length of line, and means for expelling the types from said box into the space so created between the plates in the line.

47. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, a type-packer adapted to feed types onto the stick in said frame, a chute leading to said

packer, means for supplying required types into said chute, an indicator adapted to indicate the length of types composed on the stick, two plates and means supporting said plates in such manner that they may be inserted in the line of types on said stick at any required point and will slide with the line along the said stick, a guide-rail, means adapted to retain required types in a portion of the channel leading to the packer, means for sliding said portion of the channel along the rail longitudinally of the type-line, means for separating the plates in the line by an amount required to make up the said line to the predetermined length, and means for expelling the types from the part of said channel into the space so formed between the plates in the line.

48. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, a channel, means for feeding required types into said channel, and means for packing types from said channel onto the stick, an indicator adapted to show the length of types composed on the stick, an adjustable stop adapted to limit the length of the line of types composed on said stick, two plates, means for supporting said plates in such manner that they may be inserted at any required point in the composed line, one of said plates projecting beyond the line of types, means for retaining a small number of types in a portion of the channel, means for moving said portion of the channel with the types therein longitudinally of the line of types in the stick, said portion of the channel being adapted to strike the projecting plate and move it along the stick with the types in front of it until the stop arrests said movement, means for expelling the types from the portion of said channel into the space so formed between the sticks and means for withdrawing the plates from the line of types.

49. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, a channel, means for feeding required types into said channel, and means for packing types from said channel onto the stick, an indicator adapted to show the length of types composed on the stick, an adjustable stop adapted to limit the length of the line of types composed on said stick, two plates, means for supporting said plates in such manner that they may be inserted at any required point in the composed line, one of said plates projecting beyond the line of types, means for retaining a small number of types in a portion of the channel, means for moving said portion of the channel with the types therein longitudinally of the line of types in the stick, said portion of the channel being adapted to strike the projecting plate and move it along the stick with the types in front of it until the stop arrests said movement, means for expelling the types from the portion of said channel into the space so formed between the sticks, and means adapted to be operated by the expelling means con-

nected with the channel to withdraw the plates from the line of type while the types in said channel are being expelled therefrom into the space in the line.

5 50. In a machine the combination of two frames, a composing-stick comprising a framework forming a base and two side plates adapted to slide vertically at the sides of said framework, means for feeding types into the stick, in one of the frames, means for moving the stick from one frame to the other, a projection connected to the plates on the stick, a track in the front walls of the frame in which said projection is adapted to travel, means for 5 compressing the line of types on the stick in the second frame and means operated by the compressing device adapted to allow the plates of the stick to fall during the compression, means for expelling the line of types from the stick, a projection at the rear of the plates on the stick, a track in the rear walls of the two frames in which said projection is adapted to engage, means for moving back the stick from the second frame to the first frame, said track 5 being of such form as to raise the projection during its movement whereby the side plates of the stick are raised, and operating means for moving the stick in the frames and for operating the line compressing and expelling apparatus.

51. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, means for composing types on said stick, a container and a plurality of line-binders therein, means for expelling the line-binders one at a time from said container, a compressing device and means for operating said device to hold the line of types on said stick, means for supporting the expelled binder and for engaging it with the line of types held in the compressing-types and means for expelling the bound line of types.

52. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, 5 a line-binder consisting of a plate the lower edge of which is bent upward to form a hook, a bar adapted to support said binder, a pusher, means for feeding a line of types onto the stick, a compressing device, means for operating said compressing device to grip the line of types on the stick and gearing adapted to move the supporting-bar and the pusher in such manner that the bar makes the binder to engage with the line of types and the pusher 5 expels said line of types from the stick.

53. In a machine the combination of a frame, a stick adapted to lie in said frame, a plurality of types each having a notch in the base thereof, means for feeding required types onto the stick, a line-binder consisting of a plate the lower edge of which is bent upward to form a hook, means for gripping the line of types on the stick, means adapted to bring the line-binder into engagement with the line of 5 types in such manner that its hooked edge

lies in the slots in said types and operating means for actuating the type-feeding, gripping and binder-moving devices.

54. In a machine the combination of a frame, a stick adapted to lie in said frame, a plurality 70 of types each having a notch in the base thereof, means for feeding required types onto the stick, a line-binder consisting of a plate, the lower edge of which is bent upward to form a hook, means for gripping the line of types 75 on the stick, means adapted to bring the line-binder into engagement with the line of types in such manner that its hooked edge lies in the slots in said types, means for expelling the bound line of types from the stick, and 80 means for operating the type-feeding and line-gripping devices, the binder-moving device and the line-expelling device.

55. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, 85 said composing-stick comprising a framework and two side plates adapted to slide at the sides of said framework, means for feeding required types onto said stick, means for gripping the line of types so composed, means operated by the gripping device adapted to allow the side plates of the stick to fall during the gripping movement, a line-binder, means for engaging said line-binder with the line of types gripped in the gripping device, means 90 for expelling the line of types from the stick, means for again raising the side walls of the stick and operating means adapted to actuate the gripping and moving means aforesaid.

56. In a machine the combination of a composing-frame and a justifying-frame, a composing-stick comprising a base framework and two side plates adapted to slide vertically at the sides of said framework, and means for 100 connecting together said side plates, a projection at each side of said side plates, tracks in the front and rear walls of the composing and justifying frames in which said projections are adapted to travel, the track in said rear walls being inclined, means for moving the stick from the composing-frame to the justifying-frame, means for gripping the line of types on the stick in the justifying-frame, and means adapted to be operated by said gripping device to allow the side plates of the stick to fall when the gripping device is operated, a line-binder, a device adapted to engage said binder with the line of types held in the gripping device, means for expelling 105 the bound line of types from the stick, means for moving back the stick from the justifying-frame to the composing-frame, whereby the projection at the rear of the side plates of the stick engaging in the slots in the rear walls of the composing and justifying frames is 110 raised to again elevate said plates, and means for operating the stick-moving devices and the line compressing, binding and expelling devices.

57. In a machine the combination of a frame, 115

a composing-stick adapted to lie in said frame, means for feeding a line of types onto said stick, a bar, means for projecting said bar at the rear of the line of types on said stick, a lever, a block and a slide for said block, a graduated bar and means for fixing said graduated bar in required positions in said block, means for operating said lever to move the block and graduated bar toward the first-mentioned bar whereby the line of types on the stick between the bars is compressed to an amount determined by the adjustment of the graduated bar.

58. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, means for feeding a line of types onto said stick, a bar, means for projecting said bar at the rear of the line of types on said stick, a lever, a block and a slide for said block, a graduated bar, and means for fixing said graduated bar in required positions in said block, means for operating said lever to move the block and graduated bar toward the first-mentioned bar whereby the line of types on the stick between the bars is compressed to an amount determined by the adjustment of the graduated bar, a line-binder having a hooked projection at its lower edge, means for engaging said line-binder in slots in the base of the types forming the line, means for expelling the bound line from the stick and means for operating the compressing, binder moving and expelling devices.

59. In a machine the combination of means for making the types and for forming slots in the bases of said types, a magazine for storing said types, means for releasing required types from said magazine, a composing-stick, means for feeding released types to said composing-stick, means for gripping the composed line of types, a line-binder having a turned-up lower edge, means for forcing said binder into engagement with the types, its lower edge entering the slot in the bases of said types and means for operating the type-making, type-feeding, gripping and binder-fixing devices.

60. In a machine the combination of means for making the types and for forming slots in the bases of said types, a magazine for storing said types, means for releasing required types from said magazine, a composing-stick, means for feeding released types to said composing-stick, means for gripping the composed line of types, a line-binder having a turned-up lower edge, means for forcing said binder into engagement with the types its lower edge entering the slot in the bases of said types, means for expelling the bound line of types from the stick, and means for operating the type making and feeding devices and the line-gripping, line-binder, adjusting and line-expelling devices.

61. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, means for feeding required types to said com-

posing-stick, a galley attached to said frame, means for backing the line of types composed on said stick a device for expelling the backed line of types onto the galley, a bar in said galley and means connected to the expelling device adapted to raise said bar while the line is being expelled and to allow it to fall during the backward movement of the expelling device and means for operating the line binder and expelling devices.

62. In a machine the combination of a frame, a composing-stick adapted to lie in said frame, means for feeding required types onto said stick, means for gripping a line of types composed on said stick, means for binding the gripped line of types, a galley attached to the frame, a bar adapted to move vertically at one end of the galley, a pusher, means adapted to move said pusher to expel the gripped and backed line of types onto the galley, means attached to the pusher adapted to raise the rod at the end of the galley during the forward movement of the pusher but to allow said rod to fall during the backward movement of the pusher and means for operating the gripping and pusher moving devices.

63. In a machine the combination of a frame, a composing-stick, means for composing type in a line on said stick, a tension device adapted to press the line of types to the one end of the stick during the composing, a bolt adapted to slide vertically in the other end of the stick, means for moving the stick out of said frame when the line is composed therein, gearing for producing said movement, an arm for setting in motion said gearing and means connected with said arm adapted to raise the bolt at the end of the stick when the arm is operated to set the gearing in motion.

64. In a machine the combination of two frames, two composing-sticks adapted to slide longitudinally of and across said frames, means for feeding type onto the stick at the front of one of said frames, means for justifying the line of types on the sticks in the other of said frames, means for expelling the justified line from the stick, a gearing and means connected with said gearing adapted to move a stick from the composing-frame to the justifying-frame to effect the justifying and expelling operations and to bring said stick to the rear of the composing-frame, said gearing including a shaft which completes one revolution during the cycle of movements mentioned above, and a device adapted to set said gearing in motion, said device including a catch adapted to stop the gearing on the completion of one revolution of the shaft aforesaid.

65. In a machine the combination of two frames, two composing-sticks adapted to slide longitudinally of and across said frames, means for feeding type onto the stick at the front of one of said frames, means for justifying the line of types on the stick in the other of said frames, means for binding the line of types

in the justifying device, means for expelling the justified line from the stick, a gearing, and means connected with said gearing adapted to move a stick from the composing-frame to the justifying-frame to effect the justifying and expelling operations and to bring said stick to the rear of the composing-frame, said gearing including a shaft which completes one revolution during the cycle of movements mentioned above and a device adapted to set said gearing in motion, said device including a catch adapted to stop the gearing on the completion of one revolution of the shaft aforesaid.

66. The combination of two frames, called the composing and justifying frames respectively, a composing-stick, means for moving said stick from the composing-frame to the justifying-frame, means for justifying the line of types on the stick in the latter frame and means for moving the stick back from the justifying-frame to the composing-frame.

67. The combination of two frames, called the composing and justifying frames respectively, a composing-stick, means for moving said stick from the composing-frame to the justifying-frame, a compressing-bar, means allowing of the adjustment of said bar, means for supporting pressure at one end of the line of types on the stick, and means for moving the compressing-bar to a point predetermined by the setting of said bar with the adjusting means aforesaid, whereby the line of types is compressed to a predetermined length on the stick in the justifying-frame.

68. In a machine the combination of means for making types, a magazine adapted to receive said types, means for feeding the types as they are made to the magazine, means for releasing required types from the magazine, a composing and a justifying frame, two composing-sticks, means for moving said composing-sticks longitudinally from one frame to the other and across said frames from the rear to the front of the former and from the front to the rear of the latter means for feeding types released from the magazine to the stick at the front of the composing-frame, means for indicating the length of the line of types on said stick, means for justifying said line of types, means for backing said line of types in the justifying-frame and for expelling the backed line from the stick in said frame and means for operating the type making and feeding devices, the stick-shifting mechanisms and the line justifying and expelling devices.

69. In a machine the combination of means for making types, a magazine adapted to receive said types, means for feeding the types as they are made to the magazine, means for releasing required types from the magazine, a composing and a justifying frame, two composing-sticks, means for moving said composing-sticks longitudinally from one frame to the other and across said frames from the rear

to the front of the former and from the front to the rear of the latter, means for feeding types released from the magazine to the stick at the front of the composing-frame, means for applying tension to the line as it is composed on the stick, means for indicating the length of the line of types on said stick, means for justifying said line of types, means for backing said line of types in the justifying-frame and for expelling the backed line from the stick in said frame, and means for operating the type making and feeding devices, the stick-shifting mechanisms and the line justifying and expelling devices.

70. In combination with a mold-plate, a cover-plate, and a set of matrices together forming molds for casting a set of types, means for melting type-metal and for feeding the molten metal to the molds, a tank connected to each plate, an elevated tank, a reservoir-tank, and means for circulating water from the reservoir-tank to the elevated tank and thence through the tanks connected to the mold-plate and cover-plate back to the reservoir-tank.

71. The combination of means for melting and feeding type-metal, a mold-plate, a set of matrices of types to be cast and a cover-plate adapted to form with the mold-plate and matrices, molds for casting a set of types, an aperture in each molding-compartment of the mold-plate in proximity to the matrix of said compartment, means for closing the apertures, an air-pump, means connecting the air-pump to said apertures and means for operating the air-pump and the opening and closing means of said apertures.

72. In a machine the combination of means for melting and feeding type-metal, a set of molds for casting types, a knife-plate, a tray connected to said knife-plate, a receptacle for the types, and means for operating the knife-plate and tray, and for expelling the types from the molds onto said tray.

73. In a machine the combination of means for melting and feeding type-metal, a set of molds each mold adapted to cast one type of a required set, a channel having compartments therein corresponding in number and width with the molds, means for retaining the types in said channel, and means adapted to expel the types from the molds into said channel and to operate the retaining mechanism to release the types from said channel.

74. The combination with a set of molds and means for melting type-metal and for feeding it to the molds, of a bar with sets of matrices for forming types on a plurality of its faces, and means for fixing said bar in position such that one of its set of matrices lies in the molds, one matrix in each mold.

75. In a machine the combination of means for melting and feeding type-metal, a mold-plate, a set of matrices of types to be cast, and a cover-plate adapted to form with the mold-

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plate and matrices molds for casting a set of types, blocks in said molds attached to the cover-plate, whereby types, having partial stems, are formed in said molds, and means for
 5 moving the cover-plate relatively to the mold-plate, whereby the types extruded from the molds are allowed to fall away from the blocks on the cover-plate.

76. The combination of a pot, means for
 10 heating said pot, of a spout in which the space becomes broader and shallower toward the front and terminates in a plurality of holes, and means for closing and opening said holes such that any one or more of the holes may
 15 be opened or closed quite independently of the other holes.

77. The combination of a pot, means for heating said pot, a spout bifurcated at one end and broadened at the other end and terminating in a plurality of holes, and means for
 20 opening and closing said holes.

78. The combination of a pot, means for heating said pot, a spout means for casting types, means for expelling molten material
 25 from the pot through the spout to said casting means, a safety-valve connected to said spout, a return-pipe connecting the safety-valve to the pot, and means adapted in one position to prevent the molten material from
 30 passing into the casting means and in another position to allow said material to pass.

79. The combination of the mold-plate having on its surface a series of molds, a cover-plate therefor free to slide over the mold-plate, and of means for exhausting air from
 35 the molds in the mold-plate.

80. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of a particular kind,
 40 a detent connected to each chamber and adapted when rocked to release a type from said chamber, operating means connected to certain of said detents, a plate adapted to project beyond each of the latter chambers when
 45 the types therein are exhausted, and means adapted to operate in conjunction with each plate when so projecting to move the detent in one of the remaining chambers of the magazine.

81. In a machine the combination of a magazine comprising a series of chambers each adapted to receive types of a particular kind,
 50 a detent connected to each chamber and adapted when rocked to release a type from said chamber, operating means connected to certain of said detents, a plurality of plates and means supporting said plates each opposite
 55 one chamber of the magazine in such manner that said plate will project beyond said chamber when the types therein are exhausted, a plurality of bars extending across said magazine, means between each bar and one of the remaining detents of the magazine adapted to
 60 operate said detent when the bar is raised, and means operating in conjunction with the

projecting end of a plate aforesaid to raise one of said bars when the detent of a chamber empty of types is operated.

82. The combination of a channel, a releasing device at the bottom thereof, a pair of wheels having corrugations on their peripheries and supports for the wheels above said channel, means for rotating said wheels, a pin, means for moving said pin in such manner as to tend to make it project into the channel, at succeeding intervals, and means connected to said pin adapted to feed a strip of metal between the corrugating-wheels when the pin meets no obstruction in the channel.

83. In a machine the combination of a type-metal-melting and type-molding mechanism, means for intermittently operating said mechanism and for expelling cast types from the molds, a magazine for receiving said types, means for releasing required types from the magazine and for composing said types into a line, a tray, and means operating intermittently to expel types from the magazine onto the tray whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

84. In a machine the combination of a type-metal-melting and type-molding mechanism, means for intermittently operating said mechanism and for expelling cast types from the molds, a magazine for receiving said types, means for releasing types from said magazine and for composing said types into a line, a tray adapted in one position to form part of the wall of the magazine, and in another position to project laterally therefrom, means for expelling types from the magazine onto said tray, operating means connected to the expelling means aforesaid capable of a small displacement, and an intermittently-moving part adapted to intermittently operate the expelling means when its operating means is in one position, but not to operate said expelling means when its operating means is in the second position whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

85. In a machine the combination of a type-metal-melting and type-molding mechanism, means for intermittently operating said mechanism, and for expelling cast types from the molds, a magazine for receiving said types, means for releasing required types from the magazine and for composing said types into a line, a tray, means operating intermittently to expel types from the magazine onto the tray, a bar, and means connected to the intermittently-moving parts to raise said bar during a forward movement and allow it to fall during a backward movement whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

86. In a machine the combination of a type-metal-melting and type-molding mechanism, means for intermittently operating said mechanism and for expelling cast types from the molds, a receiver, means for releasing required types from the receiver and for composing said types into a line, a tray, means for expelling types in lines from the receiver onto the tray, and means attached to said tray such that it will divide the types into convenient and compact lots as they are expelled onto the tray whereby the machine may be employed to cast types and store them in a tray or compose them into lines at the will of the operator.

87. The combination of a composing-stick, a type-packer, a stop-bar, means for rotating said packer and simultaneously reciprocating said stop-bar, and a chute adapted to direct types to said packer.

88. The combination of a composing-stick, a line-rod adapted to slide longitudinally of said stick, an indicator, means for fixing said indicator in predetermined position relative to said stick, and means projecting from said indicator adapted to be operated by the line-rod when it reaches a certain position on said stick.

89. The combination of a composing-stick, a line-rod adapted to slide longitudinally of said stick, an indicator, a bell, a striker therefor, an arm on said line-rod, and arms connected to said striker and indicator adapted to be operated by the arm on the line-rod to sound the bell and move the indicator.

90. The combination of a composing-stick, graduations on the front of said stick, a line-rod adapted to slide longitudinally of said stick, an indicator, means for fixing said indicator in predetermined position relative to said stick, and means projecting from said indicator adapted to be operated by the line-rod when it reaches a predetermined graduation on the stick.

91. The combination of a frame, a composing-stick adapted to lie in said frame, means for feeding types onto said stick, means for applying tension to the line of types on said stick, a bolt adapted to slide vertically at the feeding end of said stick, means for expelling the filled stick from the frame, and means adapted to simultaneously raise the bolt behind the line of types on the stick and to withdraw the tension from the line of types.

92. In a machine the combination of a composing-stick, means for feeding types onto said stick, two rods extending longitudinally at rear of said stick, two plates, two arms connected to each of said plates one adapted to slide on each of said rods, a frame, means projecting from the arms aforesaid into the path of the frame in such manner that when the frame is raised said plates are allowed to fall into the line of types being composed on said stick, but when said frame is depressed said plates

are raised from the stick, a receptacle for types, means for moving said receptacle to position over said plates, and means for expelling types from said receptacle and simultaneously depressing the frame aforesaid whereby the plates are raised.

93. In a machine the combination of a composing-stick adapted to receive types, means for limiting and for indicating the length of the line of types composed on the stick, a receptacle adapted to contain types for filling up spaces in the line, a plate adapted to be inserted in the line of types being composed on the stick, means for moving said receptacle longitudinally of the line of types on the stick, the plate being formed in such manner that the receptacle will strike against it when moved along the line of types, and means for expelling the types from the receptacle into the line.

94. In a machine the combination of a composing-stick, two rods extending longitudinally at rear of said stick, two plates, two arms connected to each of said plates one adapted to slide on each of said rods, means for causing said plates to fall into position in a line of types being composed on the stick, a receptacle for types, means for moving said receptacle to position over the plates on said stick, means for expelling types from said receptacle between said plates in the line and for simultaneously raising said plates, means whereby the receptacle is moved back to the filling end of the stick when released, and means connected to the receptacle adapted to engage with the plates when in their raised position to move back said plates to the filling end of the stick.

95. The combination of a composing-stick, a mirror, arms connected to said mirror, and supports for said arms such that the mirror can be laid over the stick or turned back therefrom when required.

96. The combination of a composing-stick, means for supporting a line of types on said stick, a slide of approximately the length of the stick, a plurality of plates together adapted to form a pusher, and means for engaging said plates in a row on the slide, means for bringing a line-binder to the rear of the line on the stick, and means for operating the slide and plates thereon to bring the binder into engagement with the line of types.

97. In a machine the combination of a composing-stick, a galley, reciprocating means adapted on its forward movement to expel a line of types from the stick to the galley, a bar adapted to slide vertically at the rear of the galley and inclined projections mounted upon said expelling means and engaging in slots in said bar, whereby the bar is raised on the forward movement of the expelling means and is allowed to fall on the backward movement of said means.

98. In a machine the combination with two composing-sticks, means for moving said

sticks, two frames, and a line-justifying mechanism, of a mechanism for intermittently moving the sticks and the justifying mechanism comprising a continuously-moving shaft, a
 5 second shaft, a notched cam thereon, an arm and a projection thereon adapted to engage with the notched cam, means connected to said arm adapted to rotate the shaft carrying the notched cam when the projection is raised
 10 from the notch thereof, and means for raising the projection from the notch when required.

99. The combination of means for melting type-metal and a spout for feeding the same
 15 and having a passage therethrough, means for casting types, a projection on the spout, adapted to form a deep and narrow slot in the bases of the types and through which projection said passage is carried.

20 100. The combination of the frame *s*, the stick *u*, means for feeding types onto said stick, and the reflector with its hinged supports.

25 101. The combination of the frame *t*, the stick *v*, the box *y*, the bar 550, means for expelling binders from the box *y*, a pusher, and means for operating the pusher, bar 550, and binder-expelling apparatus.

30 102. In combination with a mold-plate, a carriage formed as a tank, and means for maintaining the supply of cooling fluid to said tank.

35 103. The combination of the mold-plate *h*, having a plurality of vertical walls 66 formed on its surface, the cover-plate *i* adapted to lie over said walls and a matrix-bar having matrices for casting type formed thereon.

40 104. The combination with the mold-plate *h*, and the cover-plate *i* of the tanks *k* and *l*, and means for causing water to circulate through said tanks.

45 105. The combination with the mold-plate *h* and cover-plate *i* of catches, supports therefor, studs connected to the cover-plate adapted to be engaged by said catches and having projections thereon, rods projecting from the mold-plate adapted to engage with the projections on the catches and with the studs aforesaid and means for moving the mold-plate backward and forward.

50 106. The box 454, means for supporting same, means for frictionally retaining type in said box and pusher adapted to expel type from said box.

55 107. The combination with a melting-pot for type-metal, of a spout in which the space becomes broader and shallower toward the front and terminates in a plurality of holes and means for opening and closing said holes such that any one or more of the holes may
 60 be opened or closed quite independently of the other holes.

108. The combination of a frame, a composing-stick adapted to lie in said frame, two

plates and means for supporting said plates in such manner that they may be composed
 65 at any desired point in the line on said stick, a box adapted to contain a few types, means for moving said box into operative position over the two plates aforesaid and to separate
 70 said plates by a required amount, and means for expelling the types from said box and into the line of types between the plates.

109. The combination of a frame, a composing-stick adapted to lie in said frame, a bolt adapted to project against the types on said
 75 stick, means for guiding said bolt in front of the composing-stick, means for applying tension to said bolt in one direction, means for moving the stick out from the frame, and
 80 mechanism adapted to withdraw the bolt from the path of the types when said stick begins to move.

110. The combination of a frame, a composing-stick adapted to lie in said frame, a bolt adapted to project against the types on said
 85 stick, means for guiding said bolt in front of the composing-stick, means for applying tension to said bolt in one direction, means for moving the stick out from the frame, mechanism adapted to withdraw the bolt from the
 90 path of the types when said stick begins to move, and to return said bolt to its initial operative position when the stick again comes into position for receiving type.

111. The combination with a line of types
 95 having a deep groove in the bases of the types, of a stick adapted to carry the line, a binder having a turned-up edge adapted to engage in the groove aforesaid, and means for applying the binder to the type-line.
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112. The pusher consisting of a slide having an undercut slot therein and a plurality of plates adapted to engage in a row in said
 105 slide and to form a pusher of any length within the limits of the slide according to the number of plates taken.

113. The combination of the bar having a notched edge, and the binder having a turned-up portion at the bottom and a turned-down
 110 portion at the top with spaces in the latter portion adapted to receive the parts of the bar projecting between the notches aforesaid.

114. In combination, a pair of interacting corrugating-wheels, means for operating said
 115 corrugating-wheels, a receiving-channel and means adapted to feed a strip of material to be corrugated to said wheels when the channel is not full of corrugated pieces.

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

SHANKER ABAJI BHISEY.

Witnesses:

HERBERT A. GILL,

LEONARD E. HAYNES.