No. 609,098. Patented Aug. 16, 1898.

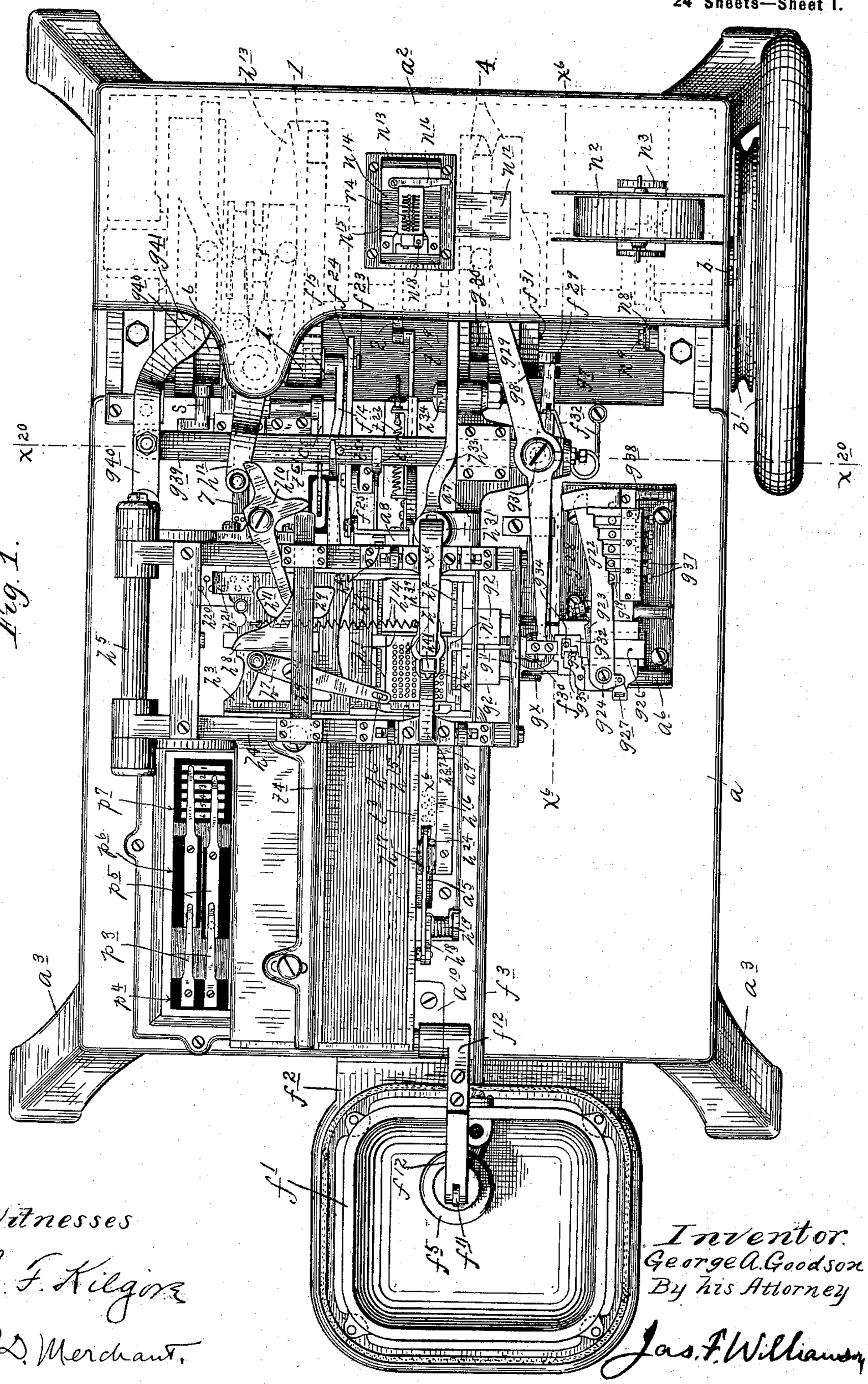
G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

(No Model.) 24 Sheets—Sheet 1.

Fig. 1.



Witnesses
C. F. Kilgore
P. D. Merchant.

Inventor
George A. Goodson
By his Attorney
Jas. F. Williamson

No. 609,098.

Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.)

(Application filed Sept. 27, 1897.)

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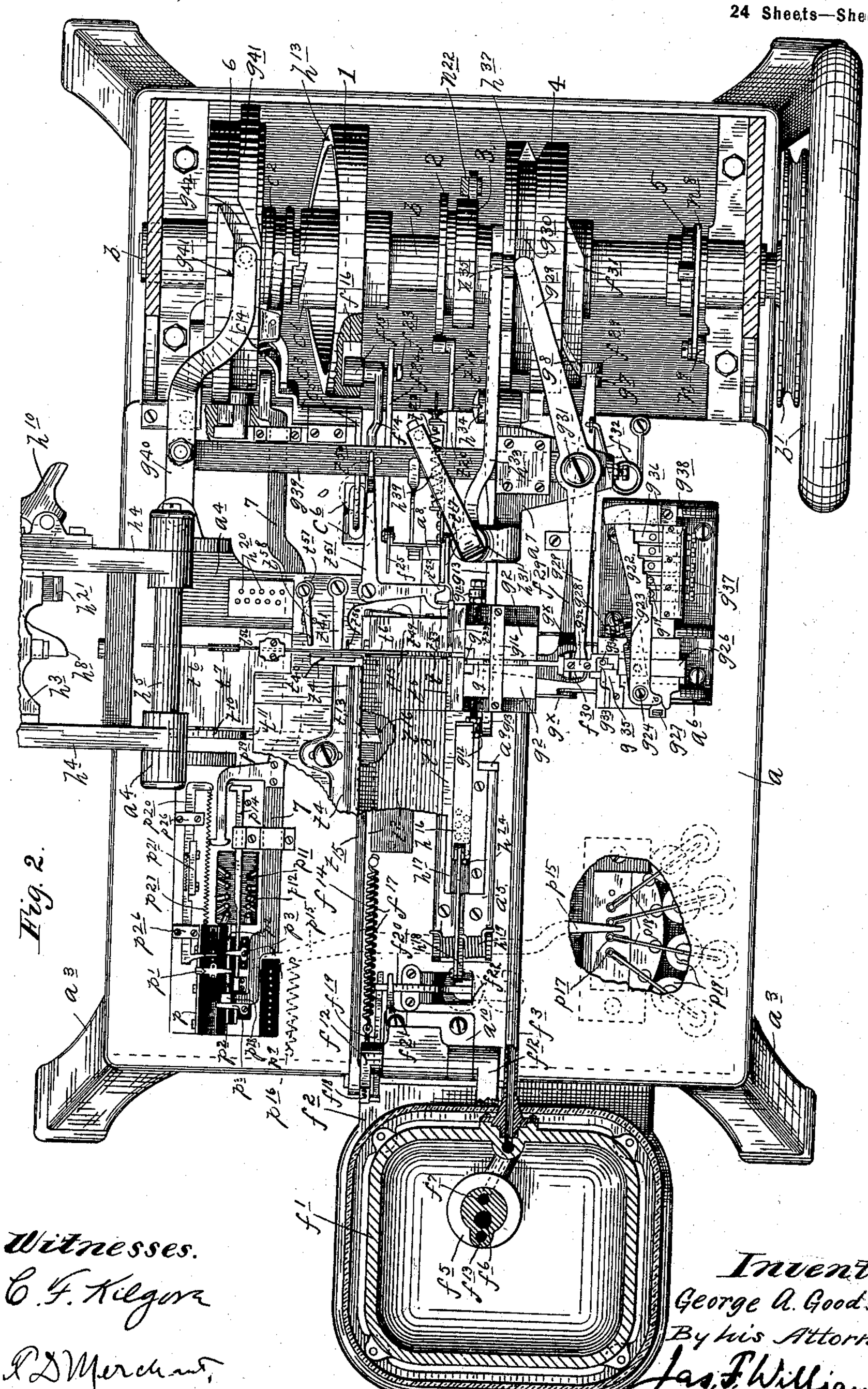

Fig. 2.

Witnesses.
C. F. Kilgore
P. D. Merchant,

Inventor.
George A. Goodson
By his Attorney.
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.) (Application filed Sept. 27, 1897.)

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Fig. 3.

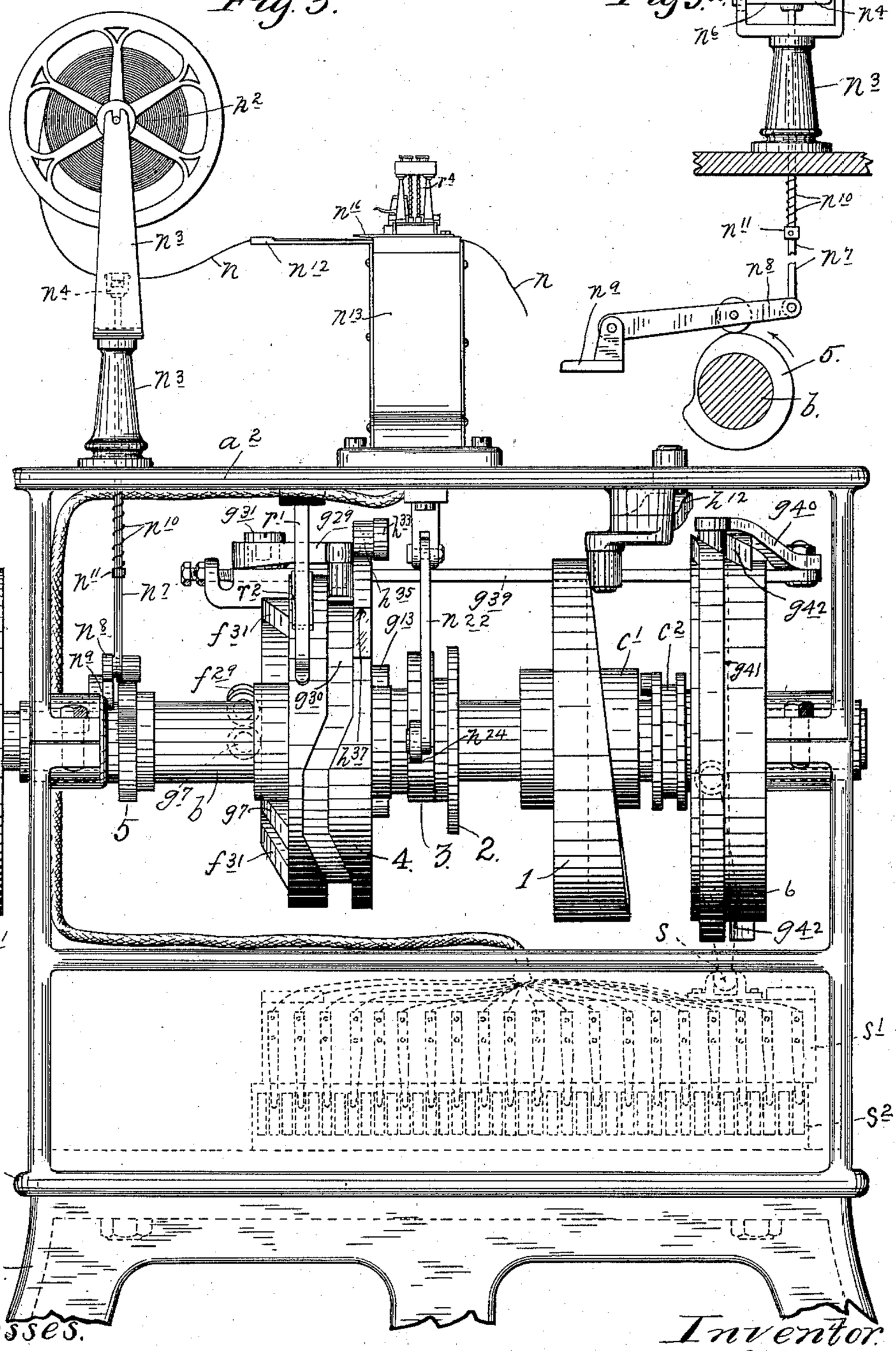

Fig. 3a.

Witnesses.
C. F. Kilgore
R. D. Merchant,

Inventor.
George A. Goodson
By his Attorney.
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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Fig. 4.

Fig. 4a.

Witnesses
C. F. Kilgore
F. D. Merchant.

Inventor
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By his Attorney
Jas. F. Williams.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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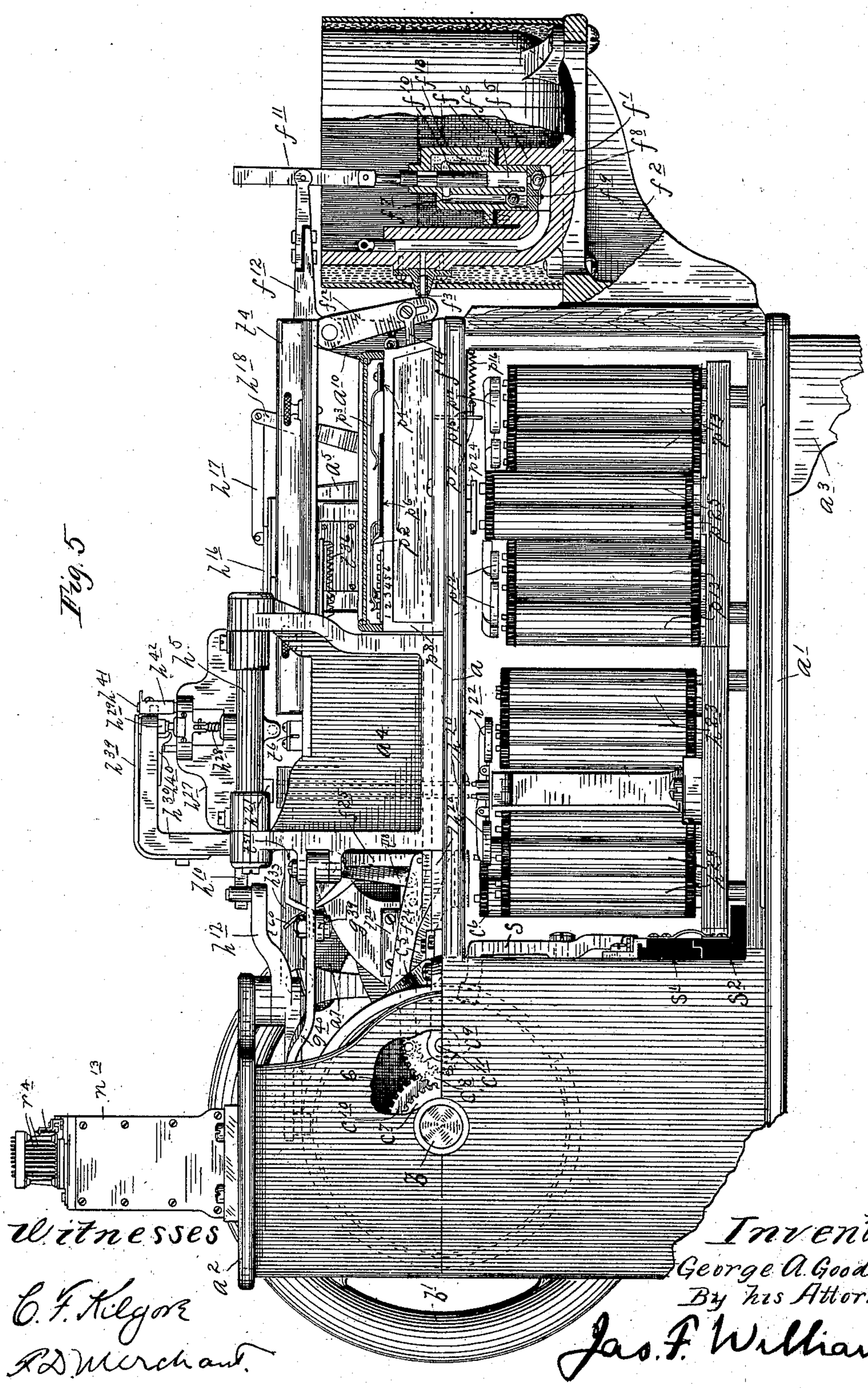
Fig. 5.



Witnesses

C. F. Kilgore

R. D. Merchant.

Inventor.

George A. Goodson

By his Attorney

Jas. F. Williamson.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

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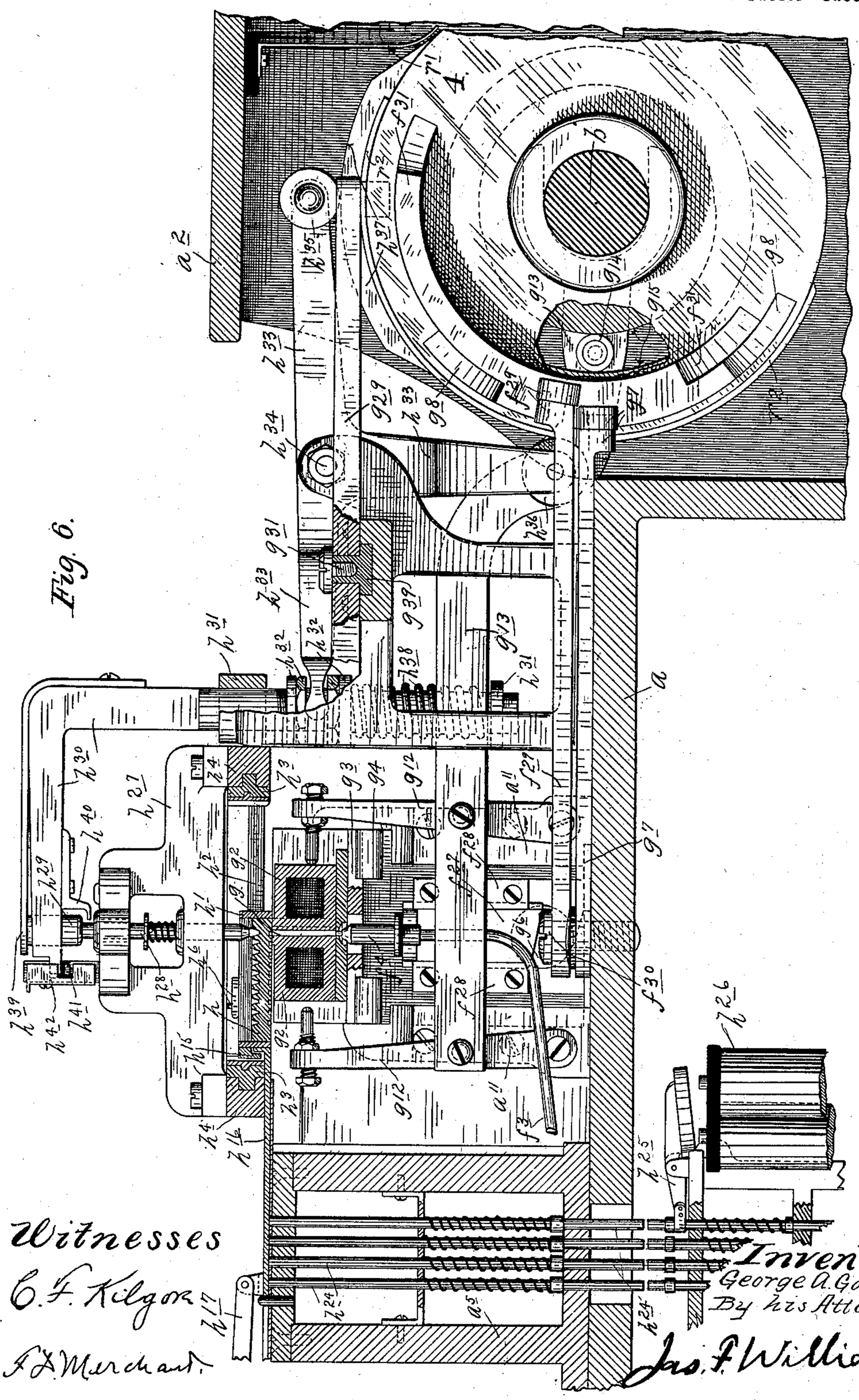
Fig. 6.



Witnesses
C. F. Kilgore
F. A. Merchant.

Inventor:
George A. Goodson.
By his Attorney
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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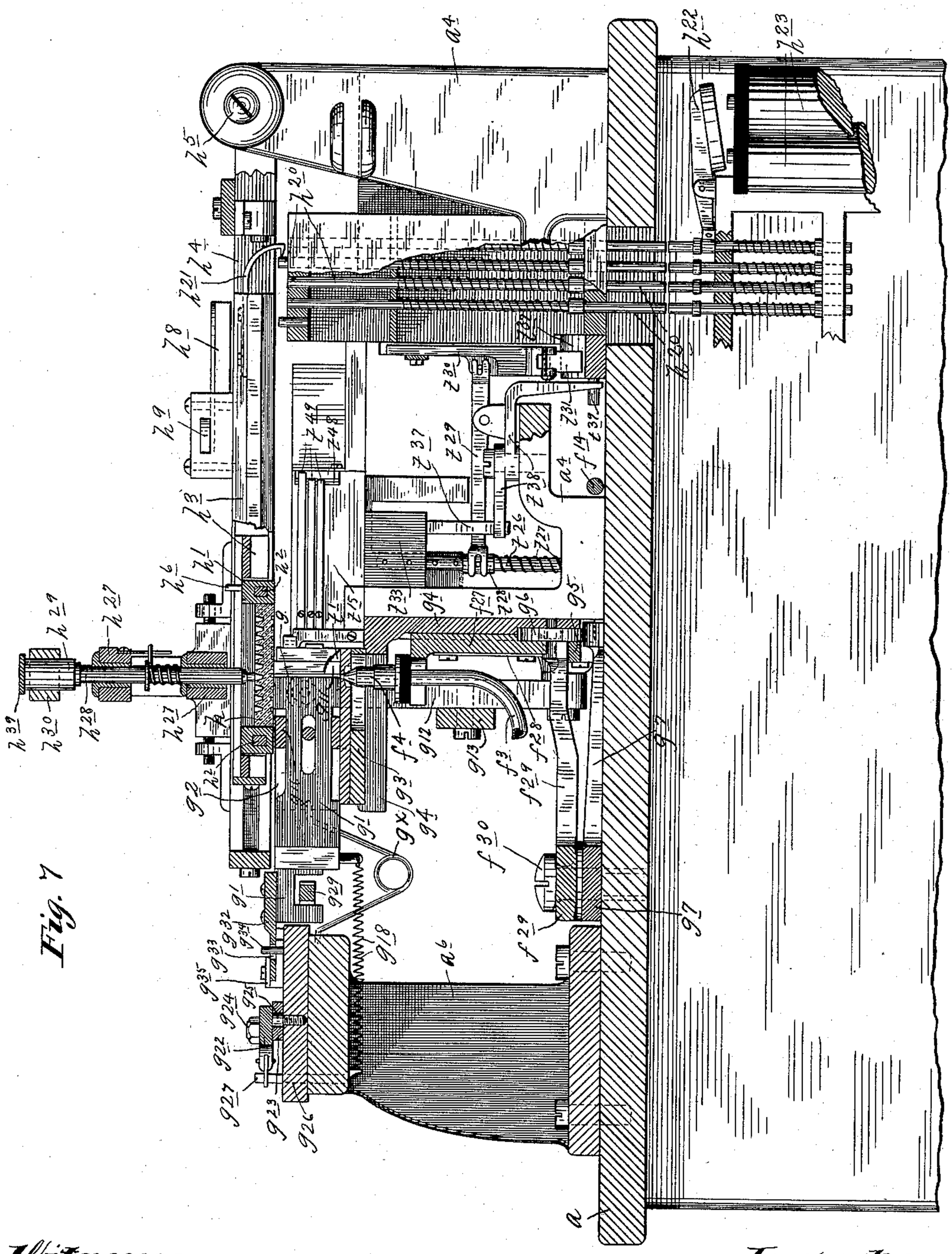

Fig. 7

Witnesses.
C. F. Kilgore
F. B. Merchant.

Inventor:
George A. Goodson
By his Attorney.
Jas. F. Williamson.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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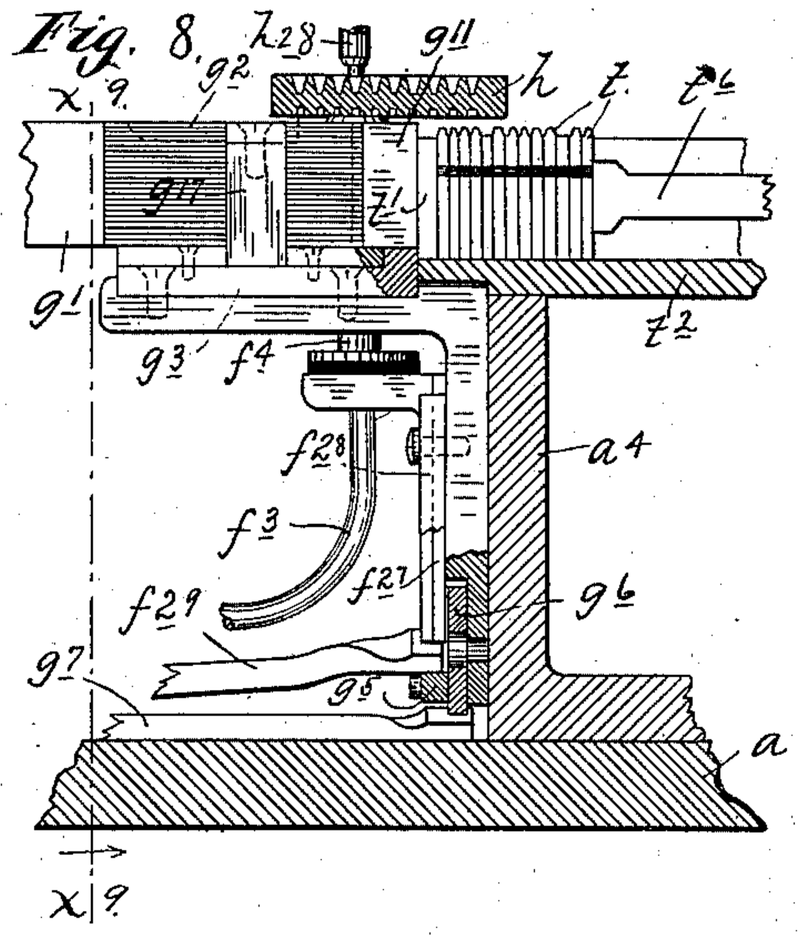
Fig. 8.



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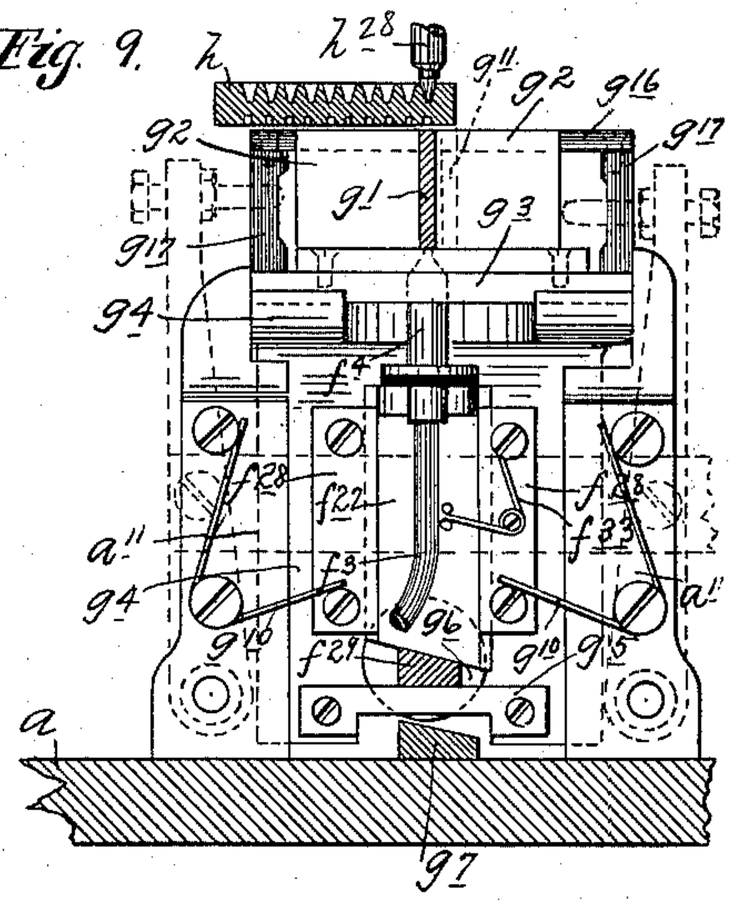

Fig. 10

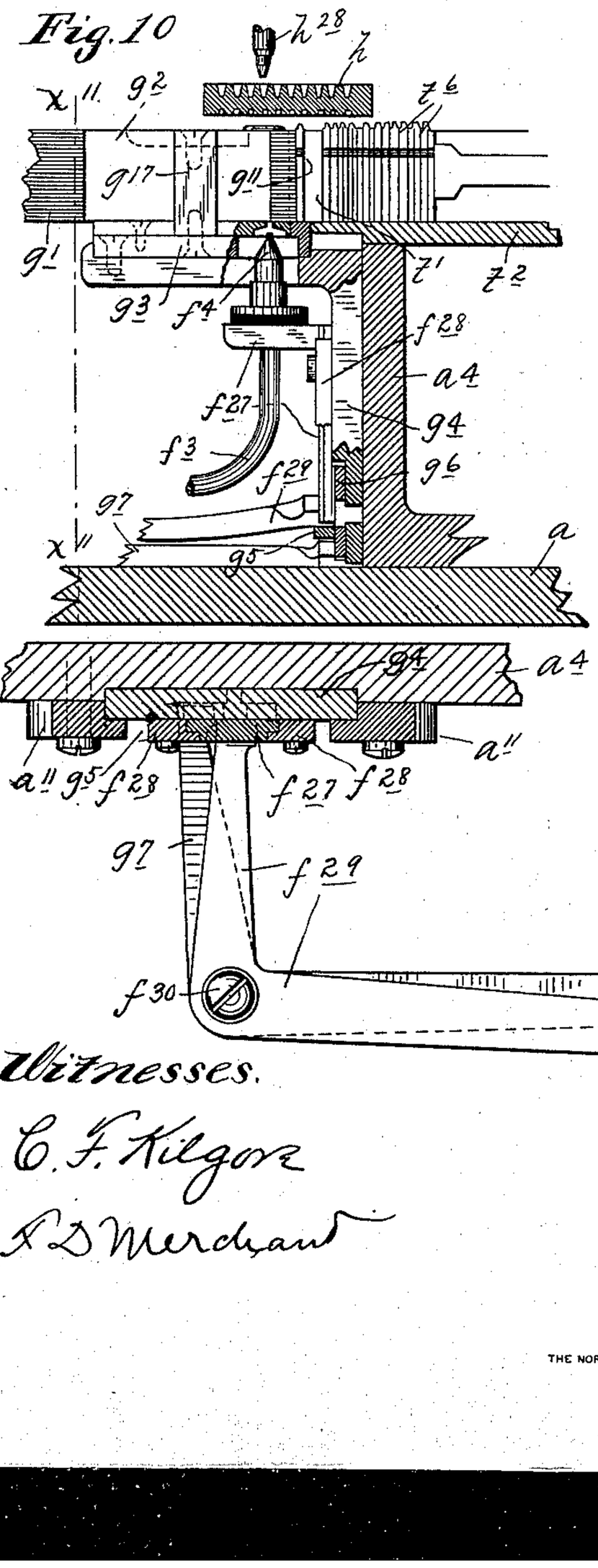

Fig. 11.

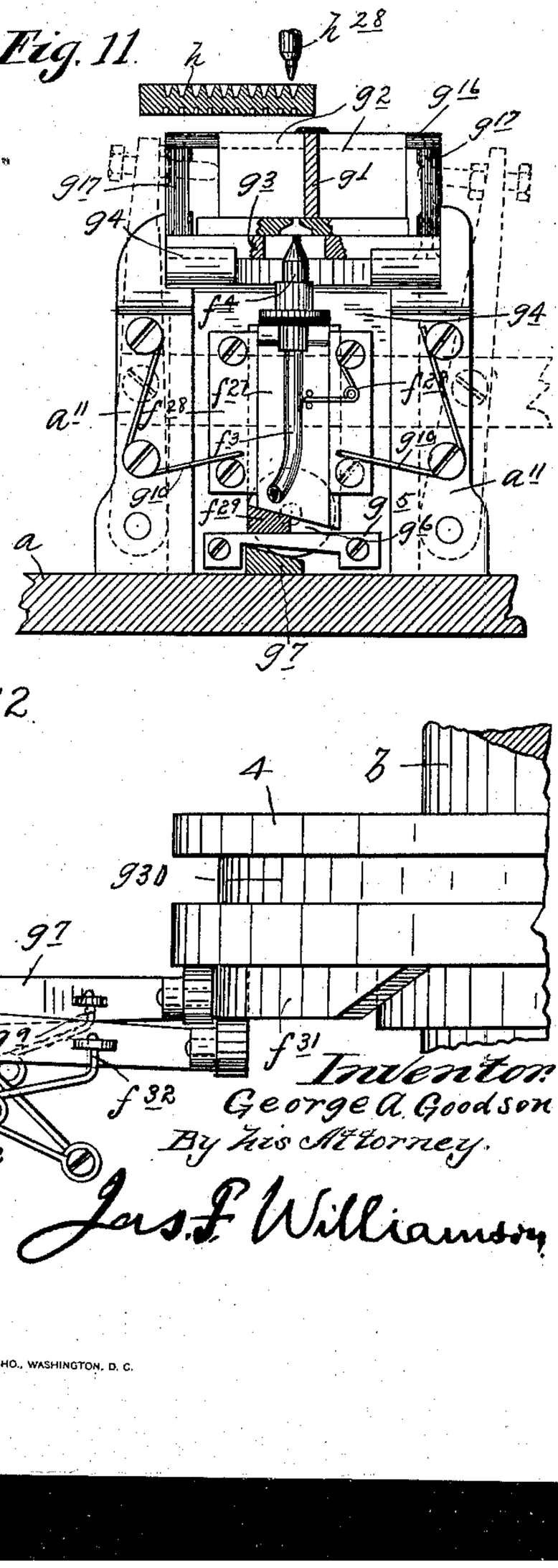

Fig. 12.

Witnesses.

C. F. Kilgore

F. D. Merchant

Inventor:

George A. Goodson

By his Attorney.

Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

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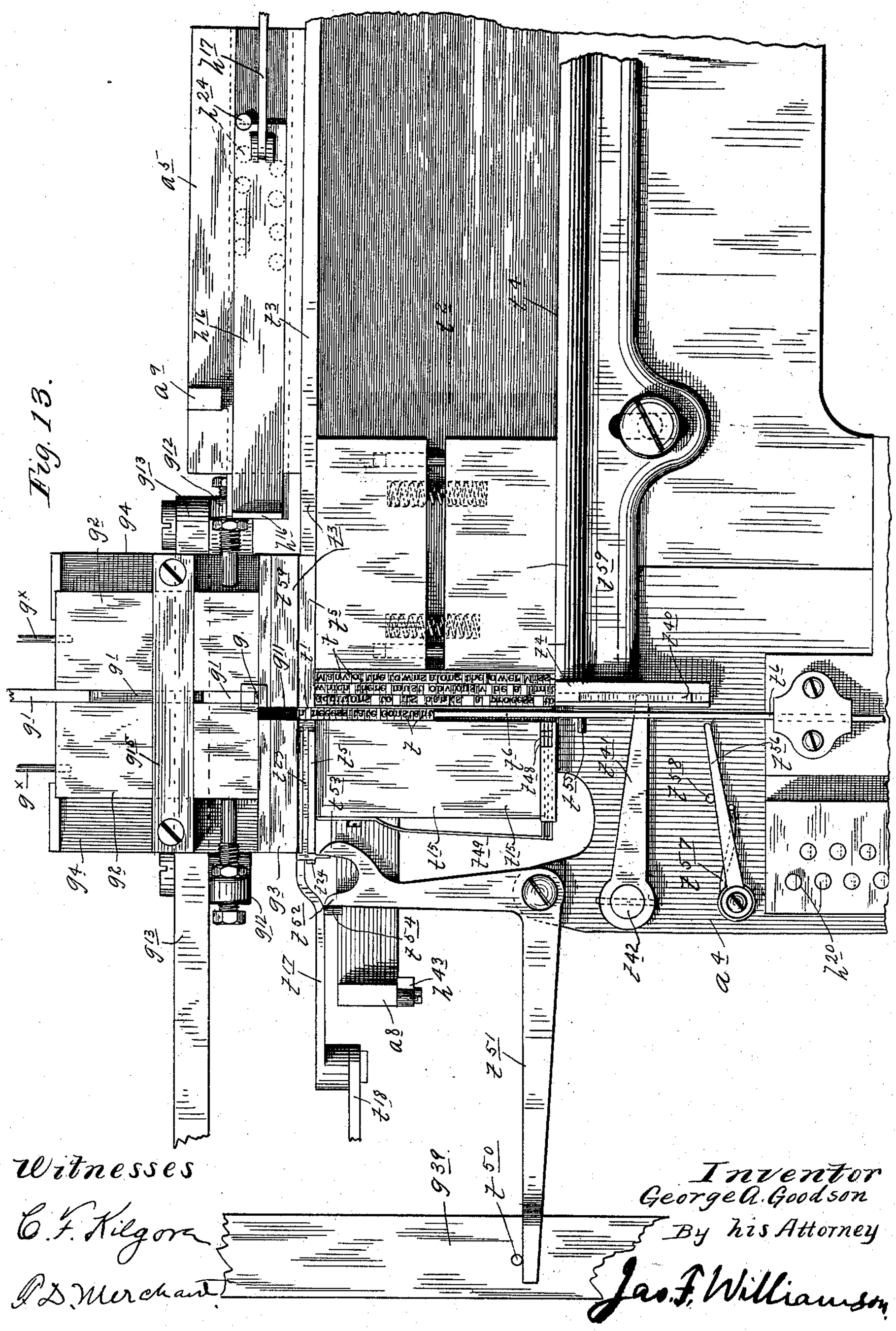
Fig. 13.



Witnesses
C. F. Kilgore
P. D. Merchant

Inventor
George A. Goodson
By his Attorney
Jas. F. Williamson

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TYPE CASTING AND SETTING MACHINE.

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Fig. 17.

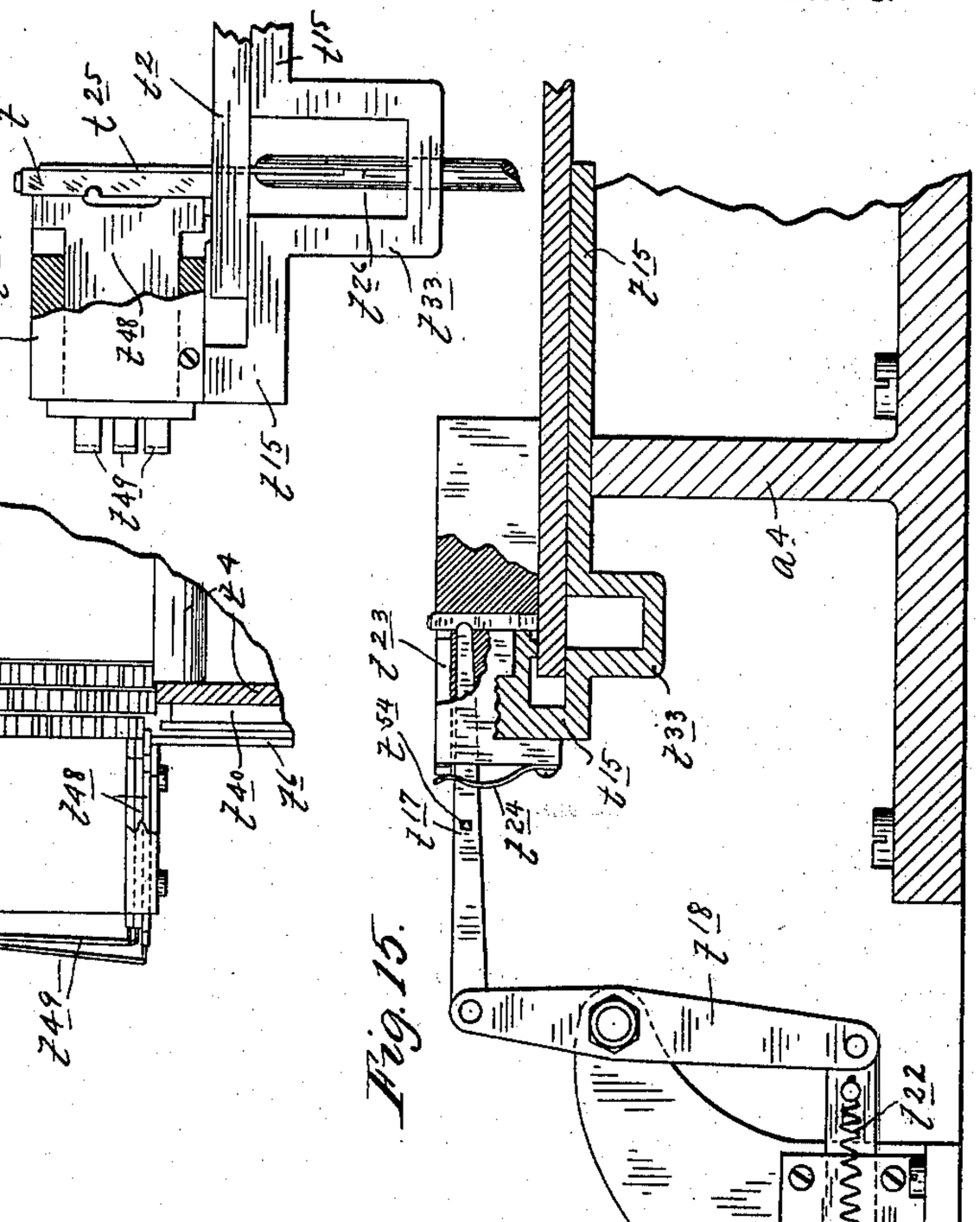


Fig. 16.

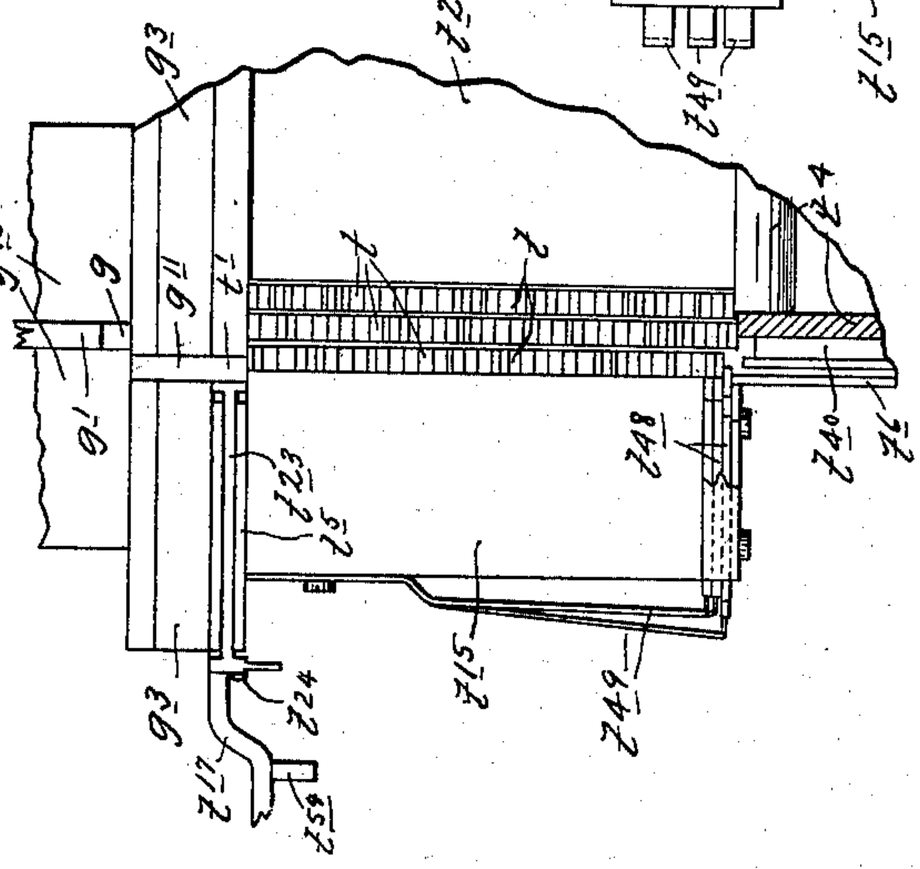
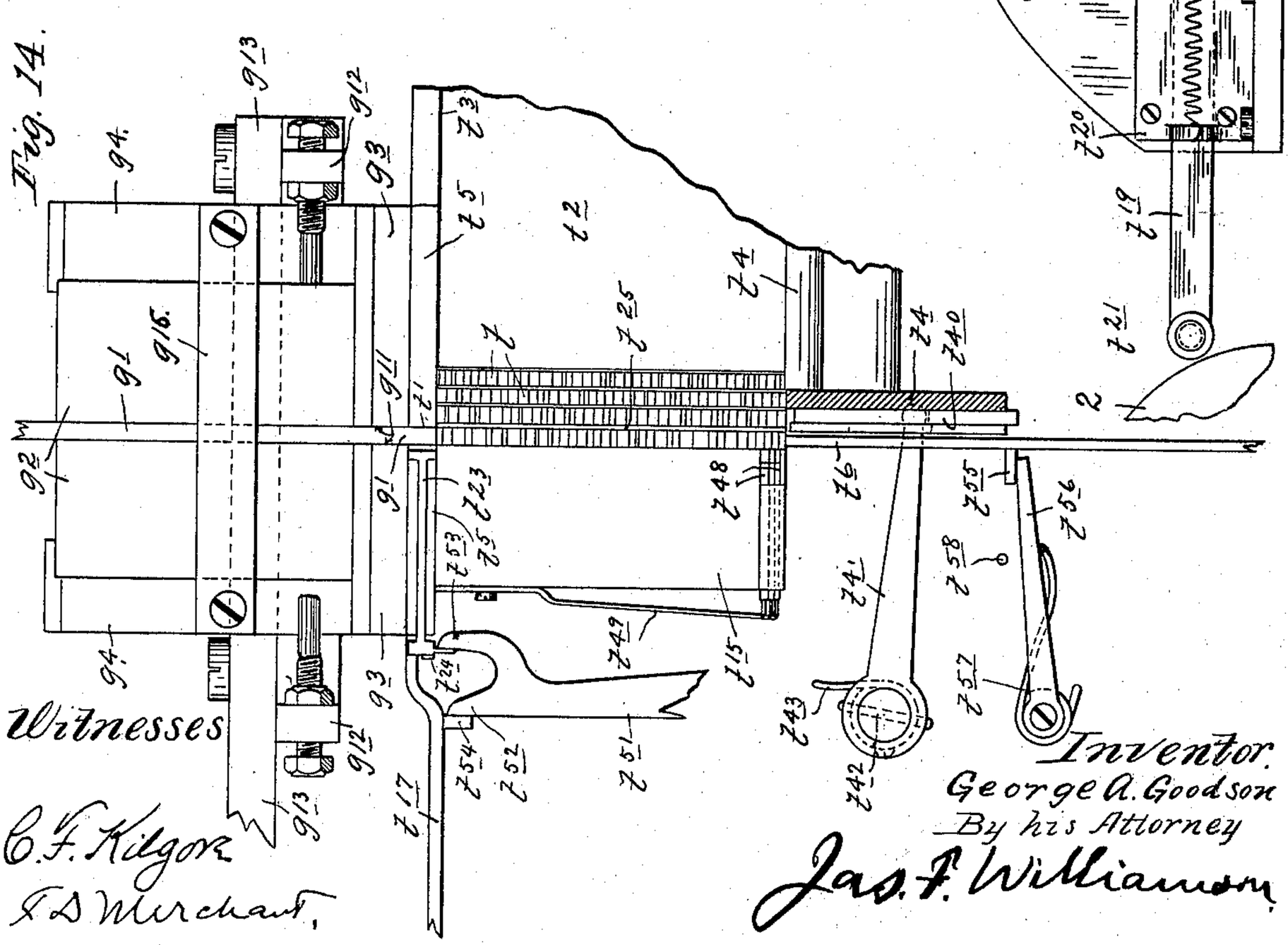


Fig. 15.

Fig. 14.



Witnesses

C. F. Kilgor

F. S. Merchant.

Inventor.

George A. Goodson

By his Attorney

Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

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Fig. 19.

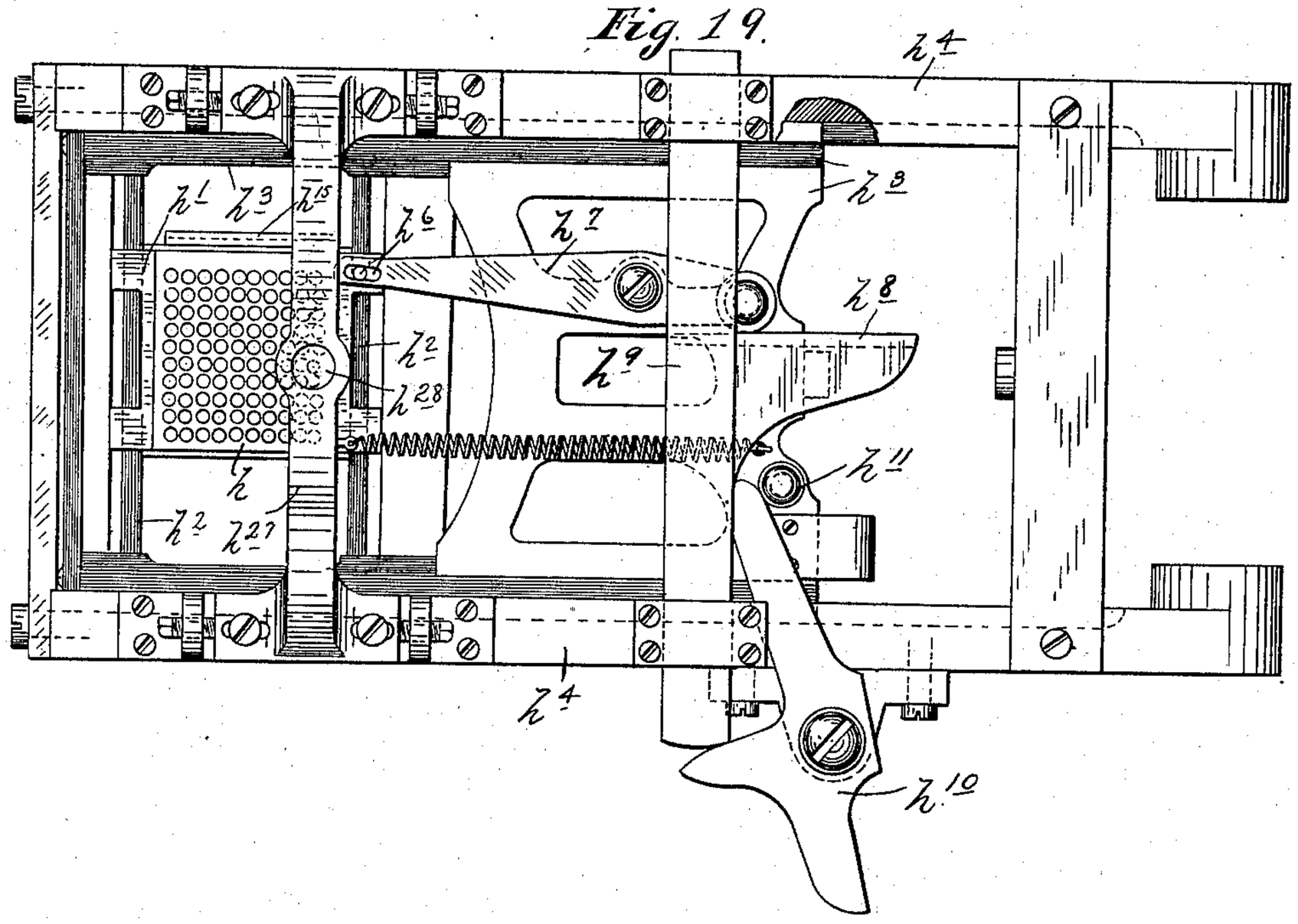
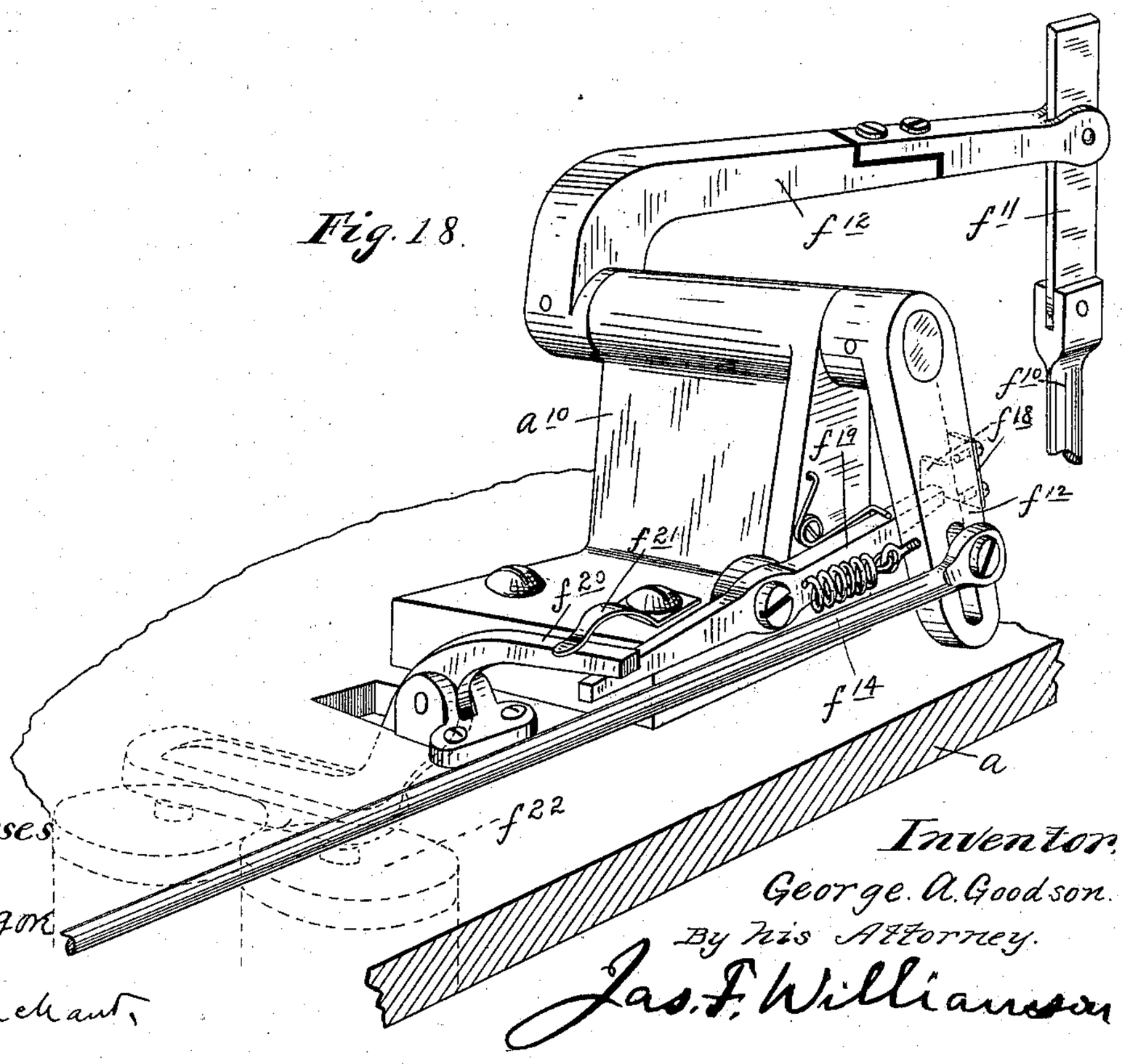


Fig. 18.



Witnesses

C. F. Kilgor

F. D. Merchant.

Inventor.

George. A. Goodson.

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Jas. F. Williamson

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(Application filed Sept. 27, 1897.)

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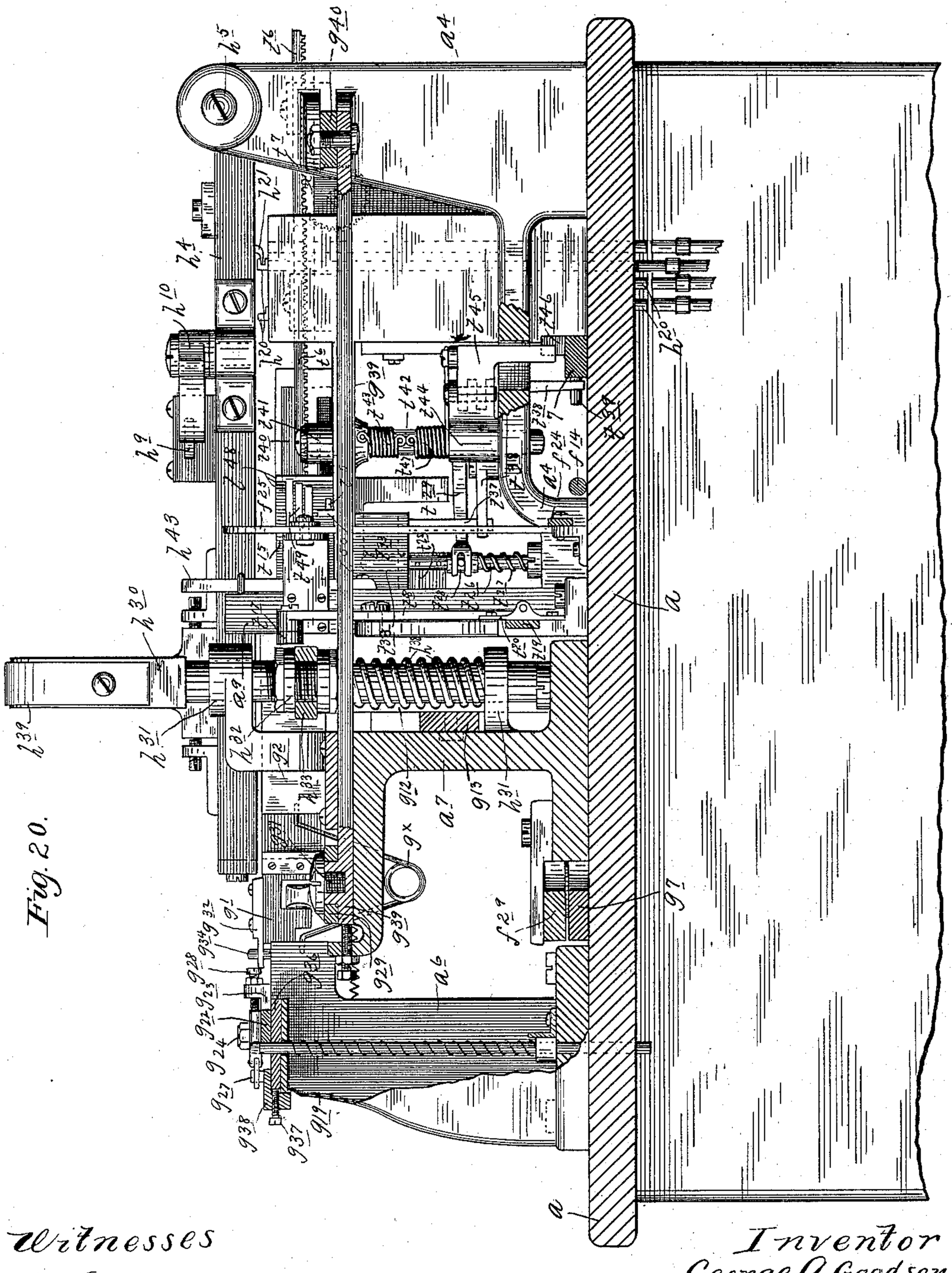

Fig. 20.

Witnesses
C. F. Kilgore
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Inventor
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By his Attorney
Jas. F. Williamson

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G. A. GOODSON.

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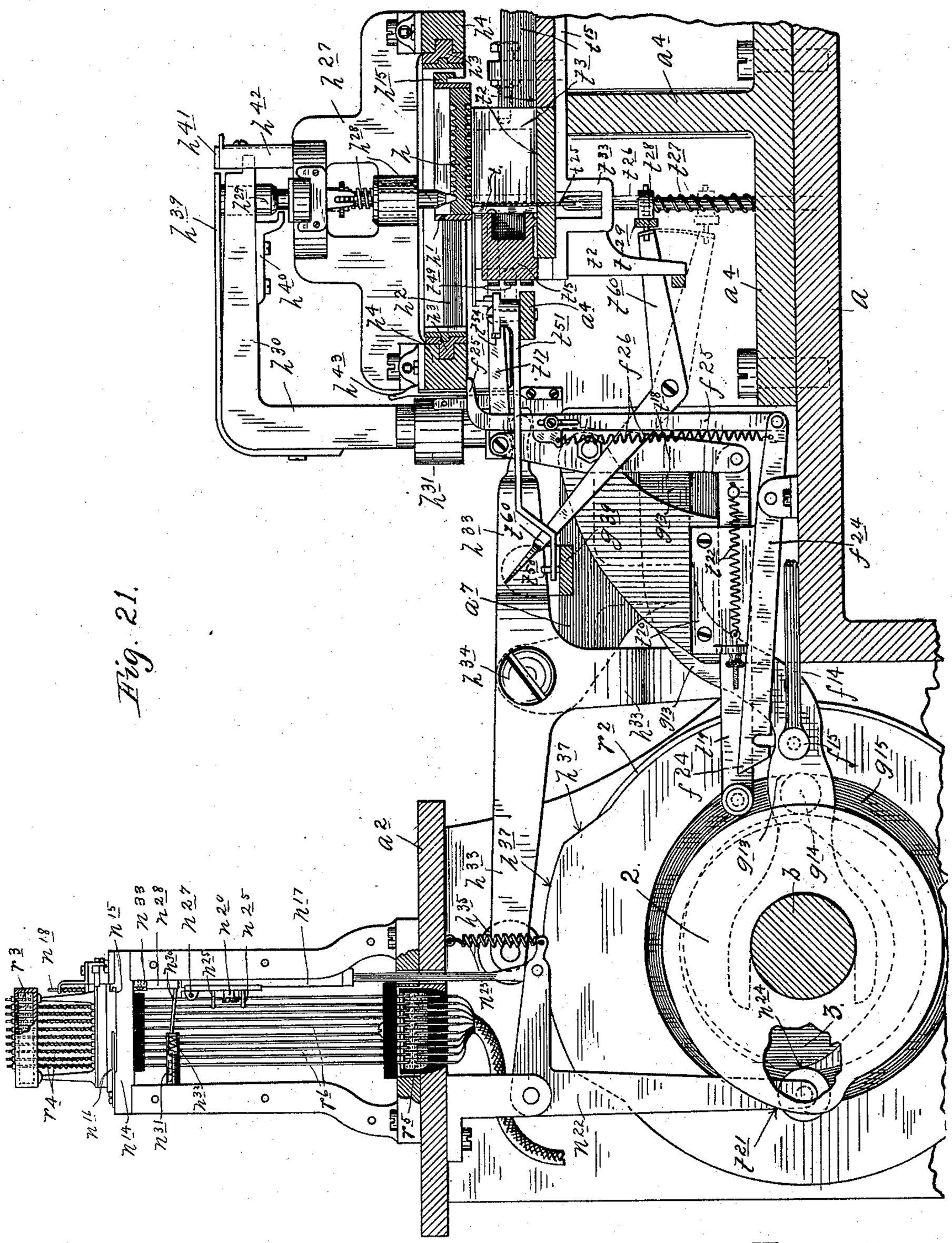

Fig. 21.

Witnesses.
C. F. Kilgor
F. D. Merchant.

Inventor.
George A. Goodson.
By his Attorney.
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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Fig. 26.

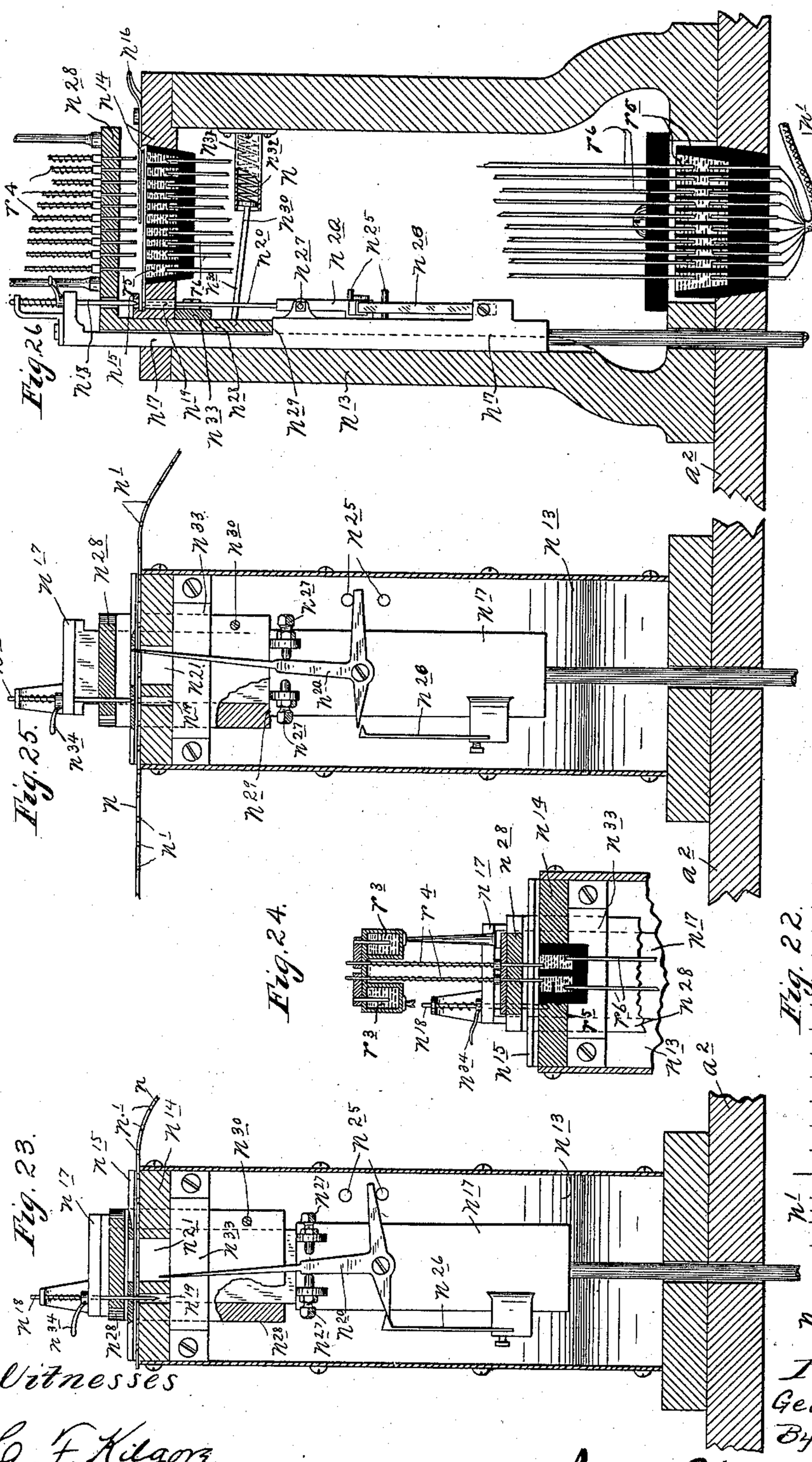
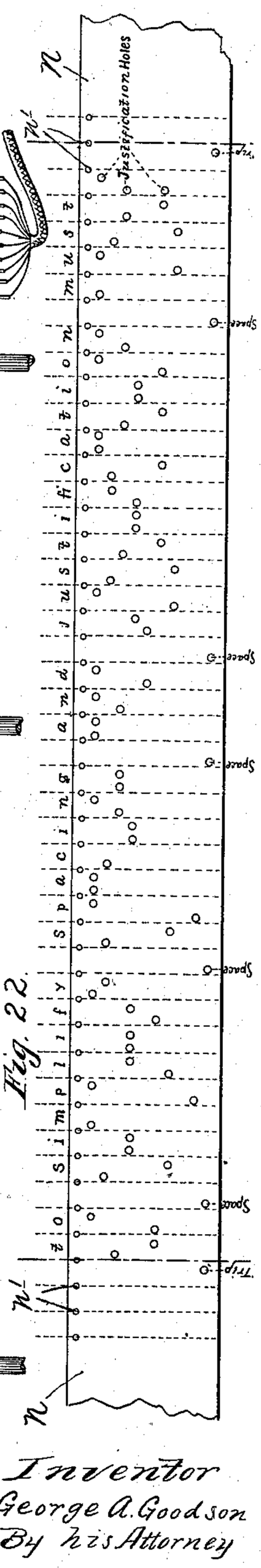


Fig. 25.

Fig. 24.

Fig. 23.

Fig. 22.



Witnesses

C. F. Kilgore

F. D. Merchant.

Inventor

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By his Attorney

Jas. F. Williamson.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.) (Application filed Sept. 27, 1897.)

24 Sheets—Sheet 15.

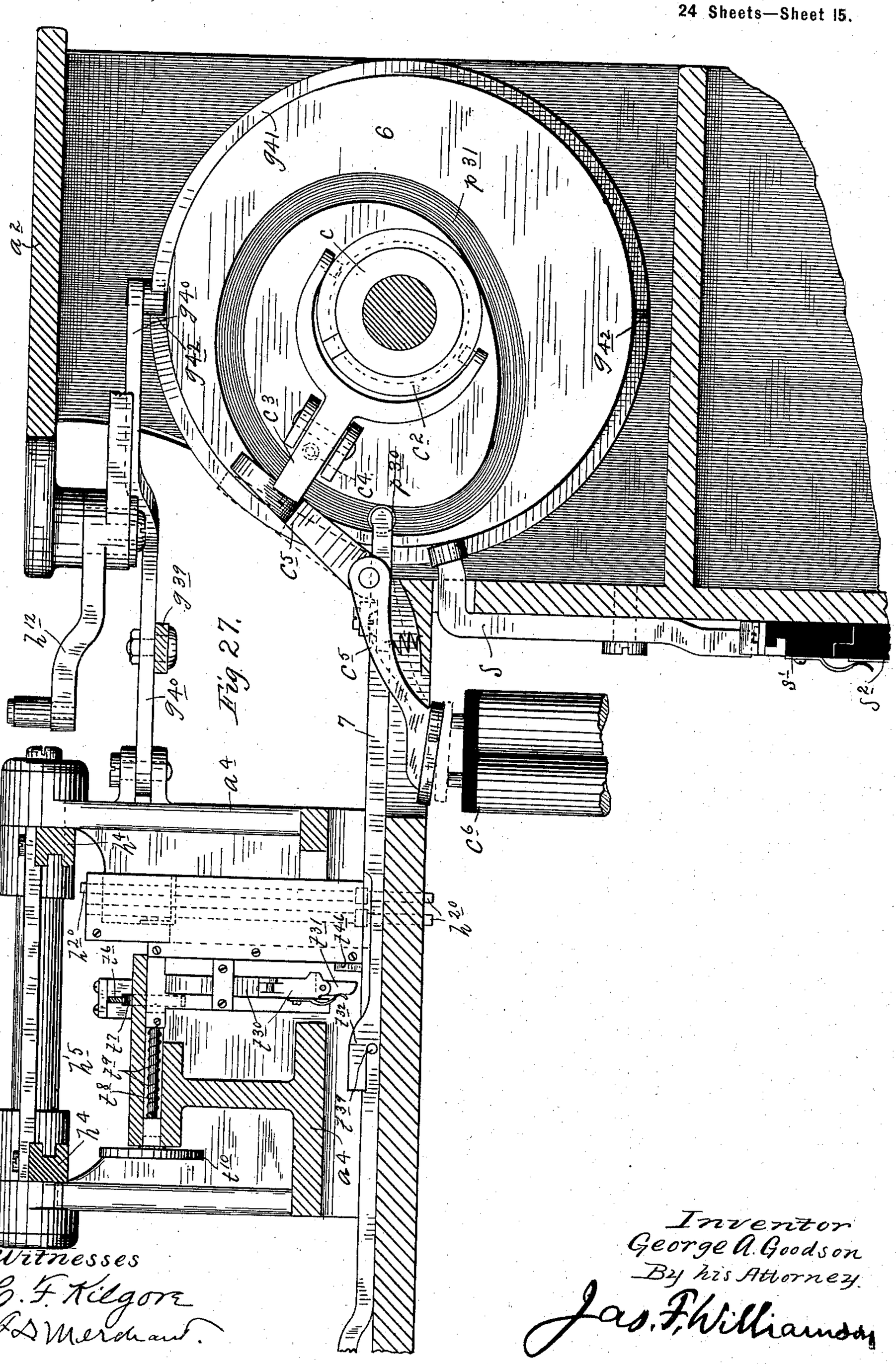


Fig 27.

Witnesses
C. F. Kilgore
L. D. Merchant.

Inventor
George A. Goodson
By his Attorney.
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

(No Model.) 24 Sheets—Sheet 16.

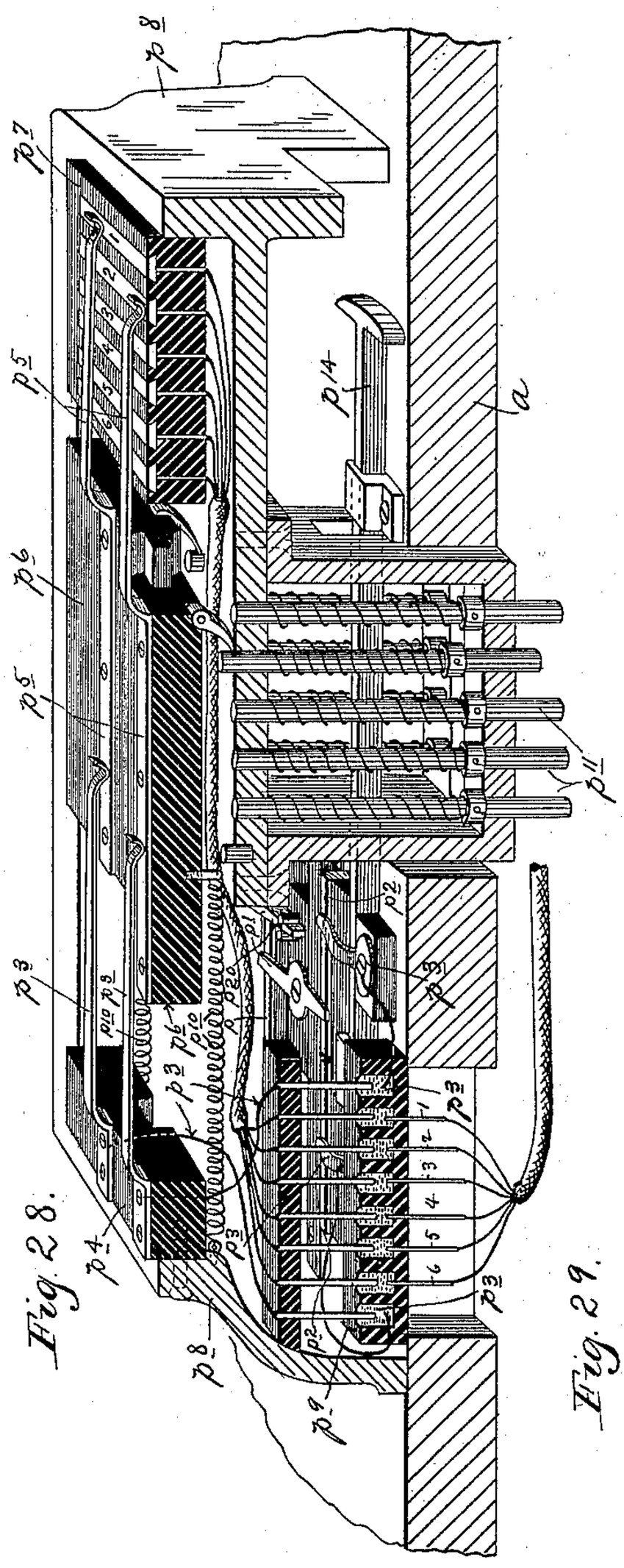


Fig. 28.

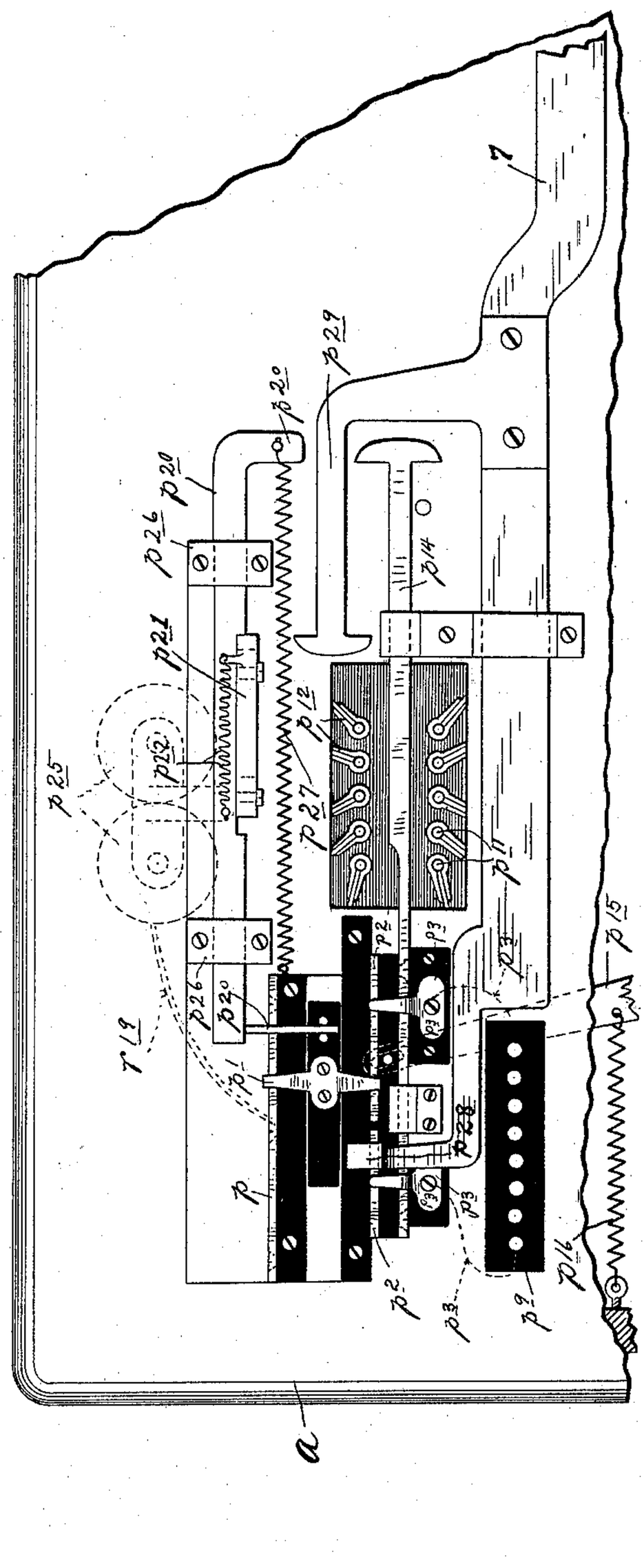


Fig. 29.

Witnesses.
C. F. Kilgore
P. D. Merchant.

Inventor
George A. Goodson
By his Attorney
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.) (Application filed Sept. 27, 1897.) 24 Sheets—Sheet 17.

Fig. 30.

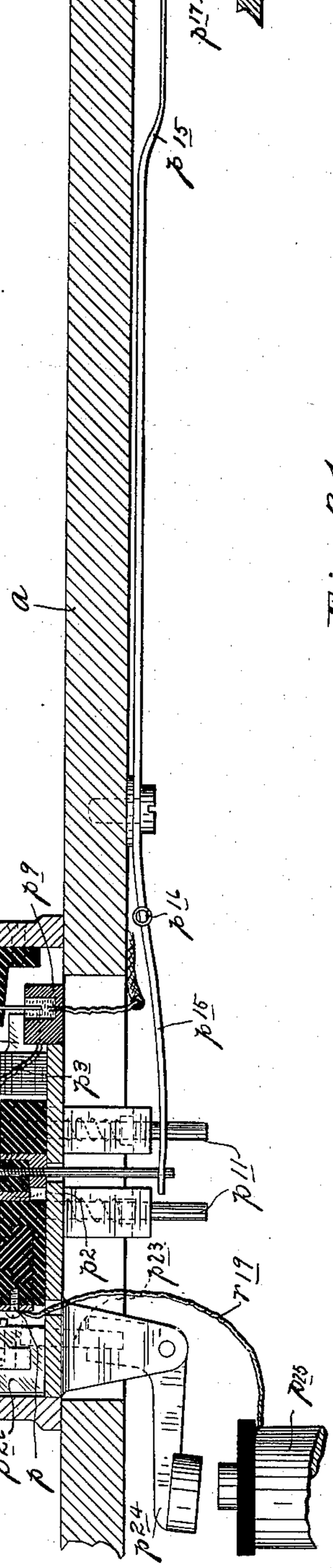
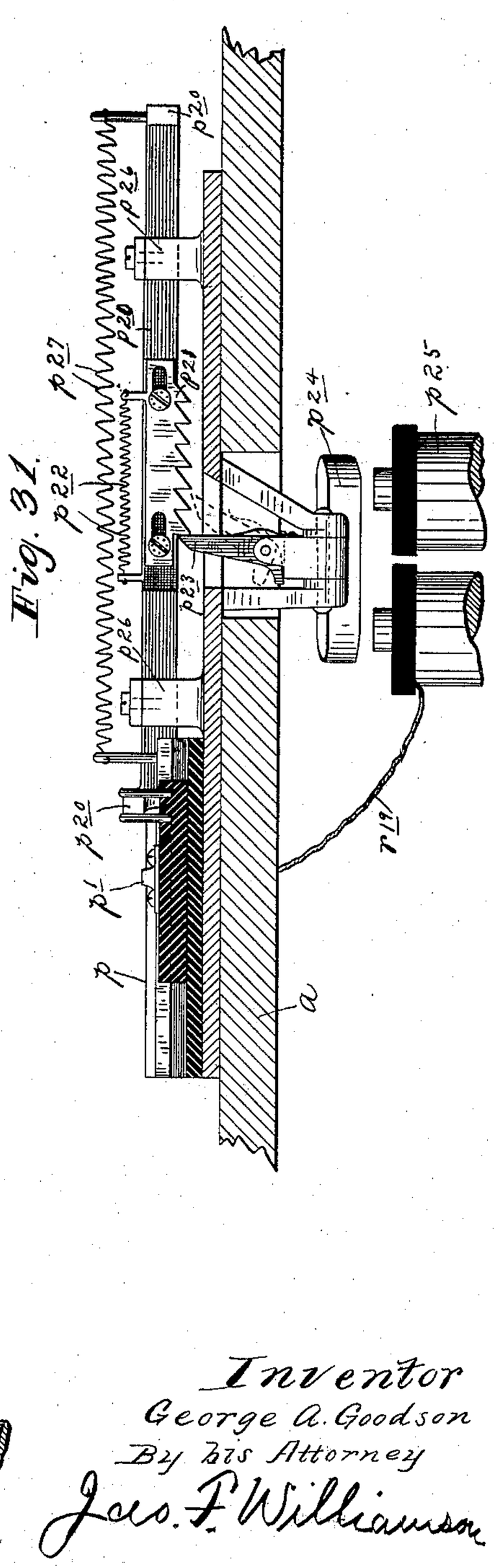


Fig. 31.



Witnesses
C. F. Kilgore
R. D. Merchant.

Inventor
George A. Goodson
By his Attorney
Jno. F. Williamson

No. 609,098.

Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.)

(Application filed Sept. 27, 1897.)

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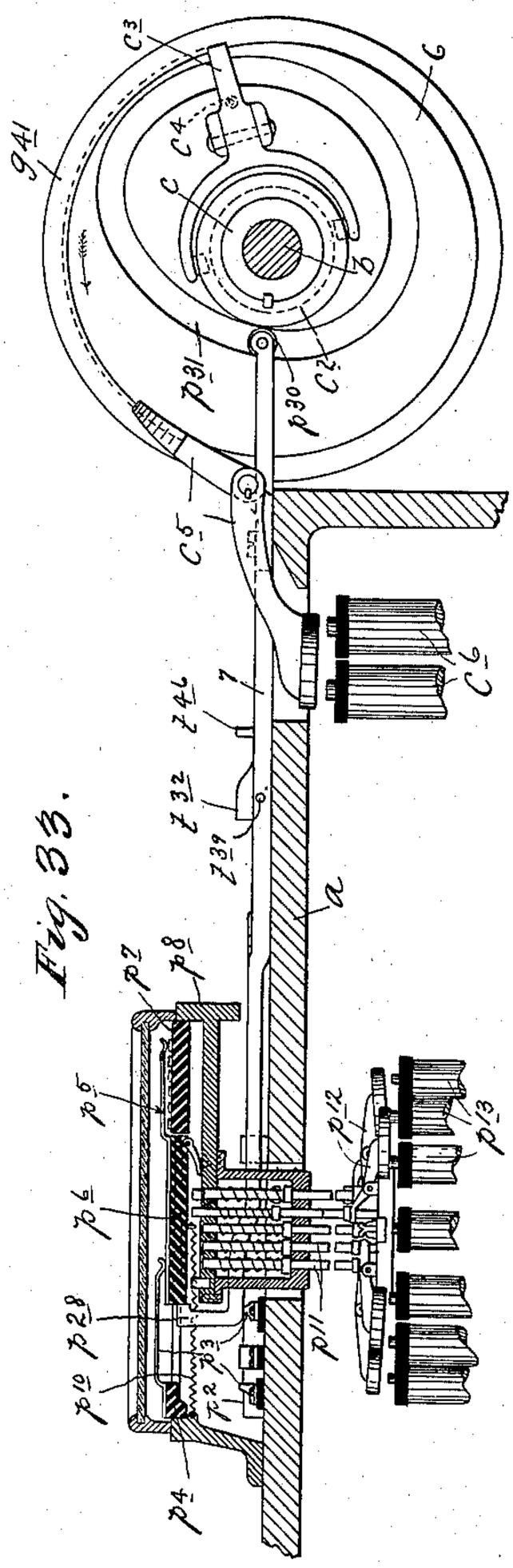

Fig. 33.

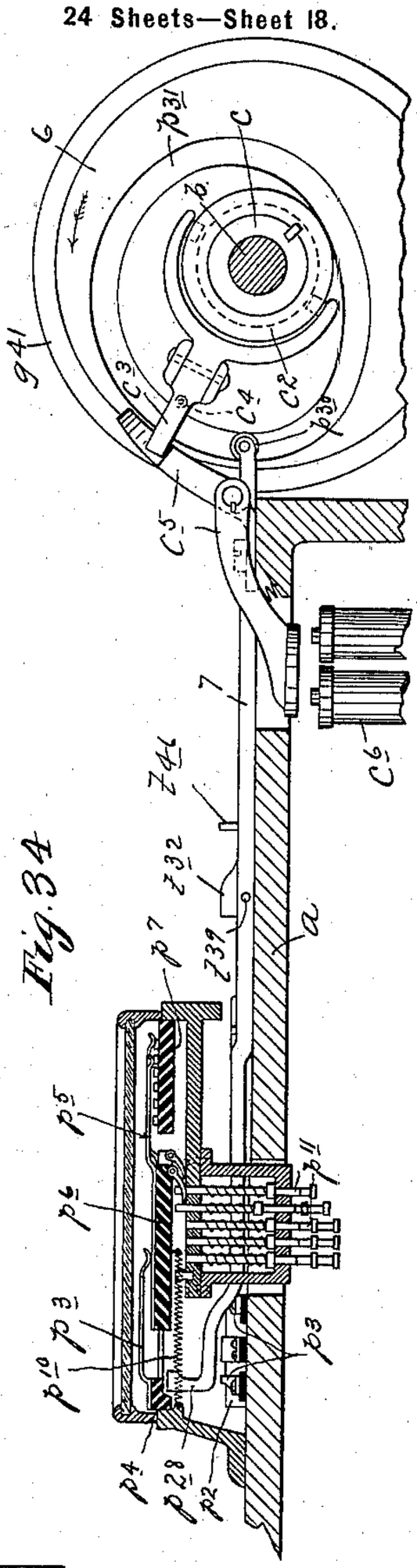

Fig. 34.

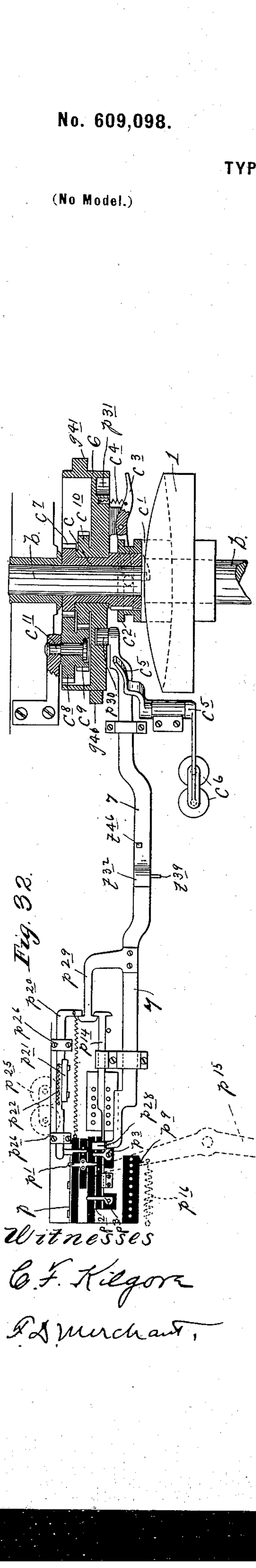

Fig. 32.

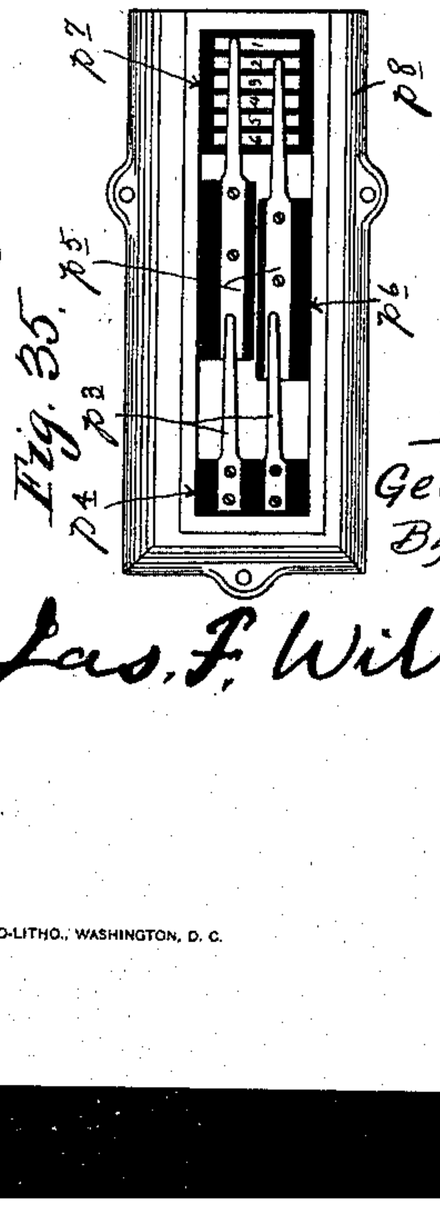

Fig. 35.

Witnesses

C. F. Kilgore

P. S. Merchant,

Inventor

George A. Goodson

By his Attorney

Chas. F. Williamson,

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.) (Application filed Sept. 27, 1897.)

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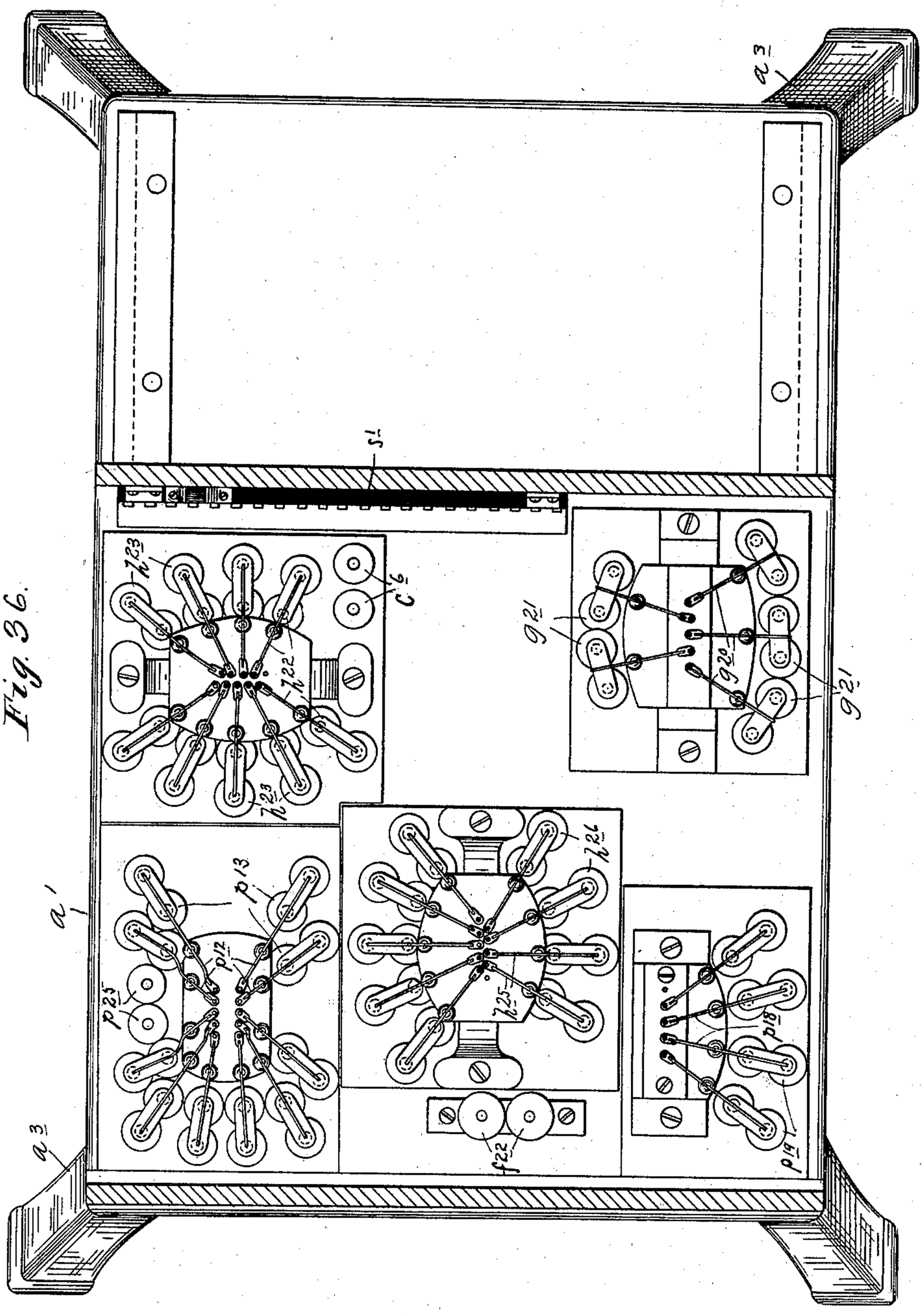
Fig. 36.



Witnesses.

C. F. Kilgore

L. D. Merchant.

Inventor:
George A. Goodson

By his Attorney,
Las. F. Williamson.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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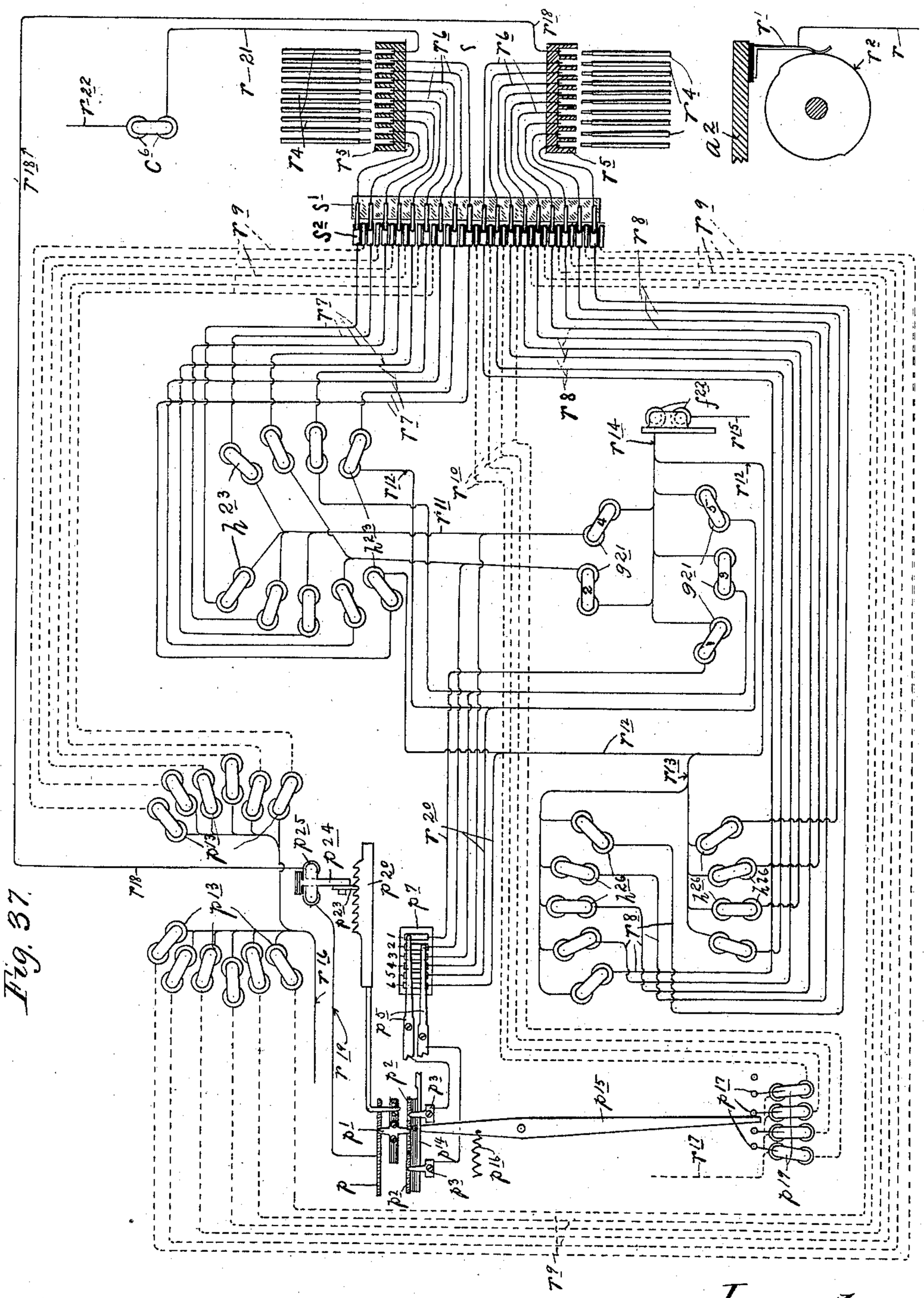

Fig. 37.

Witnesses.
C. F. Kilgora
F. D. Merchant.

Inventor.
George A. Goodson
By his Attorney.
Jas. F. Williamson.

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

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Fig. 38.

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7	1	2	1		2	3	2		4	3	4		5	4	3		7
8	2	2	0		2	3	2		4	3	4		5	4	2		8
4	1	2	3	-7	2	3	1	-1	5	4	1	+5	6	5	3	+11	4
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7	2	2	0		2	3	1		4	3	5		5	4	4		7
8	3	2	1		2	3	1		4	3	5		5	4	3		8
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Witnesses.
C. F. Kilgor
R. D. Merchant

Inventor
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By his Attorney,
Jas. F. Williamson

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G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(No Model.) (Application filed Sept. 27, 1897.)

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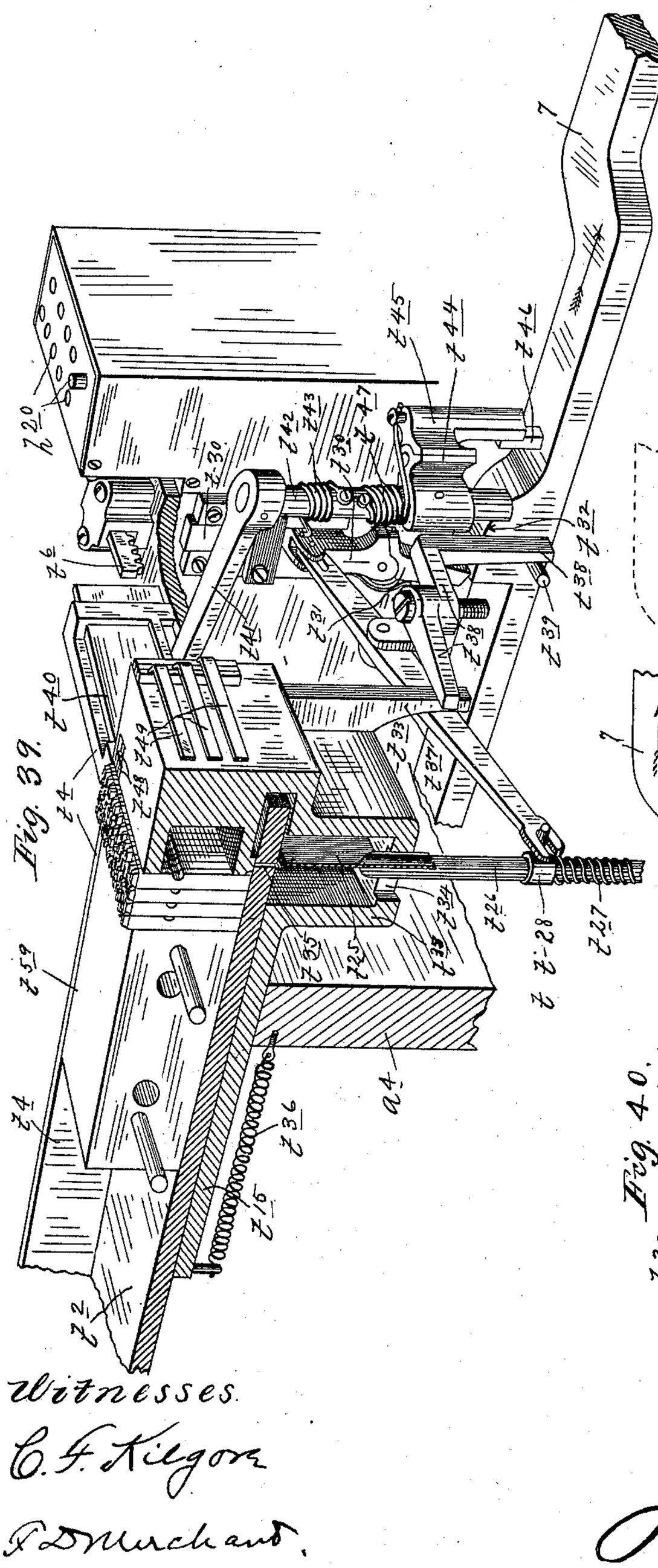

Fig. 39.

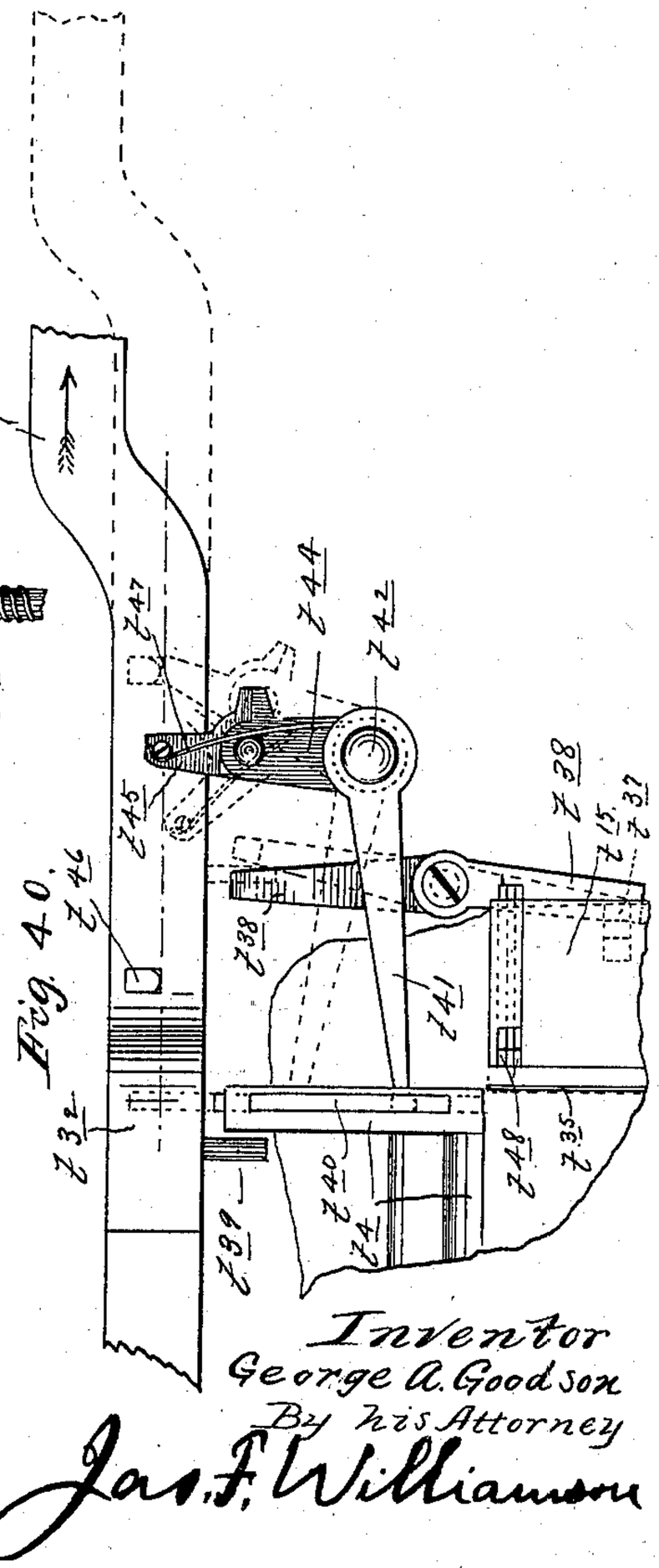

Fig. 40.

Witnesses.
C. F. Kilgore
F. D. Merchant.

Inventor
George A. Goodson
By his Attorney
Jas. F. Williamson

No. 609,098. Patented Aug. 16, 1898.

G. A. GOODSON.

TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

(No Model.) 24 Sheets—Sheet 23.

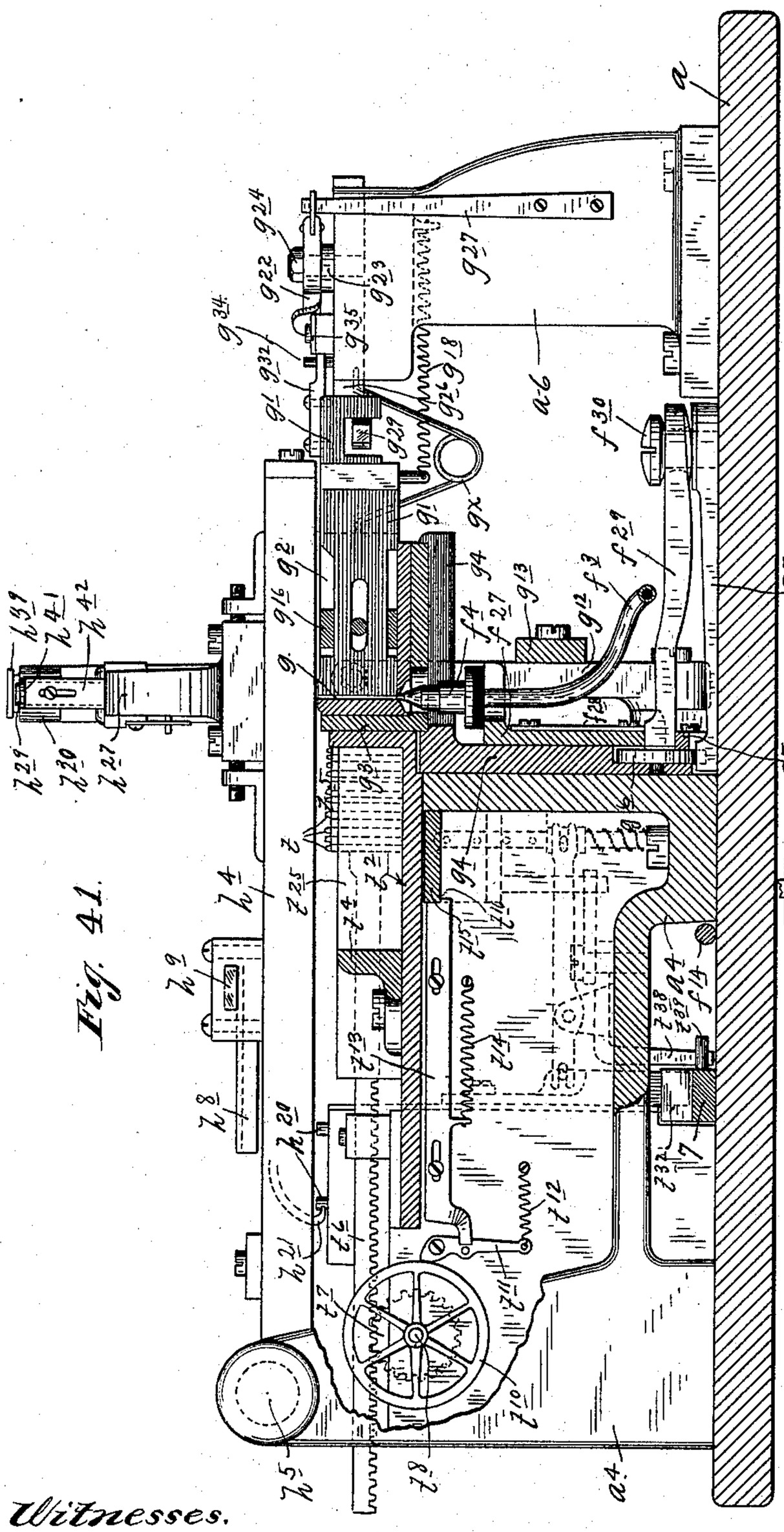

Fig. 41.

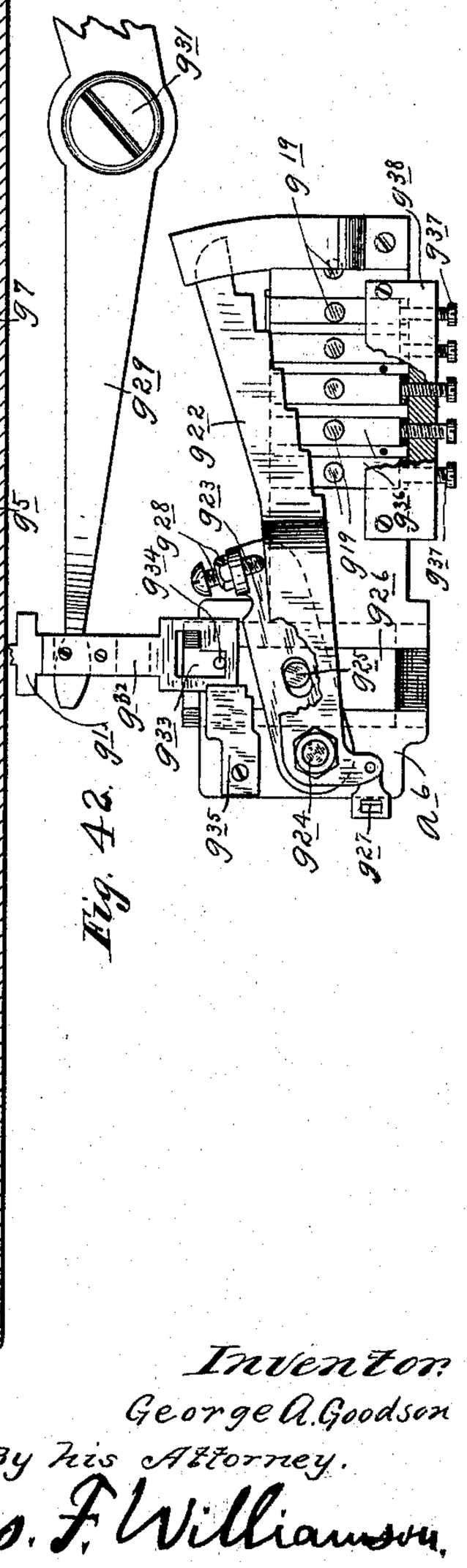

Fig. 42.

Witnesses.

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No. 609,098. Patented Aug. 16, 1898.

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TYPE CASTING AND SETTING MACHINE.

(Application filed Sept. 27, 1897.)

(No Model.) 24 Sheets—Sheet 24.

Fig. 43.

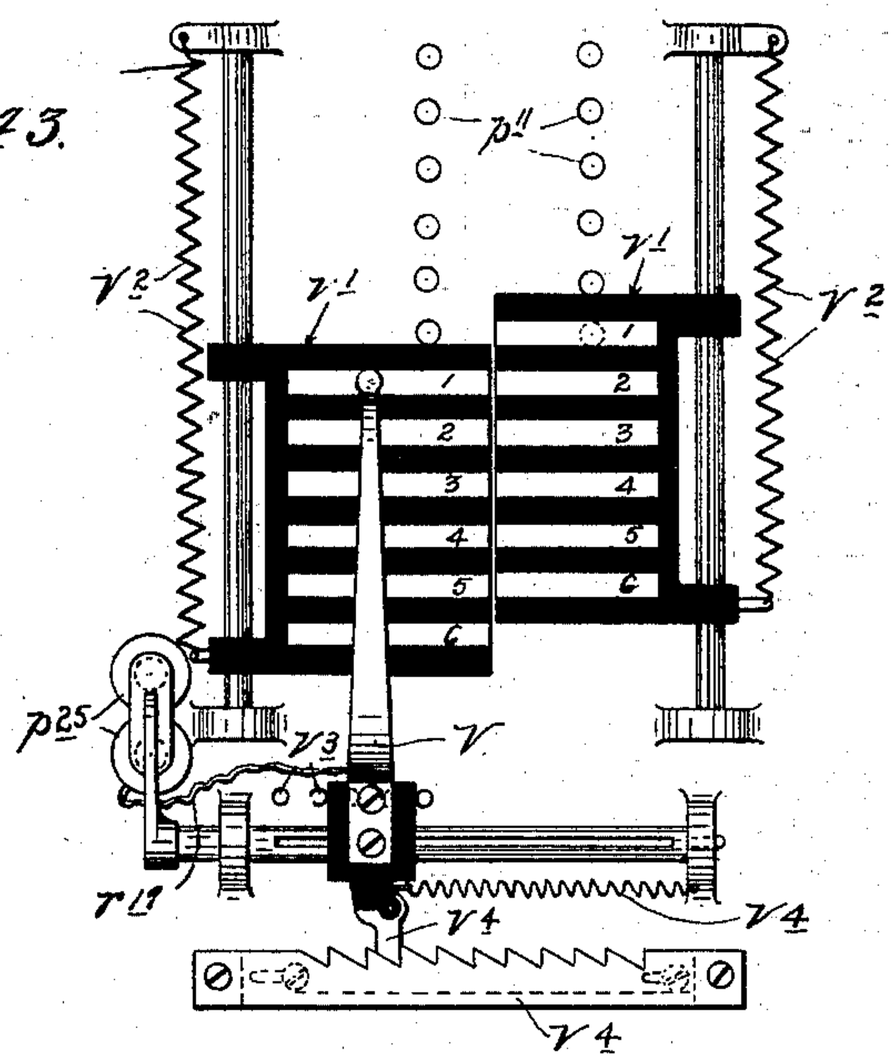
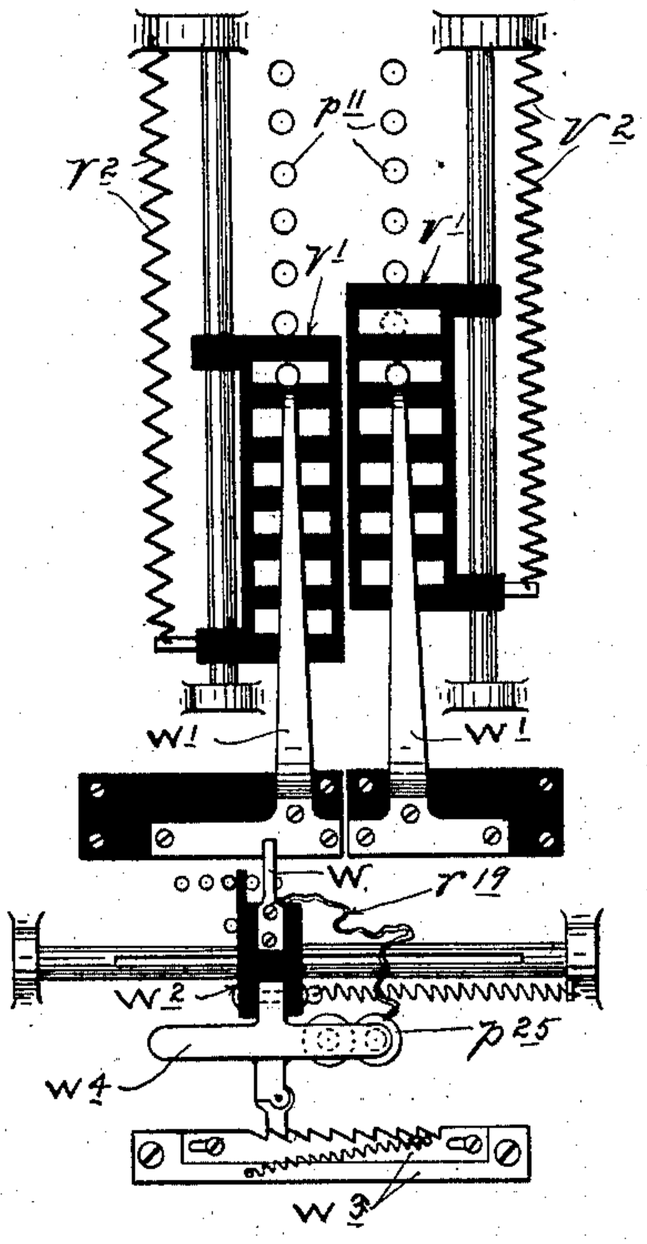


Fig. 44.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TYPE CASTING AND SETTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 609,098, dated August 16, 1898.

Application filed September 27, 1897. Serial No. 653,167. (No model.)

To all whom it may concern:

Be it known that I, GEORGE ARTHUR GOODSON, a subject of the Queen of Great Britain, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Type Casting and Setting Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to type casting and setting machines, and is especially designed to effect certain improvements in the machine disclosed in my prior United States patent, No. 530,481, of date December 4, 1894, with a view of increased efficiency.

To this end my invention consists of the novel devices and combinations of devices, which will be hereinafter described, and defined in the claims.

In its general principles and in a large number of its mechanisms the machine herein disclosed will be found to be substantially the same as disclosed in my British Patent No. 23,684 of 1894 and in my two pending applications B and C, filed January 25, 1897, under Serial Nos. 620,613 and 620,614, respectively.

As in the machine disclosed in my said prior patents, the present machine turns out as its final product justified lines of individual type set up in a galley or form ready for use in exactly the same way as hand-set type. To this end the machine operates automatically under the control of a perforated representative strip previously prepared on another machine, which may be distinguished as the "composing-machine." On this strip every element of the composition, together with certain additional actions required on the type casting and setting machine, is represented by holes therein, and the said strip is fed through this machine in the reverse order of its making on the composing-machine. The required actions for delivering the last previously-cast line of type into the galley and for setting the justifier to control the sizes of the quad-types at word-spaces, so as to justify the line following, first take place before the character-holes of the strip come into play for controlling the electric connections to set the parts for casting the type of the proposed line in succession.

The chief feature of my present invention relates to the justifier. In my prior patent the justification-space was always distributed among the first four word-spaces to the right or from the end of the line as read in the printed column. By my present improvement the justification-space is distributed among all the word-spaces of the line or so many thereof as may be necessary to effect the distribution in such a way as to have only two sizes of spaces or quads in the justified lines, and these two sizes can only differ from each other by one unit of face. The sizes of the quads may be the same throughout the line, but there never can be more than two sizes. With the justifier as shown in my prior patents there might and frequently would be three sizes of quads.

The other features of my invention relate to details of the mechanism in various parts of the machine and will appear from the detailed description and the definitions thereof to be given in the claims.

In this as in my former machine the type produced are of the kind known as "self-spacing" type, involving the unit principle for measuring the running width of type-face and the point principle of measuring the type-body transversely of the face. Otherwise stated, all the type are in running width of face multiples of a common unit and the same unit of course measures the predetermined line which must be justified.

My improved machine is illustrated in the accompanying drawings, wherein like notations refer to like parts throughout the several views.

Figure 1 is a plan view of the machine with the parts shown as they would appear when in position for casting a type in a line of five word-spaces or six words and requiring the distribution of minus seven units of justification-space. Fig. 2 is a view, chiefly in plan, but partly in horizontal section, with some parts removed, others broken away, and the pivoted frame which supports the matrix-block carriages turned backward into an

idle position for exposing the type-body mold and other parts covered thereby in Fig. 1. Fig. 3 is a right end elevation of the machine with respect to Figs. 1 and 2, with some parts removed and others broken away. Fig. 3ª is a detail showing some parts of the slack-provider. Fig. 4 is a front elevation of the machine with some parts removed and others broken away. Fig. 4ª is a detail showing some other parts of the slack-provider. Fig. 5 is a rear elevation of the machine with some parts broken away, others removed, and some parts shown in vertical section. Fig. 6 is a vertical section through a part of the machine, taken from right to left or lengthwise of the bed approximately on the two lines x^6 x^6 of Fig. 1, the section through the driving-shaft and the bed being on the forward member of said two lines and the section through the matrix-block, mold, &c., being on the rearward member of said lines looking from the front. Fig. 7 is a vertical section taken crosswise of the machine on an irregular line, but chiefly in a vertical plane, through the mold adjacent to the plunger and the matrix-block when in casting position, with some parts broken away and others shown in elevation looking from the right. Fig. 8 is a detail in vertical section, taken crosswise of a part of the machine for showing the relations of the matrix-block, the mold, the delivery-nipple, and the galley when the mold is in its uppermost or casting position. Fig. 9 is a vertical section on the line x^9 x^9 of Fig. 8, with the parts in the same position. Fig. 10 is a view similar to Fig. 8, but with the mold and the delivery-nipple in their lowered position for delivering the type onto the galley-floor. Fig. 11 is a vertical section on the line x^{11} x^{11} of Fig. 10, with the parts in the same position. Fig. 12 is a detail view, partly in horizontal section and partly in plan, showing the relations of the cam-surfaces and levers to the vertically-movable parts shown in Figs. 8 to 11, inclusive. Fig. 13 is a plan view of a part of the machine with some portions removed and others broken away for showing the relations of the mold to the type-delivery devices. Fig. 14 is a detail in plan, showing the relations of the mold and a part of the galley to the type-holder, the take-up device, &c., when the line of cast type is being delivered. Fig. 15 is a sectional elevation of some of the parts shown in Fig. 14. Fig. 16 is a detail in plan, showing the yielding plungers carried by the movable galley-head and some other parts. Fig. 17 is a sectional elevation of some of the parts shown in Fig. 16. Fig. 18 is a detail in perspective showing the pump-trip. Fig. 19 is a plan view, on an enlarged scale, showing the pivoted frame which supports the matrix-block carriages detached with the matrix-block in casting position. Fig. 20 is a vertical cross-section through a part of the machine, approximately on the line x^{20} x^{20} of Fig. 1, with some parts broken away and others removed, looking toward the left. Fig. 21 is a vertical section, lengthwise of the machine, taken across the driving-shaft in the plane of cam-wheel 1, but with said wheel removed, and showing the upper parts of the machine in a plane approximately on a line through the galley, matrix-block, &c., looking from the rear. Fig. 22 is a plan view showing, full size, a specimen strip representing a line having five word-spaces. Fig. 23 is a detail in sectional elevation in the plane of the feed-slot looking from the right, representing the feed devices for the said strip in their lowermost position with some parts removed and others broken away. Fig. 24 is a sectional elevation in a different vertical plane, but in the same direction, showing the thrust-pin carriage, which coöperates with the feed devices shown in Fig. 23, with the parts in the same position as in Fig. 23. Fig. 25 is a view of the same parts shown in Fig. 23 in the same plane, but with the feed devices in their uppermost position. Fig. 26 is a sectional elevation at right angles to Fig. 25, showing the feed devices and the thrust-pin carriage in the same position as in Fig. 25, together with some additional parts, with some portions broken away. Fig. 27 is a vertical section taken lengthwise of the machine across the driving-shaft and other parts in a plane adjacent to the forward face of the normally idle cam-wheel 6, looking from the front. Fig. 28 is a sectional perspective view of the justifier with some parts broken away and others removed. Fig. 29 is a plan view of the parts of the justifier which are located on the bed of the machine, with some portions broken away and the overlying parts removed. Fig. 30 is a cross-section through the justifier with some parts broken away. Fig. 31 is a detail in sectional elevation showing the justifier-escapement. Fig. 32 is a detail, partly in plan and partly in horizontal section, showing the relations of cam-wheel 6 and cam-slide 7 to the parts of the justifier, the differential gearing for driving said cam-wheel 6, and the clutch device for throwing said cam-wheel 6 into action between successive lines under the control of the trip-hole on the strip. Fig. 33 is a sectional elevation of the parts shown in Fig. 32, together with the additional parts of the justifier which were removed from Fig. 32 in the same position as in Fig. 32—to wit, under the extreme pull from cam-wheel 6. Fig. 34 is a view similar to Fig. 33, but showing the same parts as they would appear at the opposite extreme of the cam-wheel's revolution and with the contact-blocks of the justifier as they would appear when set for the given line. Fig. 35 is a plan view of the justifier with the parts in the same position as shown in Figs. 1 and 2. Fig. 36 is a view, partly in plan and partly in horizontal section, through the machine below the level of the main bed-plate with some of the parts removed for showing the relations of some of the electric devices. Fig. 37

is a diagram view illustrating the electric connections. Fig. 38 is a view showing the justification-chart. Fig. 39 is a perspective view showing the relations of the cam-slide 7 to some of the line-delivery devices under the action of the cam-wheel 6. Fig. 40 is a detail in plan of some of the devices shown in Fig. 39. Fig. 41 is a sectional elevation crosswise of the machine looking from the left. Fig. 42 is a detail in plan showing the stepped lever and stop devices for variably setting the mold-plunger. Fig. 43 is a plan view, partly in diagram, showing a modification of the justifier. Fig. 44 is a similar view showing another modification of the justifier.

For convenience to the reader the following classification of references will be observed, to wit:

a and its powers *a'* a^2, &c., will be used to denote the main frame and other fixed parts; *b* and its powers to denote the driving-shaft, &c., the cams thereon being numbered from 1 to 6, inclusive; *c* and its powers to denote the parts of the clutch and its trip for cam-wheel 6, the main slide operated by said cam-wheel being numbered 7; *f* and its powers to denote the type-metal and its conducting mechanism; *g* and its powers to denote the type-body mold and its connected parts; *h* and its powers to denote the matrix-block, its carriages, &c.; *n* and its powers to denote the representative strip and its feed devices; *p* and its powers to denote the parts of the justifier as shown on the machine; *r* and its powers to denote the circuit connections or wiring; *s* and its powers to denote the parts of the two-way switch; *t* and its powers to denote the type and their delivery devices, and *v* and *w* and their powers to denote modifications of the justifier.

The parts of the machine will be specified not necessarily in the order of their operation, but in that order deemed to be most conducive to brevity of statement and ease of understanding. Bearings and other fixed parts, which are so obvious as to be necessarily implied, will not be assigned reference-letters, except in so far as may be necessary to render operative parts distinct. Directions will be taken from the position of an observer facing the machine, as shown in Figs. 1, 2, and 4.

The parts of this machime which are identical with the parts disclosed in my prior United States patent or my pending applications above identified will only be described herein so far as may be necessary to render clear their functions in relation to the other parts. Many of the details of the said formerly-disclosed parts will not be noted.

The frame, (see Figs. 1, 2, 3, 4, 5, 6, 7, 20, 21, and 27.)—The framework of the machine is composed of a box-like body, of the parts of which it is sufficient to distinguish the main bed-plate *a*, the lower floor or bed *a'*, and the elevated shelf a^2. This box-like body is supported, as shown, on suitable legs a^3. On the main bed-plate *a* are located a central casting a^4, a left-hand casting a^5, a front casting a^6, and a right-hand casting a^7, which castings are made fast to the bed and serve to support various of the moving parts. The castings a^4 a^5 have pillow-blocks a^8 a^9, and there is a pump-lever bracket a^{10}. The casting a^4 has a pair of vertical guide-plates a^{11}.

The driving-shaft and its cams, (see Figs. 1, 2, 3, 4, 5, 6, 21, 27, 32, 33, and 34.)—The main shaft *b* is located at the right end of the machine and is provided with a combined driving-pulley and balance-wheel *b'* for imparting motion thereto. This shaft is kept in continuous motion. On said shaft *b* are mounted six cam-wheels numbered from 1 to 6, inclusive. Said cam-wheels 1 to 5, inclusive, are fixed to the shaft. Said cam-wheel 6 is normally idle or loose on the shaft, but may be thrown into gear therewith when desired and is so thrown into gear automatically between successive lines, as will later appear. The said several cam-wheels have different cam-surfaces which will be noted in connection with the parts operated thereby.

The clutch, &c., (see Figs. 1, 2, 3, 27, 32, 33, 34, and 39.)—The said normally idle cam-wheel 6 is mounted on a sleeve *c*, which carries the shifting member c^2 of a clutch, the other member *c'* of which clutch is shown as formed on the hub of the constantly-running cam-wheel 1. The shifting clutch member c^2 is subject to the action of a shipper-lever c^3, which is pivoted to the profile face of said cam-wheel 6 and is subject to the action of a spring c^4, which tends to throw the clutch member c^2 into engagement with the member *c'*, but is normally prevented from so doing by a spring-held armature-lever trip c^5, pivoted to the bed-plate *a* and subject to the action of a trip-magnet c^6. The sleeve *c* extends through the body of the cam-wheel 6 and at its outer end carries a gear c^7, which engages with the larger member of a pair of gears c^8 c^9, mounted to turn together on a common stub-shaft c^{11}, suitably supported from the frame. The smaller gear c^9 engages with a gear c^{10}, formed on the hub of the cam-wheel 6. The gears c^7, c^8, and c^{10} have the same number of teeth, but the gear c^9 has only half as many. Hence the effect of this differential gearing is to reduce the speed from the driving-shaft and cause the cam-wheel 6 to turn once while the shaft *b* turns twice. The cam-wheel 6 stands idle until the end of a line and is then tripped into action by the energizing of the trip-magnet c^6 under the control of the representative strip. The said cam-wheel 6 will then make one complete revolution, thereby first pulling the slide 7 toward the right and again shifting the same to its normal or idle position toward the left and for doing other work which will later appear. When said cam-wheel 6 completes its revolution, it will be thrown out of gear by the camming action between the upper arm of the trip-lever c^5 and the free end

of the shipper-lever c^3, which are arranged to open the clutch. The said slide 7, operated by this cam-wheel 6, has numerous functions in relation to the justifier and the type-delivery devices, which will later be described.

The type-metal and its conducting mechanism, (see Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 18, 21, 36, and 37.)—By a suitable burner (not shown) the type-metal f is kept in a molten condition in a suitable melting-pot f', located at the extreme left of the machine on a suitable bracket f^2, which is insulated from the machine-frame. From said metal-pot the molten metal is conducted through a metallic tube f^3, terminating in a delivery-nipple f^4 for coaction with the type-body mold, as will presently appear. In the melting-pot is located a force-pump of special construction. (Best shown in Fig. 5.) The pump-cylinder casting f^5 is provided with the cylinder-bore f^6 and a charging-chamber f^7, which communicate with each other at their lowermost level, and in the same are located corresponding check-valves f^8 and f^9. Of these check-valves the cylinder member f^8 opens outward and the charging-chamber member f^9 opens inward. The pump has a divided or two-part piston f^{10}, pivoted to an upper stem-section f^{11}, which connects with a horizontal arm of the pump-operating lever f^{12}. In the pump-cylinder casting f^5 is located a main supply-port f^{13}, which when the piston is in its uppermost position is closed thereby, but which when the piston is in its lowermost position leads through the walls of the piston-cylinder to the top of the charging-chamber f^7. With this construction on the down or forcing stroke of the piston the check-valve f^8 will open and the check-valve f^9 will close, while on the upstroke the reverse action of said valves will take place. Hence on the downstroke of said piston the metal will be forced through the tube f^3 and the nipple f^4 into the mold and the charging-chamber f^7 will be loaded by the inflow of the metal through the supply-port f^{13} between the two members of the divided piston. On the upstroke of said piston the return flow of the metal from the tube and nipple will be prevented by the closing of the check-valve f^8, and by the opening of the check-valve f^9 the charge from the chamber f^7 can enter the cylinder-bore below the piston. Hence with this pump undue back suction at the delivery-nipple is avoided, thereby preventing the backflow of the metal under the suction from the return stroke of the pump-piston and avoiding the production of a hollow type. Some difficulty was experienced in this respect with the forms of pump shown in my prior patent; but with this pump the difficulty is entirely overcome. The pump-lever f^{12} is pivoted to the pump-lever bracket a^{10} and is of the proper construction to insulate the part thereof which takes hold of the piston-stem f^{11} from the part which is connected to the said bracket a^{10} and the body of the machine. The said pump-lever f^{12} is of bell-crank form, and to the lower arm thereof is adjustably attached a rod f^{14}, which extends to cam-wheel 1 and is provided with a roller f^{15}, which works in a cam-channel f^{16} on the front profile face of said cam-wheel 1, as best shown in Figs. 1, 2, and 21. The said pump-lever f^{12} is also subject to the action of a strong spring f^{17}, acting opposite to the said cam-channel f^{16}, as best shown in Figs. 2, 4, and 18, for imparting the downstroke of the pump-piston with a quick action when so permitted by said cam-channel f^{16}. The lower arm of said pump-lever f^{12} is provided with a lateral projection f^{18}, adapted to be engaged by the outer arm of a spring-lever f^{19}, which at its inner end underlies the upper arm of a lever f^{20}, subject to a spring f^{21} and an electromagnet f^{22}. These parts f^{18} to f^{22}, inclusive, (best shown in Fig. 18,) operate as a pump-trip, so as to prevent a cast until the time desired. As will later appear, the common return-wire from all the parts which require to be set by the electric connections under the control of the representative strip while casting a line extends through the pump-trip magnet f^{22}, and when this magnet f^{22} is energized the armature-lever f^{20} will be pulled down, thereby permitting the spring-lever f^{19} to be thrown down at its outer end and releasing the pump-lever, so as to render the same subject to the pump-spring f^{17} when permitted by the cam-channel f^{16}. Provision is also made for the prevention of any action by the pump, whether the pump-trip just described is released or not, at a time when the pivoted frame which supports the matrix-block carriages is turned back into an idle position, as shown in Fig. 2. For this purpose the cam-rod roller f^{15} is provided with a stud f^{23}, (shown best in Fig. 2,) which may be engaged by a notched lever f^{24}, (shown best in Figs. 2 and 21,) which has an upwardly-projecting arm f^{25}. The said arm f^{25} underreaches the said pivoted frame supporting the matrix-block carriages, and when the said frame is in working position, as shown in Figs. 1 and 21, the said frame will hold the said arm f^{25} in a lowermost position against the tension of a retracting-spring f^{26}. Hence when the said frame is turned backward the spring f^{26} will become operative to throw down the rear arm of the notched lever f^{24} and cause the notch in the same to engage over the said stud f^{23} on the roller f^{15} of the pump-rod and hold the same from any action under the strain from the pump-spring f^{17} so long as the said pivoted frame remains turned back in its idle position. This device, made up of the parts f^{23} to f^{26}, inclusive, is therefore a safety-lock for preventing any action of the pump when the pivoted frame supporting the matrix-block carriages is not in its working position. This safety-lock is of value because it is sometimes desirable to operate the other parts when said pivoted frame is turned back without operating the pump.

The conducting-tube f^3 for the molten metal f has sufficient spring to permit a limited up-and-down motion of the delivery-nipple f^4 in respect to the mold. The mold also has a limited up-and-down motion for coaction with the matrix-block at an upper level and with the galley-floor at a lower level. The mold also has a lateral movement for shifting from the casting to the ejecting position and reversely. The relations of the said parts for the said motions are best shown in Figs. 6 to 12, inclusive. Referring to said views, it may be seen that the nipple f^4 is carried by a slide f^{27}, mounted for vertical movement between guides f^{28}, fixed to an angular bracket g^4, which in turn is mounted for vertical movement between guides a^{11}, fixed to a vertical web of the central casting a^4. The said nipple-slide f^{27} is beveled at its lower end for coöperation with the inner or cam end of a bell-crank lever f^{29}, which is pivoted to the bed-plate a, as shown at f^{30}, with its outer or long arm extending to cam-wheel number 4. The inner or cam end of said cam-lever f^{29} works over a cross-piece g^5, carried by the vertically-movable bracket g^4, so as to produce its camming action on the nipple-slide f^{27} regardless of the vertical motion of said bracket g^4 itself. The outer or long arm of said cam-lever f^{29} is subject to the action of a profile cam-surface f^{31} on the front face of said cam-wheel 4 and to a coöperating spring f^{32}, working opposite to said cam-surface f^{31}. The nipple-slide f^{27} is subject to a spring f^{33} for throwing the same downward when permitted by the cam-lever f^{29}. This up-and-down motion of the delivery-nipple f^4 is common to this and the machine shown in my prior patent and has for its obvious purpose to move the nipple into and out of the bottom or mouth of the mold-cell g. Said nipple and the whole of said tube in practice are closed into an electric circuit (not shown) supplied with a low tension or quantity current for maintaining a constant temperature in the said tube and nipple, while permitting the melting-pot to be remotely located, and thereby avoid heating the mold, all as fully explained in my prior patents. By the up-and-down motion of the nipple in coöperation with the centering-pin, which acts on the top of the matrix-block when in casting position, as will presently be noted, the matrix-block and the mold are clamped together from above and below, and this up-and-down motion of the nipple f^4 serves also to prevent the heating of the mold, which would otherwise occur if the nipple was in continuous contact with the mold. Stiff springs $g^\times$ react between the front casting a^6 and the outer ends of the mold member g^2, to be presently noted, and serve to effect the necessary endwise clamping action between the mold members g^2 and g^3 when in casting position. The up-and-down motion of said angular bracket g^4, which supports the mold members, can better be further considered after first describing more fully the parts of the mold, which will be treated under the next heading.

Type-body mold, (see Figs. 1 to 15, 20, 21, 36, and 37.)—The type-body mold is made up of the members g', g^2, and g^3, and of these members g' g^2 move from casting position to ejecting position, and vice versa, on the angular section g^3. Of the said members g' g^2, which move on the angular section g^3, the member g' is the mold-plunger and is embraced by the two members g^2, and when in casting position the three members g' g^2 g^3 coöperate, as best shown in Figs. 2, 13, and 41, to form the mold-cell g, as in my former patents and applications. The angular member g^3, however, is now carried by the vertically-movable angular bracket g^4, noted when considering the delivery nipple-slide f^{27} and the motions thereof. This bracket g^4 is mounted for an up-and-down motion, as hitherto stated, which is best shown in Figs. 8 to 12, inclusive. Referring to said views, it will be seen that the said bracket g^4 works between fixed guides a^{11}, made fast to a vertical web of the central casting a^4, as hitherto noted. At its lower end the said bracket g^4 is provided with a roller g^6, which is subject to the action of the inner or cam end of a bell-crank lever g^7, pivoted to the bed-plate a by the same pivot f^{30} as the cam-lever f^{29} for the nipple-slide f^{27}. The outer or long arm of said cam-lever g^7 extends to the cam-wheel 4 and is subject to a profile cam-surface g^8 on said cam-wheel, as best shown in Fig. 6, and to a coöperating spring g^9, as best shown in Fig. 12. The said vertically-movable bracket g^4 is also subject to a pair of springs g^{10}, tending to throw the same downward into its lowermost position whenever so permitted by the said cam-lever g^7. The angular or bed member g^3 of the mold is fixed to the horizontal part of the angular bracket g^4, as best shown in Figs. 8 and 10. Hence under the up-and-down motion of the bracket g^4, under the coöperation of the cam-lever g^7 and the springs g^{10}, the whole mold is raised or lowered therewith. As the nipple-slide f^{27}, hitherto noted, must move independently on the said angular bracket g^4, under the coöperation of its cam-lever f^{29} and spring f^{33}, it is obvious that the said lever f^{29} must have a limited rocking motion up and down at its inner or cam end. This is secured by allowing a little lost motion at its joint with the pivot-pin f^{30}. As will later appear, the matrix-block h moves constantly in the same horizontal plane. After a type has been cast the matrix-block h and the mold must be separated in order to eject the cast type from the mold-cell. In my machine disclosed in my former patents the matrix-block was lifted away from the mold, while the mold remained stationary in the casting position. Then the movable members of the mold were shifted laterally in the same plane, as when at casting position, to bring the same into ejecting position. This in turn required the galley-

floor to be at a lower level than the bottom of the mold-cell when in ejecting position, and additional devices had to be provided—such, for example, as shown in my pending application, Serial No. 620,613, hitherto noted—in order to pull the type down onto the galley-floor. By the up-and-down motion for the whole mold herein disclosed I am able to simplify the construction and get better results. Otherwise stated, I now provide an up-and-down motion, as above described and best shown in Figs. 8 to 12, for the whole mold, which permits the matrix-block to work constantly in the same horizontal plane and nevertheless enables the proper clearance to be provided between the matrix-block and the cast line of type when the mold is in position for ejecting the type. The mold is now pulled down from the matrix-block before it is shifted laterally, or, more accurately stated, before its members g' and g^2 are shifted laterally to bring the same into ejecting position; and when the parts are in ejecting position the bottom of the mold-cell is exactly on the same level as the floor of the galley, and hence when the type are ejected from the mold no further pulling-down action is required thereon. The parts are shown in casting position in Figs. 8 and 9 and in ejecting position in Figs. 10 and 11. This construction therefore constitutes a material improvement over the construction disclosed in my prior patents and applications.

The means for effecting the lateral motion on the mold members g' g^2 are the same as in my prior patents in order to shift the said parts laterally from casting to ejecting position, so as to bring the mold-cell in line with that section g^{11} of the delivery-channel formed in the vertical wall of the mold member g^3. For this purpose a pair of levers g^{12}, pivoted to the bed-plate a, embrace the said mold members g' g^2 at their upper ends and are connected to a shifting cam-lever g^{13}, which extends to the cam-wheel 4 and is provided with a roller g^{14}, working in a cam-channel g^{15}, formed on the rear profile face of said wheel. The said lever g^{13} is forked at its rear end to embrace the driving-shaft b as a convenient means of holding the rear end of said lever in proper working position, as best shown in Fig. 6. The mold members g' g^2 move on the member g^3 under a binding-bar g^{16}, supported by posts g^{17}, rising from the horizontal part of said member g^3. In its details the mold, made up of the members g' g^2 g^3, is exactly like the mold disclosed in my pending application, Serial No. 620,613, above noted. These details are of such a character as to permit the members g' g^2 to be tightly clamped together sidewise when in casting position, with the members g^2 tightly clamped endwise against the vertical wall of the member g^3 and to permit a free in-and-out motion to the plunger g' with respect to the members g^2 at all other times. The mold members g^2 g^3 are also of the proper construction to permit cooling-water to be constantly circulated therethrough. For the purposes of this case it has not been deemed necessary to illustrate or describe these details of the said mold.

The mold-plunger g' is subject to a spring g^{18}, tending to pull the same outward, as best shown in Figs. 7 and 41, for coöperation with a series of stops g^{19} and a stepped lever g^{22} (best shown in Figs. 1, 2, and 41 and certain other parts) to variably set the mold-plunger as required for the production of type of different sizes in running width of face. The said stops g^{19}, or five thereof, are subject to armature-levers g^{20} and magnets g^{21}, which are energized under the control of the representative strip, as in my former patents and as will later more fully appear. The said stepped lever g^{22} is pivoted to the top of the front casting a^6 and overlies another lever g^{23}, pivoted to the same pin g^{24}. The lever g^{23} has slot-and-pin connection, as shown at g^{25} in Fig. 42, with a slide g^{26}, mounted in a suitable guideway on the top of said casting a^6. The stepped lever g^{22} is of bell-crank form, and a spring g^{27}, applied to its very short arm, tends to throw the same rearward, so as to clear the stops g^{19}. The underlying lever g^{23} carries a gage-screw g^{28}, which forms the back-stop or point of coaction between the stepped lever g^{22} and said gage-lever g^{23}. Hence under the action of the spring g^{27} the stepped lever g^{22}, gage-lever g^{23}, and the slide g^{26}, connected to said gage-lever by the slot and pin g^{25}, normally stand at their innermost limit, with the said slide g^{26} abutting the outer end of the mold-plunger head, as best shown in Figs. 7 and 42. The said head of the mold-plunger g', marked the same as the plunger, is bifurcated and its two jaws embrace the left end of the cam-operated ejecting-lever g^{29} with sufficient clearance between the jaws to permit a certain independent movement of the mold-plunger g' under the action of its spring g^{18}, as will presently be more fully noted. The right end of the ejecting-lever g^{29} has a roller which works in a cam-channel g^{30}, formed on the periphery of the cam-wheel 4. The said ejecting-lever g^{29} is pivoted at g^{31}. To the head of the mold-plunger g' is fixed a piece g^{32}, which overreaches the slide g^{26} and is provided with a slot g^{33}, properly constructed to permit the lateral movement of the mold members g' g^2 from casting to ejecting position and to engage a pin g^{34}, rising from said slide g^{26} at the limit of the mold-plunger's ejecting motion under the action of the cam-lever g^{29} for insuring a sufficient inward movement of the slide g^{26} and the levers g^{23} and g^{22} at the time required for affording the necessary clearance to permit the stops g^{19} to be set by their magnets g^{21}. The said slotted piece g^{32} works under a keeper g^{35}, which serves to keep the outer end of the same in place and is of the proper construction to permit the up-and-down motion of the mold hitherto noted. Five of the several stop-pins g^{19} work through gage-slides g^{36} at their upper ends, which slides g^{36} are

mounted in suitable guides in the casting a^6 and are subject to gage-screws g^{37}, which limit the outward movement thereof and serve as a means of properly gaging the stops g^{19} when set for intercepting the stepped lever g^{22} and the mold-plunger g', as required. The gage-screw g^{28}, carried by the gage-lever g^{23}, serves to accomplish the same result for the sixth or fixed member of said stops g^{19}. Hence the whole six of said stops g^{19} may be set, as required, for the work to be done thereby. Otherwise stated, these gaging devices permit the necessary adjustment for the stops g^{19}, so as to produce the type of the proper size when the stops are set to intercept the stepped lever g^{22} and the mold-plunger g', as best shown in Figs. 1, 2, and 41. Having regard to the action of these parts for manipulating the mold-plunger g', the cam-actuated lever g^{29} throws the mold-plunger g' inward, as required, for ejecting the type when the mold is in ejecting position and also retracts the mold-plunger g' sufficiently far only to clear the relatively fixed or angular mold-section g^3. The clearance between the jaws of the plunger-head and the inner end of said cam-lever g^{29} then permits the mold-plunger g' to move on outward under the action of its retracting-spring g^{18} until the stepped lever g^{22} is intercepted by the set member of the stops g^{19}. When the mold is in ejecting position, the stepped lever g^{22} is held in its innermost postition by the spring g^{27}, so as to clear the stops g^{19}, as hitherto noted, and at that time the proper member of the magnets g^{21} is energized by the electrical connections under the control of the strip for throwing up the proper stop to intercept the stepped lever and mold-plunger, as just hitherto described. These actions are similar to my prior patent; but the provision of the gaging devices for securing the proper adjustment of the stops and the provision of the parts g^{32} and g^{34} for positively moving the slide g^{26} inward at the limit of the ejecting action are of the nature of improvements over said prior patent. The said gage-screws g^{37} work in an angular plate g^{38}, fixed to said front casting a^6, as best shown in Fig. 42. Said ejecting cam-lever g^{29} for the mold-plunger g' is pivoted by the pin g^{31} to a shifting-bar g^{39}, which extends rearward to a cam-lever g^{40}, as best shown in Figs. 1 and 2. This lever g^{40} is a lever of the second class, with its left end pivoted to the rearmost part of central casting a^4 and its right end provided with a roller which is subject to the action of two cam-surfaces g^{41}, formed on the periphery of the normally idle cam-wheel 6 and having between the same at diametrically opposite points two passes g^{42} at the proper places to permit the roller of said cam-lever to pass from one to the other of said cam-surfaces g^{41}. In the normal or idle position of said cam-wheel 6, occupied during the casting of a line, the parts will be in the position shown in Figs. 1 and 2, with the forward member of said cam-surfaces g^{41}, as shown in said views, holding the cam-lever g^{40}, shifting-bar g^{39}, and pivot-pin g^{31} at their forward limit; but as soon as the last type of the given line is cast and the trip-hole on the strip has tripped the clutch and thrown the normally idle cam-wheel 6 into action the other member of said cam-surfaces g^{41} will come into play, thereby shifting the cam-lever g^{40}, bar g^{39}, and pivot-pin g^{31} rearward and holding the same by the other member of said cam-surfaces g^{41} for a half-turn of said cam-wheel 6. This shift of the pivot g^{31} occurs at the initial part of the turn of the cam-wheel 6, and thereby causes the ejecting-lever g^{29} to impart a long stroke to the plunger g' at the proper time for pushing the type held in the section t' of the delivery-channel outward beyond the same onto the floor of the galley. Otherwise stated, this extraordinary stroke pushes that part of the line which is held in the channel-section t' of the galley-wall into proper position for the action thereon by the galley-head at the proper time. At the end of the half-turn of the normally idle cam-wheel 6 the roller of the cam-lever g^{40} runs through the opposite member of the two passes g^{42}, and thereby restores the parts g^{39} g^{31} to their normal or forward position under the control of the forward member of said cam-surfaces g^{41}, as shown in Figs. 1 and 2.

The further devices and the actions therefrom required to deliver the cast type will be considered under the heading "type-delivery devices," to be later described.

The matrix-block, (see Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 19, 20, 21, 37, and 41.)—The matrix-block h has on its under surface or face the required matrices arranged in rows in two directions and is provided on its back with centering-holes in corresponding arrangement for permitting the matrix-block to be brought into casting position for any desired type by a two-way movement of said matrix-block. The details of the construction of this matrix-block h itself for insuring accuracy and perfection of said matrices and accuracy in the location of the centering-holes at a low cost were all set forth in my prior patent, and it is not deemed necessary to repeat the same here. The said matrix-block h is mounted on a small carriage h', adapted to move on guides h^2 transversely of its main carriage h^3, which is mounted for forward-and-backward movement in a suitable frame h^4. The frame h^4 is pivoted by hinge-bolt h^5 to suitable bearings projecting from the rear part of the central casting a^4, which arrangement permits the said frame h^4 and all the parts carried thereby to be turned over from the working position (shown in Fig. 1) into the idle position (shown in Fig. 2) for exposing the mold and the other underlying parts of the machine. To the carriage h', by slot-and-pin connection h^6, is attached the forward end of a lever h^7, pivoted to the main carriage h^3. The rear end of the lever h^7 is subject to the action of a cam h^8, projecting from a slide h^9, which is mounted

to move transversely of the frame h^4 and the main carriage h^3. The said slide h^9 projects toward the driving-shaft and is subject to the action of one member of a three-arm cam-lever h^{10}, pivoted to said frame h^4. Another and longer arm of said cam-lever h^{10} is adapted to engage a roller h^{11} at the rear end of the main carriage h^3. The third or right-end arm is subject to the action of a cam-lever h^{12}, pivoted to the shelf a^2 of the main frame and subject at its right end to a profile cam-surface h^{13} on the cam-wheel 1. The main carriage h^3 is subject to the action of a spring h^{14}, tending to pull the same toward the front. The transverse carriage h' has at its left a downturned lip h^{15}, which is constantly engaged by the upturned right end of a bumper-slide h^{16}, as best shown in Fig. 6, which sliding joint permits the matrix-block to move forward and backward with its main carriage h^3, while always maintaining connection with the said bumper-slide h^{16}. Said bumper-slide h^{16} connects by a link h^{17} with an arm h^{18}, pivoted to the left casting a^5 and subject to a spring h^{19}, tending to throw the same toward the left and carry with it the said bumper-slide h^{16} and the transversely-movable or small matrix-block carriage h'. Hence from the spring h^{14}, before noted, the block comes under tension to move toward the front, while from the spring h^{19} the block comes under tension to move toward the left. The cam-surface h^{13} on cam-wheel 6, through the cam-levers h^{12} h^{10} h^9, moves the matrix-block toward the right and toward the rear into an extreme or initial position, thereby setting the said springs h^{14} and h^{19} under tension for moving the same in the opposite direction as soon and as rapidly as permitted by the said cam-surface h^{13}. In this movement of the matrix-block h under the tension from said two springs h^{14} and h^{19} the block will move on the resultant line of the two forces, or, otherwise stated, any particular matrix will take a diagonal or shortest-path course from its initial to its casting position. In this movement of the block its forward travel is determined by a series of stops h^{20}, spring-seated and adapted to engage with a downturned lip h^{21} on the main carriage h^3 when thrown up by their armature-levers h^{22} and magnets h^{23}. These stops are ten in number, nine being subject to magnets and the other or forward member being fixed, and hence by the same the matrix-block may be intercepted in any one of ten different positions in its forward travel for selecting the row containing the matrix desired. Likewise in its movement toward the left under the action of said spring h^{19} the said bumper-slide h^{16}, and hence the matrix-block h, may be intercepted by any one of a corresponding series of spring-seated stops h^{24}, which are under the control of corresponding armature-levers h^{25} and magnets h^{26}, for selecting the individual matrix from the row. The stops h^{20}, which variably intercept the matrix-block in its forward movement, may therefore be called the "row-selecting" stops, and the stops h^{24}, which variably intercept the said matrix-block in its movement toward the left, may therefore be called the "individual" stops. It should be noted that in this diagonal or positioning movement of the matrix-block for casting the said springs h^{14} and h^{19} can only move the matrix-block carriages in the two opposite ways as rapidly as the cam-surface h^{13} on cam-wheel will permit. Hence the matrix-block is controlled in both directions and is intercepted by the set members of said stops without jar or backlash. The said stops for intercepting the matrix-block are set by their respective magnets when the said block is thrown to the extreme of its right-hand and rearward travel into its idle or initial position under the action of said cam-surface h^{13} on cam-wheel 1 and the coöperating levers h^{12} h^{10} h^9, hitherto noted, when the said magnets are energized under the control of the representative strip, as will later appear. Of the said two sets of stops h^{20} and h^{24} nine out of each set are subject to magnets, and the tenth of each set is a fixed stop, not requiring any magnet, inasmuch as it measures the extreme movement of the matrix-block. The matrix-block makes these two extreme movements under the action of its springs h^{14} and h^{19} whenever none of the movable stops are thrown up, and this extreme movement in each direction brings into casting position a high surface on the face of the block for coöperation with the type-body mold to produce quads. Hence whenever word-spaces are reached on the controlling-strip no movable stop need be thrown up for positioning the matrix-block, and this permits the word-space hole on the strip to be used for controlling the connections to the mold-plunger-stop magnets by way of the justifier, as will later appear, over the escapement branch of the working circuit to produce quads of the desired size for justifying the line.

The rows from front to rear on the matrix-block all contain matrices of the same size of face. As there are only five sizes of face for character-type, ranging from two to five units, several rows on the matrix-block are devoted to matrices of the same size. This grouping of the matrices into rows of the same size permits the magnets controlling the row-selecting stops for the matrix-block and the magnets controlling the positioning of the mold-plunger for the corresponding character-type to be grouped and connected up in series, as will later appear.

The pivoted frame h^4 for the matrix-block carriages is provided with a yoke h^{27}, in which is mounted the spring-seated centering-pin h^{28}. The said centering-pin is subject to the action of a loose head h^{29}, carried in the horizontal arm of a vertically-movable plunger h^{30}. The plunger h^{30} is mounted for vertical movement in suitable fixed guides or bearings h^{31}, projecting from the central casting a^4.

The stem of said plunger is provided with a grooved nut or collar h^{32}, which is embraced by the forked forward end of a three-armed cam-lever h^{33}. This cam-lever h^{33} is pivoted to a projection from the main casting at h^{34}. The two arms of this lever h^{33}, standing approximately at right angles to each other, are provided with rollers h^{35} and h^{36}, respectively, which are subject to the action of a peripheral cam-surface h^{37} on the cam-wheel 4. The stem of the plunger h^{30} is encircled by a stiff spring h^{38}, reacting between the collar h^{32} and the lower member of the fixed guides h^{31}. Under the action of the cam-surface h^{37} on the roller h^{35} the plunger h^{30} is forced downward against the spring h^{38}, thereby depressing the spring-seated centering-pin h^{28} and causing the pin to center the matrix-block h in casting position and clamp the same to the type-body mold. Later the same cam-surface h^{37}, acting on the roller h^{36} of said lever h^{33}, will rock the said lever in the opposite direction and force the plunger h^{30} into its uppermost position. The spring h^{38} will assist in this action and keep the roller h^{35} in contact with the cam-wheel. The plunger h^{30} is provided with a stiff flat spring h^{39}, which overreaches the loose head h^{29} and serves as a safety device to prevent breakage under the clamping action of the plunger h^{30} on the centering-pin h^{28}. The spring h^{39} is strong enough to resist the required clamping strain, but will yield, if necessary, to prevent breakage of the parts under the action of the cam. The loose head h^{29} is subject to the keeper h^{40} on the horizontal arm of the plunger, which prevents said head h^{29} from falling out of place when the plunger is turned to one side. When in working position, the free end of the horizontal arm of the plunger is adapted to be engaged by a keeper composed of a fixed part h^{41} and a finger-slide h^{42}, which fixed part rises from the yoke h^{27}. This keeper is of the proper construction to permit the up-and-down motion of the plunger h^{30} within the limits required, while preventing the plunger from turning in its bearing-guides h^{31} as long as the finger-slide h^{42} is in its lowermost position; but by raising the finger-slide h^{42} the plunger may be disengaged from its keeper and turned to one side for permitting the pivoted frame h^4 to be turned backward, as shown in Fig. 2. When the said pivoted frame h^4 is in its working position, it rests on pillow-blocks a^8 and a^9, fixed, respectively, to the central casting a^4 and the left-hand casting a^5, as best shown in Figs. 4 and 10. When down in working position, said frame is held by a suitable spring-catch h^{43} rising from the central casting a^4, as best shown in Fig. 21.

Under the spring movement on the matrix-block carriages the matrix-block is approximately brought into proper position for alining the selected matrix with the type-cell g of the mold. The spring-seated centering-pin h^{28} is then forced downward by the plunger h^{30} into the proper member of the centering-holes on the back of the matrix-block. The lower end of the pin h^{28} is conical, and the said centering-holes on the back of the block are bell-mouthed or of reversely-conical shape, and hence under the downward movement of the pin the matrix-block will be brought to the exact position required for centering the selected matrix in casting position. The matrix-block h is so mounted as to have sufficient play for this centering action when the pin h^{28} is depressed in the proper centering-hole.

Before the centering-pin h^{28} is depressed by the mold-plunger h^{30} the type-body mold reaches casting position. Then under the cooperation of said centering-pin h^{28} from above and the cam-actuated bracket g^4 from below the matrix-block and the mold are tightly clamped together. The pump is then tripped through the connections under the control of the strip, and the cast takes place as quick as the pump-cam channel f^{16} on cam-wheel 1 will permit. After the cast is made the mold is pulled down away from the block, as hitherto described, and the cam-surface h^{13} on cam-wheel 1 becomes operative through the cam-levers h^{10} h^9 h^8 h^7 to restore the matrix-block to initial position against the tension of its propelling-springs h^{14} and h^{19}.

At this point the consideration of the casting action may be dropped until after the representative strip and the electric connections are described.

The strip and its feed devices, (see Figs. 1 to 5, 21 to 26, and 37.)—A specimen of the representative strip n as it comes from the composing-machine is shown full size in Fig. 22. By reference to said view it will be seen that the said strip is provided with evenly-spaced feed-holes n' on one margin and with a series of working holes differently located crosswise of the strip between the dotted lines which mark the feed-spaces. These working holes represent all the controlling actions required from the strip and are distinguished by the wording which appears adjacent to the strip in said view. As the strip is fed through the type casting and setting machine in the reverse order of its making on the composing-machine, as hitherto noted, the first working hole which comes into action is the trip-hole marked with the word "Trip." This controls the connections to the trip-magnet c^6 for the clutch, thereby throwing the normally idle cam 6 into action for imparting motion to the slide 7 and shifting the movable member s' of the two-way switch and doing other work, as will later appear. At the next feed-step on the trip the three holes marked "Justification holes" come into action for controlling the connections on the setting-circuit for energizing three sets of magnets used to set three corresponding sets of stops for positioning three parts of the justifier. During these two feed-steps on the strip the normally idle cam-wheel 6 makes its complete turn and is again tripped out of gear into its idle position. Thereafter

the character-holes in the strip come into action in succession for controlling the connections to the magnets which set the stops for positioning the matrix-block and the mold-plunger for the character-type for the first word. Then the word-space hole comes into action, controlling the connections over the escapement branch of the working circuit and through the justifier to the mold-magnets for positioning the mold-plunger to make quads of the required size to justify the line. These actions are repeated in succession until the end of the line, when the trip at the head of the next line will come into action for again tripping the clutch to start the cam-wheel 6, as before. The ends of the line are distinguished on the said strip by the heavy broken transverse lines. The character-holes are sufficiently distinguished by being in feed-spaces directly opposite the corresponding characters of the line indicated just outside one margin of the strip. The word-space holes are indicated by the word "Space." The said strip n, properly prepared, comes to the type-casting machine in considerable quantities wound on a suitable spool n^2. The said spool n^2 is loosely journaled in the prongs of a suitable forked holder n^3, rising from the frame-shelf a^2 near the front end of the machine, as best shown in Figs. 1, 3, and 4. At this point the strip is subject to a slack-provider which, as shown, comprises a guide-keeper having a body portion n^4 and a spring-latch n^5. As best shown in Figs. 4 and 4^a, the latch n^5 is subject to a base-spring n^6, which will hold the same in either its open or closed position. The said guide-keeper embraces the strip and is carried by the upper end of a stem or rod n^7, which extends downward through the post of the holder n^3 to a cam-lever n^8, as best shown in Figs. 3 and 3^a. The cam-lever n^8 is pivoted to a part of the frame at n^9 and is subject to a light spring n^{10}, working opposite to the cam-wheel 5. The spring n^{10} encircles the rod n^7, as shown, and reacts between the shelf a^2 and a collar n^{11} on the rod. Under the coöperation of said cam-wheel 4 and the light spring n^{10} the proper motions are imparted to the rod n^7 and the keeper $n^4 n^5$ to give a light pull on the strip downward at a time when the strip is held stationary at the feed devices, as will later appear, so as to pull off from the spool a sufficient portion of the strip to afford a slack section therein, upon which the feed devices of said strip operate. The said feed devices are best shown in Figs. 23 to 26. Referring to Fig. 3 and said views Figs. 23 to 26, the said feed devices will now be noted. In passing from the slack-provider the strip n next moves through a guide-keeper n^{12}, projecting from the pedestal n^{13}, which contains the feed devices. The said pedestal n^{13} is bolted to the frame-shelf a^2. In its travel through said pedestal the strip n moves over a bed-plate n^{14} and underneath guide-keepers n^{15} and n^{16}, which overreach the margins of the strip. Of these guide-keepers the member n^{16} is pivoted so as to swing to one side for the insertion and removal of the strip sidewise into position on the bed-plate for the action of the feed devices and the thrust-pin contacts r^4, which form part of the electric connections, which will later be described. A vertically-movable plunger n^{17} is suitably guided on the pedestal and carries at its upper end a feed-needle n^{18}, which works downward through a guide-hole n^{19} in the bed-plate n^{14} and the fixed keeper n^{15}. Below the bed-plate the said plunger carries another feed-needle n^{20}, which is pivoted to the plunger for rocking motion in the line of feed. The upper end of the rocking feed-needle n^{20} plays in a feed-slot n^{21} of the bed-plate n^{14}, which is in line with the guide-hole n^{19} for the other needle n^{18}. These feed-needles n^{18} n^{20} engage the marginal feed-holes n' of the strip n in succession for imparting the feed motion thereto. The stem of the feed-plunger n^{17} extends to the horizontal arm of a bell-crank lever n^{22}, pivoted to a part of the frame, as best shown in Figs. 23 and 21. This cam-lever n^{22} is subject to a spring n^{23} and to a peripheral cam-surface n^{24} on cam-wheel 3. Under the coöperation of said spring and cam-surface n^{23} n^{24} the said plunger n^{17} receives an up-and-down motion at the proper times for the work required. The needle-lever n^{20} is formed with three arms, two of which are opposite in a horizontal plane. At the limits of the up-and-down motion on the plunger n^{17} the right arm of said needle-lever n^{20}, as shown in Figs. 23 and 25, becomes subject to pins n^{25}, which rock the same in the line of feed. The other or left arm of said needle-lever becomes subject to a spring-latch n^{26}, carried by the plunger for holding the needle at the extreme left-hand limit of its rocking movement. The vertical arm of the needle-lever n^{20} is subject to gage-screws n^{27}, carried by the plunger for fixing its throw. The thrust-pins r^4 are mounted in an angular block or carriage n^{28}, the horizontal part of which overreaches the bed-plate n^{14} and the vertical part of which is subject to the action of the feed-plunger n^{17}. The vertical part of said carriage n^{28} works on a suitable seat or guideway n^{29}, formed on the face of the plunger n^{17}. This seat n^{29} is of sufficient length to permit a limited independent motion of the plunger n^{17} with respect to the thrust-pin carriage n^{28}. The said carriage n^{28} is subject to the outer end of a piston-spring n^{30}, the head of which works in a cylinder n^{31} against a spring n^{32}, as best shown in Figs. 21 and 26. With this construction the said spring n^{30} will hold the thrust-pin carriage n^{28} in any position where set by the plunger n^{17}. The feed-plunger n^{17} and the thrust-pin carriage n^{28} are kept in place in respect to the vertical wall of the pedestal n^{13} by a cross-bar n^{33}. Having regard now to the action of these feed devices, the parts are shown in their lowermost position in Figs.

23 and 24, and at this time it is obvious that the upper needle n^{18} is holding the strip and that the lower or rocking needle n^{20} is in position to engage the next forward hole of the strip under the upward motion of the plunger n^{17}. The lower needle n^{20} thus engages the strip before the upper needle n^{18} clears the strip. Then under the continued upward movement of the plunger n^{17} the right arm of the rocking needle n^{20} will strike the upper member of the fixed pins n^{25} and rock the needle into the position shown in Fig. 25, thereby feeding the strip forward one step. Under this upward stroke of the plunger n^{17} the thrust-pin carriage n^{28} is also carried upward to its limit and will there be held by the piston-spring n^{30}, as shown in Fig. 26. The throw on the rocking needle n^{20} is so adjusted as to impart a slight overfeed to the strip, and the parts are so arranged, as shown in Fig. 25, to leave the said needle n^{20} free at that time for a limited backward motion. Then on the initial part of the downstroke of the feed-plunger the upper needle n^{18} will engage the next rearward hole on the strip before the needle n^{20} withdraws from the strip, and thereby pull the strip backward the least bit and accurately center the same at the point required for coöperation with the thrust-pins r^4. During this centering action on the strip by the upper needle n^{18} the thrust-pin carriage n^{28} is held up by the piston-spring n^{30}. After the strip has thus been properly centered by the upper needle n^{18} the overhanging head of the plunger n^{17} will engage with the thrust-pin carriage n^{28} and pull the same downward therewith throughout the rest of its downward stroke, thereby bringing all the parts into the position shown in Figs. 23 and 24. This separation of the plunger n^{17} and the thrust-pin carriage n^{28} and the addition of the other devices for permitting a limited downward movement of the feed-plunger before the thrust-pin carriage is moved downward therewith permits the rocking needle n^{20} to be adjusted for a slight overfeed and the upper needle n^{18} to operate with the centering action on the strip, as above described, and these features constitute a material improvement over the feed devices disclosed in my prior patent. By actual practice I have found that with the use of these improved feed devices the strip can be fed and centered with absolute precision, as required, for proper coöperation with the thrust-pin contacts r^4. Of course it will be recalled that these two devices act on a slack section of the strip supplied under the control of the slack-provider, as described. This prevents any tearing of the strip. The slack-provider n^4 n^5, &c., acts on the strip near the spool at a time when the pressure from the spring-seated thrust-pins r^4, not passing through the working holes of the strip, is on the strip, thereby holding the strip at that point under much more friction than is necessary to unwind the strip from the spool n^2 under the action of the slack-provider.

For convenience the upper needle n^{18} is spring-seated and provided with a handle n^{34} for permitting the needle to be raised by hand, whenever so desired, for any purpose—such, for example, as the removal and insertion of the strip into and out of working position.

At this point further consideration of the strip may be dropped until the justifier, the wiring, and other parts have been specified.

The justifier, (see Figs. 1, 2, 3, and 27 to 38.)—A justifier of course is a device for controlling variable spacing devices. In my machine the justifier controls variable word-spacing devices. The word-spacing device on my machine is the mold-plunger g', which may be variably set by the electric devices under the control of the strip for making quads of six different sizes, ranging from one to six units of space, for use at word-spaces. In my machine, therefore, the justifier is a device placed in electric connections of the working circuit for controlling the mold-plunger, so as to produce quads of the required size for justifying the line. The principle and the actions of the justifier can therefore be more readily understood after tracing the wiring; but it is convenient for locating some of the wiring to specify the parts of the justifier at this point.

Referring especially to Figs. 27 to 38, inclusive, the parts of the justifier will now be noted. Most of the parts may be located in Figs. 28 and 29. With a main-lead contact p constantly coöperates a traveling contact p', having a step-by-step movement under the control of an escapement which will presently be described. The traveling contact p', according to its position, also coöperates in succession with a pair of shifter-contacts p^2. With the contacts p^2 coöperate contacts made up of a series of divided members all marked with the same reference-letters p^3. Two of these contacts p^3 are located on the bed, so that the same are always in contact one with each of the contacts p^2. Two others of said divided contacts p^3 are carried on a fixed insulating-block p^4 and constantly coöperate with a pair of contact-fingers p^5. The contact-fingers p^5 are carried by insulating-blocks p^6 and may be set to coöperate with the same or any two adjacent members of a pair of branch-lead contacts numbered 1 to 6, inclusive, located on a branch-lead board p^7, of insulating material. The numbers 1 to 6, indicating said branch-feed contacts, are arranged in the order of the sizes of the quads produced under the control thereof. The fixed block p^4, movable blocks p^6, and the fixed block p^7 are all carried by a removable frame p^8, which when in position brings the said parts in proper location for coöperation with other parts of the justifier located on the bed of the machine. The wiring from the branch leads on the branch board p^7 and from

the contacts p^3 is so disposed that contact-fingers marked with the same reference-letters will engage with corresponding cells of a mercury-box p^9, located on the bed-plate a. The movable blocks p^6 are under tension from springs p^{10} to move toward the left, but may be variably intercepted by any one of six spring-seated stops p^{11}, subject to armature-levers p^{12} and magnets p^{13}, and thereby be properly positioned for coöperation with the desired members of the branch-lead contacts on the board p^7. The pair of contacts p^2 are suitably insulated from each other and are carried by a shifter p^{14}. The shifter p^{14} is engaged by a lever p^{15}, which is pivoted to the under surface of the main bed-plate a and is subject to the action of a spring p^{16}, tending to throw the said shifter toward the left; but the long arm of said lever p^{15} may be intercepted in any one of five different positions by a series of five stops p^{17}, subject to armature-levers p^{18} and magnets p^{19}. The magnets p^{13} for setting the stops p^{11} and the magnets p^{19} for setting the stops p^{17} are set under the control of the representative strip, as will later appear.

It has been noted that the traveling contact p' moves under the control of an escapement. As shown, this escapement comprises a pair of racks p^{20} and p^{21}, with the latter or smaller member p^{21} mounted for a slip motion on the other under the tension of a light spring p^{22}, as best shown in Figs. 29 to 31. Said two racks coöperate with a spring-dog p^{23}, carried on the upper arm of an armature-lever p^{24}, subject to a magnet p^{25}, which is energized at word-spaces under the control of the strip. The escapement-racks p^{20} p^{21} are mounted on the bed of the machine and are held by suitable guide-keepers p^{26}. The long rack p^{20} has at its opposite ends a pair of projecting fingers marked with the same reference as the rack itself. The left member of said rack-fingers p^{20} takes hold of the insulating-block which carries the traveling escapement p', as best shown in Figs. 28 and 29, and the other member of said rack-fingers is taken hold of by the right end of the retracting-spring p^{27} of the escapement, as best shown in Fig. 29. On the bed-plate a of the machine is located the cam-slide 7 noted when considering the clutch, which is related to the cam-wheel 6, as best shown in Figs. 27 and 32 to 34, inclusive. This slide 7 has an upturned outer end p^{28}, which is adapted to engage behind the movable blocks p^6, as best shown in Figs. 29, 33, and 34, and has also an offset arm p^{29}, which is adapted to engage with the right-hand member of the rack-fingers p^{20} and a corresponding angular projection from the shifter p^{14}, as best shown in Figs. 29 and 32. At its right end the slide 7 is provided with a roller p^{30}, working in a cam-channel p^{31} in the profile face of said cam-wheel 6. When this cam-wheel 6 is tripped into action, as hitherto noted, the said cam-channel p^{31} will move the slide 7 from the position shown in Fig. 27 into the position shown in Figs. 32 and 33 and then back into the position shown in Figs. 27 and 34. Under the movement of said slide 7 toward the right the parts will assume the position shown in Figs. 32 and 33, or, otherwise stated, the movable blocks p^6, the shifter p^{14}, and the escapement-racks p^{20} p^{21} will be drawn toward the right into an extreme or initial position against the tension of their respective retracting-springs, hitherto noted. During this time the stops p^{11} for intercepting the blocks p^6 and the stops p^{17} for intercepting the shifter p^{14} will have been thrown up by their respective magnets under the control of the strip. Hence as soon as said cam-channel p^{31} on the wheel 6 causes the slide 7 to move toward the left the said movable blocks p^6 and said shifter p^{14} will move backward under the tension from their retracting-springs until intercepted by their respective set stops, or, otherwise stated, the parts will assume the position shown in Figs. 34 and 35. The escapement-racks will of course be held in their initial position by the escapement-dog p^{23}, as best shown in Figs. 29 to 31. Thus the parts of the justifier will be set for any given line, which, as shown, is for the line represented on the strip in Fig. 22—to wit, a line of six words or five word-spaces.

At this point the consideration of the justifier may be dropped until after the wiring has been specified.

The wiring and the switch, (see Figs. 3, 21, 26, 27, 36, and 37.)—It will be most convenient to first note the switch. As best shown in Fig. 27, the cam-wheel 6 operates a pivoted lever s, which at its lower end takes hold of the upper or movable member s' of a two-way switch. The fixed member s^2 of said switch is located directly below the member s', and has double the number of contacts compared with the member s' for coöperation with the member s' in two different positions to establish what are later distinguished as the "working" and the "setting" circuit connections. The switch-lever s is operated by the same profile cam-surfaces g^{41} which were hitherto pointed out as operating the cam-lever g^{40} for shifting the fulcrum g^{31} of the type-ejecting lever g^{29}. The roller on the switch-lever s also works through the passes g^{42} in exactly the same way. Normally the forward member of said cam-surface g^{41} on the cam-wheel 6 holds the movable member of the switch-board at the rear or as shown in Figs. 3 and 37, but at the proper time will throw the same forward and hold the same there for a half-turn of the cam-wheel 6. When in its rearmost position, the working-circuit connections are established, as shown in full lines in the diagram view Fig. 37, and when in its forward position the setting-circuit connections are established, as shown in dotted lines in said diagram view Fig. 37.

For tracing the wiring attention is directed

especially to the diagram view Fig. 37. From any suitable source of electricity the current can pass over supply-wire r to an insulated spring-contact r', depending from shelf a^2. The said spring-contact r' is in position to engage a contact-strip r^2, fixed on the periphery of cam-wheel 4 during a little over one-half turn of said cam-wheel. Hence during that time the current can pass to the driving-shaft b and over the frame of the machine to the mercury-wells r^3 at the top of the thrust-pin carriage n^{28}. The thrust-pins r^4 have L-shaped projections at their upper ends, as best shown in Fig. 24, the depending portions of which dip constantly in the mercury-wells r^3. Thence the current can reach the thrust-pins r^4, and whenever the carriage n^{28} is lowered such of the pins r^4 as pass through the perforations in the strip can reach the insulated mercury-wells r^5, which are located in the bed-plate n^{14}, over which the strip passes. Thence sections of wires r^6 connect to corresponding mercury-wells r^5 at the bottom of the pedestal n^{13}, as best shown in Figs. 21 and 26. Corresponding sections of the same wires r^6 lead from eighteen of the mercury-wells r^5 to eighteen contacts bearing the same reference located on the movable member s' of the two-way switch. From the opposite sides of the center of the fixed member s^2 of said two-way switch extend two sets of nine wires, shown in full lines. The rear set r^7 lead to the nine magnets h^{23}, which control what has been called the "row-selecting" stops h^{20} for intercepting the matrix-block in its forward movement. The forward set r^8 of said wires, shown in full lines, lead to the nine magnets h^{26}, which control the movable members of what has been called the "individual" stops h^{24} for intercepting the matrix-block in its movement toward the left. From said fixed member s^2 of said switch also extend two sets r^9 of six wires, shown in dotted lines, which lead to the magnets p^{13}, which control the movable members of the series of stops p^{11}, which intercept the blocks p^6 of the justifier for properly setting the same. From the central part of said fixed switch member s^2 extend four wires r^{10}, shown in dotted lines, to the magnets p^{19}, which control the movable members of the stops p^{17} for variably intercepting the lever p^{15} and setting the shifter p^{14} of the justifier.

The return-wires from the row-selecting magnets h^{23} unite into five wires r^{11} r^{12}, of which the four members r^{11} extend to corresponding members of the mold-magnets g^{21}, marked on the diagram with numbers indicating the sizes of face which they control, and the other wire r^{12} extends directly to the common return-wire r^{14} from said mold-magnets g^{21}. From individual-stop magnets h^{26} the return-wires all unite to a common wire r^{13}, which is shown as uniting with the wire r^{12} and through the same with the wire r^{14}. The wire r^{14} extends to the pump-trip magnet f^{22}, whence wire r^{15} leads back to source.

From the justifier-magnets p^{13} the return-wires unite to a common wire r^{16}, leading back to source, and from the justifier-magnets p^{19}, controlling the shifter-stops, the wires unite to a common wire r^{17}, leading back to source.

From one of the mercury-wells r^5 a wire r^{18} extends to the escapement-magnet p^{25} of the justifier. From said magnet p^{25} a return-wire r^{19} extends to the main-lead contact-strip p of the justifier. Thence the current passes over the traveling contact p' and the set contacts of the justifier to the proper member of the numbered branch-lead contacts on the branch board p^7. Thence the current passes over the proper member of the six wires r^{20}, five of which lead one to each of the five mold-magnets g^{21}, and the other or sixth member of which leads to the return-wires r^{12} and r^{14} and over the same to the pump-trip magnet f^{22}. From another of the mercury-wells r^5 a wire r^{21} extends to the clutch-trip magnet c^6, whence a wire r^{22} extends back to source.

As hitherto stated, the movable member s' of the switch normally stands as shown in the diagram view Fig. 37, or in position to establish the circuit connections over the wires shown in full lines and distinguished as the working circuit. When the movable member of the switch is shifted forward to its opposite position, it will stand in position to establish the connection over the dotted-line wires distinguished as the "setting-circuit." Otherwise stated, the spring-seated thrust-pins r^4 to the number of eighteen may be used for a double purpose at different times—to wit, to set the parts of the justifier when the movable member of the switch is in position to establish the setting-circuit connection and to position the stops for the matrix-block and the mold-plunger when the movable member of the switch is in its normal position, or that taken when it establishes the connections for the working circuit. One of the other members of the twenty thrust-pins r^4 and its coöperating parts is appropriated to the trip-circuit, which is always available, and still another of said thrust-pins r^4 and its coöperating parts is appropriated to the escapement branch of the working circuit for coöperation with the space-holes and the justifier to control the position of the mold-plunger for making quads of the desired size to justify the line.

With the exception of the changes required by the addition made to the justifier in the present machine the wiring just hereinbefore described is substantially the same as in my prior patent. Let it be noted that all the return-wires from the working circuit or magnets which control parts which coöperate, when casting the type of a given line, unite to the common return-wire r^{14}, which leads to the pump-trip f^{22}. This insures the proper timing of the release for the pump, and of course no cast can take place at any other time. It should be further recalled that when the escapement branch of the working

circuit is called into action by the space-holes on the strip the matrix-box assumes an extreme position toward the front and toward the left under the action of its retracting-springs, thereby bringing the block in position for coöperation with the mold to cast a quad, as hitherto stated.

Of course the working holes on the strip must be made on the composing-machine by a bank of punches devoted to the same purposes as the bank of thrust-pins r^4, so as to bring the holes in proper position crosswise of the strip for coöperation with said thrust-pins r^4 on this type casting and setting machine.

The action of the justifier, (see Figs. 28, 29, 37, and 38.)—The wiring having been located, the action of the justifier can now be readily traced.

In the drawings, the parts of the justifier are shown in the positions required for the production of the line of type, properly justified, which is represented on the strip shown in Fig. 22. By reference to this view it will be seen that said line reads "to simplify spacing and justification must." This is a line of six words or five spaces. It should be further noted that "fi" is a logotype. The predetermined column-line, for which the machine is arranged, has one hundred and thirty units. The normal quad is three units. The character type range from two to six units. The quads may range from one to six units. If measured, it would be seen that the words above quoted and represented in Fig. 22, if normal quads were used, would more than fill out the line by an excess of seven units. Otherwise stated, there must be justification by way of subtraction amounting to seven units, or, using a convenient notation, minus seven units of justification-space must be distributed. The machine is constructed to justify lines ranging from five to nine words or lines having from four to eight word-spaces. The type are made and set up from the right toward the left, in respect to the reading-line, when in print. The justifier is constructed to permit a possible number of five steps or escapements to the traveling contact p' before it passes off from the right member onto the left member of the shifter-contacts p^2; but the shifter may be set so that the traveling contact p' will make this shift at an earlier desired number of steps. In the drawings the shifter is shown as set to permit the said traveling contact p' to make three steps on the right member before passing to the left member of said shifter-contacts p^2. The right member of said shifter-contacts p^2 coöperates with the sectional contacts p^3 and that member of the contacts p^5, carried by the blocks p^6, which is set for coöperation with the two-unit lead on the branch board p^7. The other or left member of the shifter-contact p^2 cooperates over the sectional contacts p^3 with that member of said contacts p^5 which is set to coöperate with the one-unit lead contact on the branch board p^7. Hence during the first three steps of the traveling contact p' the escapement-circuit will be closed through the two-unit member of the mold-magnets g^{21}, and during the remaining two escapements for the given line the escapement-circuit will be closed through the one-unit member of the mold-magnet g^{21}. Hence for the first three escapements or spaces to the right two-unit quads will be made, and for the remaining two escapements or spaces to the left hair-spaces or one-unit quads will be made. Otherwise stated, the quads expressed in numbers according to size of face will read in the printed line from the left toward the right 1 1 2 2 2. The normal spacing would have been 3 3 3 3 3. Hence it is obvious that the seven minus units of justification-space have been distributed and that the given line (shown in Fig. 22) will be justified.

Suppose the line had contained eight word-spaces and required the distribution of minus seven units. Then the parts of the justifier would have been so set that the traveling contact p' would coact for one step or escapement only with the shifter-contact p^2 to the right and for the remaining seven steps with the shifter-contact p^2 to the left, and the contact-fingers p^5 would have been so set that the member thereof coöperating with the right-hand member of the shifter-contacts p^2 would rest on the three-unit member of the branch-lead contacts on the branch board p^7, while the other member of said contact p^5 would rest on the two-unit member of said branch-lead contacts. Hence the quads expressed in numbers would read 2 2 2 2 2 2 2 3, and comparing this with the normal spacing it will be seen that the minus seven units have been distributed. Suppose, again, a line of six word-spaces requiring a distribution of eleven units of justification-space by way of addition to the normal spacing. In that event the parts of the justifier would be so set as to make five quads to the right of five units each and one quad to the left of four units, or, expressed in numbers, the spacing would read 4 5 5 5 5 5. From these concrete examples it must be obvious that the justifier must have parts capable of being set to do three things—to wit, to make quads to the right and to the left of a given point of shift in every line and to effect this shift at an earlier or later time in the line, as may be required. In other words, only two sizes of quads are ever made, and these never differ from each other by over one unit. The machine is constructed to justify lines having from four to eight word-spaces, as before stated, and to distribute among any of said lines justification-space ranging from one to eight units by way of subtraction and from one to fifteen units by way of addition.

Reconsidering the concrete examples above noted, if asked to state why the justification-space should be distributed exactly as stated the answer is that the wiring from the fixed member of the switchboard s^2 to the justi-

fier-stops magnets p^{13} and p^{19} are arranged to accomplish that result on an arbitrary principle, according to a predetermined scheme of justification, worked out to effect the most even distribution possible. This predetermined distribution is indicated on the chart shown in Fig. 38. Referring to said view, it will be seen that the chart is shown as composed of four columns of three rows of circles in each column. The circles are further grouped into sets containing five series of three each, each set being distinguished by the heavy-line circles at the head thereof. To the left of each set, inside the chart, will be noticed either a negative or positive number representing the justification-space. Outside the margin of the chart will be noticed another series of numbers for each set, reading from four to eight down the column, and these represent word-spaces or lines ranging from four to eight spaces. Reading the rows crosswise in each set the number within the right-hand circle or third row of the column represent the number of quads to the right of the shift in any given line, and which will be of the size expressed in units indicated by the number in the circle standing in the left-hand column, while the intermediate circle represents the sizes of the quads to the left of the shift in that particular line. Otherwise stated, the right-hand row in each column represents the number of escapements before the shift of the traveling contact, from the right-hand member of the shifter-contacts p^2 to the left-hand member thereof, in any given line, and the left-hand row of each column represents the sizes of the quads to the right and the intermediate or middle row of the sizes of the quads to the left of the shift in any given line. By observing this explanation the distribution for every possible line may be read on the said chart. For example, in a line of eight word-spaces requiring the distribution of minus three units the reading will be found at the foot of the left-hand column, and expressed in numbers will be read "3 3 3 3 3 2 2 2" in the printed line, or, considering the quads as made by the machine, the first three to the right will be two-unit quads and the remaining five to the left will be normal or three-unit quads. Again, suppose the line to have four word-spaces and require the distribution of ten units by way of addition. In that event the proper reading will be found at the top of the right-hand column and would be expressed in numbers, and considering the line as set, two quads to the right of six units each and two quads to the left of five units each, and, expressed in the printed line, the spacing would be "5 5 6 6." For some distributions the sizes to the right and the sizes to the left of the shift in the given line will be the same. For such cases the circle in the right-hand row in each column is marked with the cipher or zero-mark, because in that event it is a matter of indifference where the shift occurs or whether any shift is made. In such cases the contacts p^5 of the justifier would both be set to coöperate with the same member of the branch-lead contacts on the branch board p^7. It will further be noted on reference to said chart that sometimes the larger-sized quads are to the right and sometimes to the left of the shift in successive lines. This is purposely done to balance the distribution in respect to the column of printed lines for securing a better appearance on the printed sheet. No provision is made on the machine, as shown in the drawings, for the production of a seven-unit quad. The three-character type, which might have had seven-units face, are cut down to six units, so as to occupy the six-unit row on the matrix-block. Hence on the machine shown it is not possible to distribute thirteen, fourteen, or fifteen units of justification-space, by way of addition, in lines having only four spaces, and on the chart the circles in the left-hand row for such lines are left vacant. This gives no trouble on the machine, because it is found that such lines very rarely ever occur.

In my former patent the justifier was constructed to distribute all the justification-space among the first four word-spaces to the right from the end of the line as set, and thereafter to make normal spaces. Hence there might be and frequently were three sizes of quads, and some of these might differ from each other by more than one unit. By my present improvement or addition to the justifier there can never be but two sizes of quads, as hitherto stated, and the justification-space will be distributed among all the word-spaces of any line ranging from five to nine words and in such a way as to give the most even distribution possible. It is of course obvious that this is a radical improvement over my prior patent.

Modifications of the justifier, (see Figs. 43 and 44.)—To render the principle of the justifier more distinct, I have shown two possible modifications in the structure of its mechanism. For example, the justifier might take the form shown in Fig. 43. In that view the traveling escapement-contact is mounted also for a rocking motion and is shown of sufficient length to overreach the branch-lead board, and this branch board is shown as made up of two sections v', adapted to be variably set by two sets of stops p^{11} for alining any desired members of the branch leads for coaction with the traveling contact v in succession. The traveling contact v must then be adapted to be variably set for a possible number of five escapements over the left-hand member or section of the branch-lead board before passing to the other member thereof. Stops v^3, corresponding to the shifter-stops in the main view, will answer this purpose if it be assumed that the said traveling contact v be moved to its initial position by some kind of a yielding device. The said

traveling contact v is shown as under the control of a suitable escapement, all the parts of which are marked with the same reference-letter v^4, with the exception of the magnet, which is marked p^{25}, as in the main views. The return-wire r^{19} from said magnet p^{25} extends directly to the traveling contact v, with sufficient slack for permitting the travel of said contact. The blocks v' of the branch board are shown as subject to the retracting-springs v^2.

In the modification shown in Fig. 44 the branch board and its parts may be assumed to be the same as in Fig. 43, with the exception that the sections v' are relatively narrow. With the branch leads thereon coöperate a pair of corresponding contacts w', having bases of sufficient length for coöperation with the main lead contact w in succession. The contact w is carried by a block w^2, forming part of an escapement, the other members of which are indicated by the reference-letter w^3, with the exception of the magnet, which, as before, is marked p^{25}. The block w^2 has an armature w^4 of sufficient length to overreach the magnet p^{25} throughout the travel of the contact w. The block w^2 may be variably set, as in the other modification, under the control of stops w^5, corresponding to the shifter-stops in the main views. The return-wire from the escapement-magnet p^{25} extends directly to the contact w. It is obvious that this traveling escapement-contact w may be set to coact for five or any less number of times with the left-hand member of the branch-lead board and for the remainder of escapements in the given line with the other member of said branch board. Hence parts of the justifier shown in this modification may be set relative to each other for effecting the distribution with the same result as the form shown in the main views. It is also obvious that still a third modification would be possible, wherein the branch board would be made up in two sections capable of being set relative to each other, but carried on a frame mounted for travel under the control of an escapement and adapted to be variably set like the shifter shown in the main views or like the escapement-contact shown in the modifications to bring the set members of the branch leads into coöperation in succession with a fixed or non-traveling contact connected to the return-wire of the escapement-magnet. These modifications, illustrated and suggested, are of course not nearly so desirable as the form shown in the main views, but have been indicated simply to make clear that the mechanism may take various forms.

In all the different forms it will be seen there is present what may be called a "main-connection controller" and a pair of "branch-connection controllers." The pair of branch-connection controllers in each form are capable of being set variably in respect to each other for bringing any desired members of their branch connections into proper position for coaction in succession with the main controller. The main controller always has a part capable of being set to determine the number of said coactions between one of said branch controllers before the coactions begin with the other, under a relative traveling movement of some of the parts relative to others. In the preferred form, as shown in the main views, for example, the board p^7, having the numbered contacts, and the contacts p^5, carried by the movable blocks p^6, together with the divided or sectional contacts p^3, constitute what may be called the "pair of branch controllers," capable of being variably set by shifting the blocks p^6 for bringing any desired members of the branch leads in position for coaction in succession with the traveling-contact member p' of the main controller, and the main controller in the preferred form may be regarded as made up of the fixed main-lead contact p, the escapement-controlled traveling contact p', and the shifter-contacts p^2. Of these contacts, forming a part of the main controller, the shifter members p^2 are adapted to be variably set to determine the number of coactions between the main-lead contacts and the set members of the branch-lead contacts in succession. In the modifications shown in Fig. 43 the two sections v', each provided with the series of numbered branch leads, constitute what may be called the two "branch controllers," and the traveling contact v, mounted for the traveling and rocking motion, as described, under the control of the escapement, itself constitutes the main controller and is adapted to be variably set to determine the number of coactions with one of the branch controllers v' before passing to the other. Likewise in the modification shown in Fig. 44 the two branch controllers are similar to those in Fig. 43; but intermediate contacts w' are provided with extended bases, over which the traveling contact w of the main controller moves as permitted by the escapement, and this traveling member w is capable of being set variably to determine the number of coactions with one branch controller before passing to the other.

As the variable word-spacing devices in this machine are electrically controlled and the justifier is located in the escapement branch of the working circuit for controlling the connections at word-spaces to produce the quads of the required size for justification, it is obvious that the justifier, as shown, may be regarded as a combination switch-board capable of being set to control the electric connections to the mold-plunger magnets at word-spaces to produce quads of the required size for the given line. The same principle of construction, however, would apply if the justifier was organized to control mechanical connections or fluid-pressure connections.

The type-delivery devices, (see Figs. 1, 2, 3, 5, 7, 13, 14, 15, 16, 17, 20, 21, 27, 32, 33, 34, 39 to 42.)—With the devices so far described

character type and quads will be cast by the machine under the control of the representative strip, and the quads will be of the proper size to justify the line of cast type. In the consideration of the type-body mold and matrix-block the description was carried to a point where the type as cast were delivered in the delivery-channel outward of the angular mold-section g^3 under the successive ejecting actions of the mold-plunger g', and note was also made of the devices provided for shifting the fulcrum of the ejecting-lever g^{29} under the initial movement of the normally idle cam-wheel 6, so as to impart a long or extraordinary stroke to the mold-plunger g' at the proper time for moving the entire line of cast type outward, so as to be flush with the mouth of the galley. It is necessary to resume the discussion at the point where the type t are delivered in succession by the mold-plunger g' into the delivery-channel t' as cast. This section t' of the delivery-channel is formed in an extension of the forward or fixed side wall of the galley, the floor of which is marked t^2, and also extends toward the right beyond the mouth of the galley, thereby forming a ledge or lip numbered the same as the floor itself for receiving the type. The said fixed wall of the galley is marked t^3, and the adjustable wall at the rear is marked t^4. It will also be recalled that when the mold is in ejecting position the bottom of the mold-cell g is on the same level as the top of the galley-floor t^2, which permits the type to be delivered by the mold-plunger g' into the delivery-channel t' on their feet without requiring any vertical movement of the type. On account of the location of some other parts it will be convenient to distinguish that part of the fixed galley-wall t^3 which extends to the right beyond the delivery-channel t' from the other portion of said wall, and for convenience it may be called the "guide-block" t^5.

The type t as delivered are pushed out by the mold-plunger g' against a spring-held abutment-rack t^6, as best shown in Figs. 13, 14, and 41. This abutment-rack t^6 at its rear end engages with the pinion t^7, fixed to the right end of a shaft t^8, which is subject to a torsion-spring t^9, (best shown in Fig. 27,) and which shaft at its left end is provided with a friction-disk t^{10}. (Best shown in Fig. 41.) A friction-pawl t^{11}, subject to spring t^{12}, is normally held by said spring against said friction-disk t^{10} and coöperates therewith to hold the abutment-rack t^6 in whatever position it may be set against the strain from said torsion-spring t^9. A releasing-slide t^{13} is normally held by spring t^{14} away from the pawl t^{11}, as shown in Fig. 41; but at the proper time the said slide becomes subject to a cam-surface on the galley-head slide t^{15}. The said cam-surface is marked t^{16} and may be seen at a point broken away in Fig. 2. This cam action of the surface t^{16} on the releasing-slide t^{13} occurs at the time when the galley-head slide t^{15} is pushed toward the left for delivering the line of type into the galley, as will presently appear, and when this release occurs the abutment-rack becomes free to assume its normal or innermost position under the action of its spring t^9. The galley-head and its slide are marked with the same reference t^{15}.

Referring now especially to Figs. 13 to 17, inclusive, certain other parts will be noted. As the type are delivered in succession by the mold-plunger g' into the channel t' they are first engaged by a holding-finger t^{17}, as best shown in Fig. 15. This finger t^{17} works in a suitable guideway formed in the guide-block t^5 and is carried on the upper end of a pivoted lever t^{18}, connected below to a cam-lever t^{19}. The cam-lever t^{19} is mounted for sliding movement in a suitable guide-keeper t^{20} and is subject to the action of a cam-surface t^{21} on cam-wheel 2, as best shown in Figs. 2 and 3, and is also subject to a spring t^{22}, working opposite to said cam-surface t^{21}. The spring t^{22} tends to throw the holding-finger t^{17} into its innermost position for engaging the type-nick in the last-ejected type when the plunger retreats. At the time when the type is being pushed out by the mold-plunger g' the cam-surface t^{21} throws the holding-finger t^{17} outward, so as to clear the delivery-channel t', until the type reaches its limit under the normal ejecting action of said mold-plunger g'. Then before the said mold-plunger begins to retreat the cam t^{21} permits the spring t^{22} to become active, thereby forcing the finger t^{17} into its holding position. This device may be called the "type-holder" and serves to prevent the last-ejected type from falling back in the channel as the mold-plunger retreats. In said guide-block t^5 is also mounted what may be called a "take-up" device t^{23}, (best shown in Figs. 13, 14, and 15,) which is normally subject to a spring t^{24}, tending to hold the same in its innermost position. This device t^{23} is adapted to yieldingly press against the last two or three type previously ejected into the delivery-channel t' and hold the same against the opposite wall of the channel under sufficient tension to resist the abutment-rack t^6 in case there should be any slip from the friction devices which hold the said rack. The head of the take-up device t^{23} is of the proper form on one of its vertical corners to permit a camming action between the same and the mold-plunger g' when in ejecting position, thereby allowing the type to pass. This take-up device t^{23} also serves to insure the alinement of the type against one wall of the delivery-channel t', which is wide enough to insure a free movement of the type therethrough.

The rearward continuation of the delivery-channel for the type is formed by the galley-head t^{15} on one side and an automatic composing-rule t^{25} on the other. (Best shown in Figs. 13 and 17 for its working position and best shown in Fig. 39 in its lowered or idle

position.) This rule t^{25} is provided with a downwardly-extended stem t^{26}, suitably guided for vertical movement and normally held in its uppermost position by a spring t^{27}, reacting between its lower guide-bearing and a collar t^{28} on said stem, as best shown in Figs. 20 and 21. The said collar t^{28} is engaged by the forward end of a pivoted lever t^{28}, which extends to a slide t^{30}, mounted for vertical movement in suitable fixed guides secured to the frame, as best shown in Figs. 27 and 39. The said slide t^{30} is provided at its lower end with a one-way spring-dog t^{31}, which is adapted to be engaged at the proper time by a raised cam-surface t^{32} on the cam-slide 7, as best shown in Fig. 39. The said cam-surface t^{32} moves onward toward the right, under the action of the cam-wheel 6, beyond the spring-dog t^{32}, and the said dog pivots against its spring on the return motion of the slide 7 to permit the cam-surface t^{32} to pass the dog into its idle or normal position. Under the action of this cam-surface t^{32} and the said parts t^{30} t^{29} t^{26} the composing-rule t^{25} is thrown down or made to retreat at the proper time to clear the floor of the galley and permit the line of type to be forced into the galley-mouth by the galley-head t^{15}. As quick as the cam-surface t^{32} passes the spring-dog t^{31} the rule-spring t^{27} becomes active to restore the rule t^{25} to its uppermost or normal position ready for use for the next line. The galley head and slide t^{15} are properly shaped to permit this up-and-down motion of the composing-rule t^{25} without interfering with the sliding motion on said galley-head t^{15}. For this purpose the body of the galley-slide t^{15} is provided with a yoke portion, as shown at t^{33}, (best seen in Fig. 39,) and the floor of this yoke portion is slotted, as shown at t^{34}, for permitting the slide t^{15} to move without interference from the rule-stem t^{26}. The rule t^{25} works, of course, through a suitable slot t^{35} in the galley-floor t^{2}.

The galley-slide t^{15} is normally held toward the right in composing position by a strong spring t^{36}, (best shown in Fig. 39,) but is provided with a downwardly-projecting arm t^{37}, which at the proper time is subject to the forward arm of a bell-crank lever t^{38}, suitably supported from the frame, the other arm of which is downturned and subject at the proper time to a lateral pin t^{39} from the cam-slide 7. Hence at the proper time, under the motion imparted to the cam-slide 7 by the normally idle cam-wheel 6, the lever t^{38} will be rocked by the pin t^{39}, and thereby the galley-head t^{15} will be moved toward the left against the tension of its retracting-spring t^{36} for delivering the cast line into the mouth of the galley. On the return motion of the slide 7 by said wheel 6 the spring t^{36} will restore the galley-head to its normal or composing position. When the line of type is delivered into the galley, it becomes subject to a line-clamp t^{40}, (best shown in Figs. 13, 14, 16, and 39,) seated in the rear wall t^{4} of the galley at the mouth of the galley. The said line-clamp t^{40} is engaged by an arm t^{41}, carried on the upper end of a rock-shaft t^{42}, which is subject to a torsion-spring t^{43}, as best shown in Figs. 20 and 39, tending to throw the said arm t^{41} forward and hold the line-clamp t^{40} under tension in clamping position against the end of the last-delivered line of type. The said rock-shaft t^{42} has fixed thereto a lever t^{44}, having a one-way spring-dog t^{45}, which depends therefrom in position to be engaged by a vertical stud t^{46} on the cam-slide 7. The spring for the dog t^{45} is shown at t^{47} and gets its base of resistance on the shaft t^{42}, as best seen in Fig. 39. When the cam-slide 7 is moved toward the right by the normally idle cam-wheel 6, the stud 46 will engage the dog t^{45}, and thereby rock the shaft t^{42} and arm t^{41} toward the rear against the tension of the spring t^{43}, thereby throwing the line-clamp t^{40} rearward out of the way of the galley-head and the line of type to be delivered in the mouth of the galley. As this stud t^{46} on the cam-slide 7, operating on the dog t^{45}, will swing the lever t^{44} in the arc of a circle, the stud will pass on by the said dog into the dotted-line position shown in Fig. 40. Hence on the return motion of the slide 7 the stud t^{46} must pass the said dog t^{45}, and in this action the dog t^{45} will yield against the spring t^{47}, assuming the dotted-line position to the left, as shown in Fig. 40. Of course as quick as the stud t^{46} swings the dog t^{45} and the lever t^{44} toward the right into the dotted-line position shown in Fig. 40 the spring t^{43} will instantly restore the line-clamp t^{40} into its normal position for clamping the last-ejected line.

The galley-head t^{15} is provided at its rear end with a series of narrow plungers t^{48}, (best shown in Figs. 13, 14, 16, and 17,) which are normally held in their innermost position by corresponding springs t^{49}, but which plungers t^{48} will yield backward, if necessary, in case the line of type should happen to be too long to enter the galley or the end type be otherwise intercepted in any way when the galley-head t^{15} moves inward to deliver the cast line into the galley.

When the normally idle cam-wheel 6 imparts the shifting movement to the fulcrum g^{31} of the ejecting-lever g^{29} for causing the mold-plunger g' to make its long or extraordinary stroke, a stud t^{50} on the shifting-bar g^{39} will engage the rear arm of the bell-crank lever t^{51}, the other or forward arm of which is provided with two fingers or prongs t^{52} t^{53}. The prong t^{53} engages behind the outer end of the take-up device t^{23} and the finger t^{52} engages behind a stud t^{54} on the type-holder finger t^{17}, as best shown in Figs. 13 and 14, and under the rocking motion of the bell-crank lever t^{51} will move the said take-up device and type-holder outward, so as to clear the delivery-channel t' for the said long stroke of the plunger g', as best shown in Fig. 14. Under this long stroke of the mold-

plunger g' the line of type ahead of the plunger will force the abutment-rack t^6 outward to its limit, and in this outward movement of said rack t^6 a stud t^{55} thereon will strike the free end of a lever t^{56}, pivoted to the central casting a^4, as best shown in Figs. 13 and 14, and subject to a spring t^{51}, tending to hold the same against a stop-stud t^{58}. The instant that the rack-stud t^{55} engages with the top of the spring-held lever t^{56} the said abutment-rack t^6 will then be obliged to move under the increased tension thereon from the spring t^{57}, as shown in Fig. 14, thereby causing the abutment-rack to coöperate with the mold-plunger g' at the final part of said plunger's long stroke to pack the line of type, and the parts are so timed that this occurs just prior to the inward movement of the galley-head for delivering the line of type into the galley. The said spring-held lever t^{56} may therefore conveniently be called the "line-packer." Under the inward movement of the galley-head t^{15} the line of type and the whole form within the galley will be moved against a suitable piece of printers' furniture t^{59}, located in the galley and serving the usual function of a back-stop or abutment for the form of type.

The shifting leverage for the mold-plunger g' in order to give the same the long stroke heretofore described at the initial part of the turn of cam-wheel 6 is a new function over my prior patent, and the devices for imparting that function, together with all the other devices which coöperate with the mold-plunger g' and the other shifting parts under the said long stroke or shifting leverage, are new over my prior patent. These several features therefore constitute improvements for insuring the delivery of the type. The yielding plungers in the galley-head, the line-clamp, the composing-rule, the take-up device, and the type-holder are all new features over my prior patents. These various details enable the type to be properly held until the line has been cast and then insure the safe delivery of the line into the galley.

The composing-rule t^{25} is shown as provided with a hand-lever t^{60} of bell-crank form, with its short arm taking hold of the same collar t^{28} as its cam-lever t^{29}, as best shown in Fig. 21. This enables the composing-rule to be thrown down by hand whenever so desired.

Operation: All the parts of the machine have now been specified in detail, and the actions of the respective subgroups of mechanism have been quite fully stated in connection with the detailed description of the parts. Nothing more than a summary statement of the general operation of the machine as an entirety is therefore deemed necessary.

In a summary way the general action may, it is thought, be sufficiently stated as follows: The trip-hole at the head of the line, on the strip end, comes first into position for coaction with the proper member of the thrust-pins to close the trip-circuit, and thereby the normally idle cam-wheel 6 is tripped by the clutch into gear with the driving-shaft. Said cam-wheel 6 then makes the one turn while the shaft makes the two. This turn of the cam-wheel 6 shifts the parts which change the leverage on the mold-plunger, so as to render the same capable of its long stroke at the proper time, shifts the movable member of the switch first into position for establishing the setting-circuit connections and then back to its normal position, and moves the cam-slide 7 first to the extreme right and then again to the extreme left. By the movement of said cam-slide 7 toward the right the escapement of the justifier is set and the movable contact-blocks p^6 and the shifter p^{14} thereof are placed under tension from their retracting-springs and all the line-delivery devices subject to said slide 7 are operated to deliver the last-previously-cast line of type. During this time the stops at the justifier are set under the control of the justification-holes of the strip, so as to intercept said movable blocks p^6 and said shifter p^{14}, as required to properly set the justifier for the coming line. During the return of the cam-slide 7 toward the left, or before the same, all the parts of the line-delivery devices subject thereto also reassumed their normal positions. Before the said cam-wheel 6 completed its turn the fulcrum for the mold-plunger-ejecting lever was restored to its normal position. At the end of its turn said cam-wheel 6 is tripped out of action. Thereafter under the feed movements of the strip the character and word-space holes thereof come into action in succession, and thereby control the stops which variably intercept the matrix-block and the mold-plunger, as required, to position the same for casting the type of the line. Whenever a word-space is reached the circuit is closed over the escapement branch of the working circuit and through the set members of the justifier-contacts to the mold-stop magnets, thereby producing the quads of the required sizes to justify the line. At the same time that the matrix-block-stop magnets and the mold-stop magnets were thus energized under the control of the strip the pump-trip magnet is energized, as required to permit the cast. The type for the given line having been thus cast in succession, the trip-hole at the head of the next line on the strip comes into action, thereby again starting the normally idle cam-wheel 6 for delivering the said line of type just cast and setting the justifier as required for the next line.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. A justifier comprising a main-connection controller and a pair of branch controllers each capable of controlling all the branch connections, which three controllers have parts adapted to be variably set in respect to each other to secure a variable number of coactions between the main controller and each of said two branch controllers, in succession, for producing spacings of the same or differ-

ent sizes, as required to justify the line, substantially as described.

2. A justifier comprising a main-connection controller and a pair of branch-connection controllers, which branch controllers have parts adapted to be variably set for causing any two desired branches to coact, in succession, with the main controller, and which main controller has a part capable of being set to determine the number of coactions between said main controller and the set members of said branch controller, substantially as and for the purposes set forth.

3. A justifier comprising a main-connection controller and a pair of branch-connection controllers, which branch controllers have parts adapted to be variably set to fix the space-sizes, for the given line, and which main controller has an escapement-controlled traveler adapted to coact in succession, with the set members of said branch controllers, and is provided with a shifter adapted to be variably set to fix the number of coactions between said traveler and the set members of the said branch controllers, substantially as described.

4. The combination with electrically-controlled variable spacing devices, of a justifier to control the same, comprising a main-lead controller and a pair of branch-lead controllers, in the circuit connections, which three controllers are adapted to be variably set to secure a variable number of contacts between said main lead and the set members of said branch leads, in succession, under a relative traveling movement of said main-lead and branch-lead controllers, substantially as described.

5. The combination with electrically-controlled variable spacing devices, of a justifier in the circuit connections for the same comprising a main-lead controller and a pair of branch-lead controllers, which branch-lead controllers are adapted to be variably set to fix the space-sizes, and which main-lead controller has an escapement-controlled traveling contact, adapted to coact, in succession, with the set leads of said branch controllers, and a shifter adapted to be variably set to fix the number of contacts or coactions between said traveling member and said two set branch members, substantially as described.

6. The combination with a justifier having three elements which require to be variably set, in respect to each other, in order to secure a variable number of coactions between one thereof and each of the other two, in succession, of a representative strip having three perforations to control the setting of said justifier elements, and connections controlled by said holes of said strip, to effect the variable setting of said elements of the justifier, substantially as described.

7. The combination with variable, electrically-controlled word-spacing devices, and a representative strip having word-space holes to control said electric connections, at word-spaces, of the justifier comprising the pair of branch-lead controllers adapted to be set to variably fix the space-sizes and a main-lead controller having a traveling lead for coaction with the set members of said branch leads, in succession, a shifter adapted to be variably set to fix the number of coactions between said traveling lead and said set branch leads, and an escapement for imparting a step-by-step motion to said traveling lead, at word-spaces, under the control of said strip, substantially as and for the purposes set forth.

8. The combination with the representative strip, having the three justification-holes, of the justifier having the two branch controllers which require to be variably set, and having the main controller provided with the shifter which requires to be variably set, means for moving said parts of the justifier into an extreme or initial position against retracting-springs and three corresponding series of stops adapted to be variably set, under the control of said holes in said strip, for variably intercepting said three parts of the justifier, to properly set the same as required, substantially as described.

9. The justifier in the circuit connections to the mold-plunger magnets, comprising the branch-lead board, with leads corresponding to the possible size of the quads, the two contact-fingers adapted to be set variably for cooperation with the same or two different branch leads, the traveling lead adapted to coact, in succession, with said finger-contacts, a shifter with a pair of contacts connecting one with each of said finger-contacts and over which said traveling lead moves, which shifter is adapted to be variably set to determine the number of coactions between said traveling lead and said finger-contacts, in succession, and an escapement for imparting a step-by-step motion to said traveling contact at word-spaces, substantially as described.

10. In a justifier, the combination with two elements adapted to be variably set to make spaces of two different sizes, of a third element adapted to be variably set for coaction with the other two elements, in succession, to determine the number of said spaces to be made of each size, in any given line, substantially as and for the purposes set forth.

11. The combination of an integral-font matrix-block working in a constant horizontal plane, a galley-floor parallel thereto, at a lower level, and a type-body mold movable in the vertical plane, at right angles to said block, for coöperation with said block, at the upper level, to cast the type, and for coöperation with the galley-floor at the lower level, for permitting the type to be ejected from the mold, directly onto the galley-floor on their feet, substantially as described.

12. The combination with the matrix-block and the galley, located at two different levels, of a vertically-movable support, the type-body mold carried by said support, and means for

raising said support and holding the same in its uppermost position, for coöperation with the matrix-block in the casting action, substantially as described.

13. The combination with the matrix-block and the galley, located at different levels, of the vertically-movable support g^4, the type-body mold, as described, having its bed-sections fixed to said support, the cam-controlled lever g^7, for raising said support and mold into casting position and the springs g^{10} for lowering the same, substantially as described.

14. The combination with the matrix-block and the galley, located at different levels, of the vertically-movable support, the mold having its bed member fixed to said support, the nipple-slide carried by said support and vertically movable thereon, and the cam-levers and springs for operating said mold-support and nipple-slide, substantially as described.

15. The combination with the matrix-block and the galley, located at two different levels, of the vertically-movable mold-support, the nipple-slide carried by and vertically movable on said support, the mold having its bed member fixed to said support, the matrix-block centering-pin and its plunger, the shifting-lever for shifting laterally the movable members of the mold on the bed member thereof, the ejecting-lever for the mold-plunger, and coöperating cams and springs for operating all of said parts in the proper order, substantially as described.

16. The combination with the mold-plunger and its ejecting-lever, of devices for shifting the leverage, to impart an extraordinary or long stroke to said plunger, substantially as and for the purposes set forth.

17. The combination with the mold-plunger and its ejecting-lever, of a constantly-running cam for operating the said lever, to eject the successive type as cast, a shifting-bar and a cam-lever, and a normally idle cam-wheel on the driving-shaft operating to hold the fulcrum of said ejecting-lever in a normal position, as the type are cast, but operative, when said normally idle cam-wheel is tripped into gear with the driving-shaft, to shift the fulcrum of said ejecting-lever, substantially as and for the purposes set forth.

18. The combination with the mold and melting-pot and the delivery-nipple, of the force-pump therein, having the cylinder and the charging-chamber, in communication, at their lower ends, an outwardly-opening check-valve in said cylinder, an inwardly-opening check-valve in said charging-chamber, a two-sectioned piston in said cylinder, and a supply-port through the cylinder to said charging-chamber, which opens between the piston-sections, on the working stroke, and is closed by said piston, on the return stroke, whereby back suction at said nipple is avoided, substantially as described.

19. The combination with the matrix-block and its carriages for permitting a two-way movement of said block, of cams and cam-levers adapted to simultaneously operate on said block, in two different directions, at right angles to each other, against independent retracting-springs, acting at right angles to each other, whereby any particular matrix on the block takes a diagonal or shortest-path course from initial to casting position and reversely, substantially as and for the purposes set forth.

20. The combination with the matrix-block h and its main carriage h^3, of the small carriage h' mounted for movement crosswise of said main carriage, the lever h^7 pivoted to said main carriage and acting on said small carriage, the cam-slide h^8 h^9, movable transversely of said main carriage, for operating the lever h^7, the three-armed cam-lever h^{10}, one of its arms acting on said cam-slide and the other on said main carriage, and suitable retracting-springs applied one to each of said carriages, for action at right angles to each other, all substantially as and for the purposes set forth.

21. In a type casting and setting machine, the combination with the controlling-strip and suitable intermittent feed devices for the same, of an idle or non-driven spool from which the strip is unwound, and an automatic slack-provider comprising a device movable transversely to the strip and operative thereon at a point near the spool, when the strip is held stationary, at the point of feed, for pulling from the spool a slack section in said strip, which later becomes subject to said feed devices, with said parts constructed and arranged to first pull the slack section in the strip, and then instantly free the same from all tension until after the feed takes place, substantially as and for the purposes set forth.

22. In a type casting and setting machine, the combination with the controlling-strip and suitable feed devices for the same, of the bank of coöperating thrust-pins, an idle or undriven spool or holder from which the strip is unwound, and the slack-provider comprising the yoke embracing the strip, at a point near the holding-spool, and subject to a coöperating cam and spring, which cause the yoke to pull on the strip at a time when the strip is held stationary at the point of feed by the pressure thereon from those members of the thrust-pins which do not pass through holes in the strip, substantially as and for the purposes set forth.

23. The combination with the strip and the feed-plunger, of the feed-needles and the thrust-pin carriage subject to said plunger, but with said parts so related that the pin-carriage may be temporarily held up in an idle position while the plunger and upper needle make the initial part of their downstroke, whereby the rocking needle may be set to impart a slight overfeed to the strip, and the upper or centering needle will pull the same back and accurately center the strip before the pin-carriage is pulled down by the plunger, substantially as and for the purposes set forth.

24. The combination with the strip and the feed-plunger, of the feed-needles carried by said plunger, the lower member of which is mounted for rocking motion, at the opposite limits of the plunger's stroke, and the thrust-pin carriage seated on the plunger and subject thereto, but free to be held stationary while the plunger makes the initial part of its stroke, before becoming subject thereto, and means for temporarily holding the said carriage wherever left by said plunger, substantially as and for the purposes set forth.

25. The combination with the strip, of the feed-plunger n^{17}, the feed-needles n^{18} and n^{20}, mounted thereon, as described, the fixed pins n^{25}, for rocking the lower or pivoted needle, the spring-latch n^{26} carried by the plunger, the thrust-pin carriage n^{28} seated on and subject to said plunger, but free to be held stationary while the plunger makes the initial part of its stroke, and the yielding or spring action device n^{30} n^{31} n^{32}, for holding said carriage wherever left by the plunger, substantially as and for the purposes set forth.

26. The combination with the mold-plunger and the series of stops for variably intercepting the same, of the adjustable gage-plates or guides for the upper ends of said stops, substantially as and for the purposes set forth.

27. The combination with the mold-plunger, stepped lever and slide, of the gage-lever underlying the stepped lever and connected to said slide, the spring tending to throw the stepped lever to its limit on said gage-lever, the series of stops and the gage-plates or guides for the upper ends of the same, substantially as and for the purposes set forth.

28. The combination with the mold-plunger and the ejecting-lever for the same, of the slide g^{26}, the gage-lever g^{23} connected to said slide, the stepped lever g^{22} subject to spring g^{37}, the slotted plate g^{32} carried by the mold-plunger and the pin g^{34} on the slide g^{26}, for coöperation, substantially as described.

29. The combination with the mold, of a galley having a delivery-channel through one wall thereof, and a type-holder seated in said galley-walls as a guide, and operating to engage each ejected type before the mold-plunger retreats and to clamp the same against the opposite wall of said delivery-channel, for preventing the type from falling back toward the mold in the delivery-channel, substantially as described.

30. The combination with the mold, the galley and the abutment-rack, of the take-up device operating to yieldingly clamp the last few type previously ejected against the walls of the delivery-channel, for alining the said type against one wall of said channel, and insuring proper resistance to said spring-held abutment-rack, substantially as described.

31. The combination with the mold and the abutment-rack, of the line-packer adapted to coöperate with the rack, at the outward limit of the line's movement, under the ejecting action of the plunger, to pack the line, substantially as described.

32. The combination with the mold-plunger, its ejecting-lever and the shifting-leverage devices, for imparting a long stroke thereto, after the line is cast, of the abutment-rack and the spring-held line-packer, adapted to intercept said rack, when under the action of said mold-plunger, at the said long stroke, to pack the line, substantially as described.

33. The combination with the mold-plunger, its ejecting-lever g^{29}, the fulcrum shifting-bar g^{39}, the cam-lever g^{40} and the cam-surfaces g^{41}, with passes g^{42}, on the normally idle cam-wheel 6, of the spring-held abutment-rack t^{6} having the stud t^{55}, and the spring-held line-packer g^{56} in the path of said stud, near the limit of the rack's outward movement, all substantially as and for the purposes set forth.

34. The combination with the galley, of a line-clamp independent of the galley and movable through one wall of the galley, as a guide and adapted to engage with one end of the line of type last delivered for holding the same in the galley, substantially as described.

35. The combination with the galley and the line-clamp, of a releasing device, operative to throw the line-clamp into an idle position, at the proper time, to permit the entrance of the line into the galley, substantially as described.

36. The combination with the type-holder and the take-up device, of a device operative to throw the said parts outward into an idle position, at the time when the mold-plunger makes its long stroke, substantially as and for the purposes set forth.

37. The combination with the mold and the shifting-leverage devices, of the spring-held type-holder, the spring-held take-up device, the spring-held bell-crank lever t^{51} with fingers t^{52} and t^{53}, engaging said type-holder and take-up devices, and the stud t^{50} on the shifting-bar g^{39}, for rocking the lever t^{51} and throwing the type-holder and take-up device into their idle positions, at the proper time, substantially as described.

38. The combination with the pump and its actuating devices, of the pivoted frame h^{4} for supporting the matrix-block carriages, and a safety-lock for the pump, normally held in its releasing position when said frame is in its lowered or working position, but adapted to engage with some part of the pump-actuating devices, and lock the same in an idle position, when the said pivoted frame is turned over into an idle position, substantially as and for the purposes set forth.

39. The combination with the cam-rod f^{14}, having the stud f^{15} and the pivoted frame h^{4}, of the safety-lock for the pump comprising the notched lever f^{24}, the vertical arm f^{25}, normally held down by said frame, and the spring f^{26}, for throwing the notched lever f^{24}

into engagement with the stud f^{15} and locking the pump when the said frame is turned over, substantially as described.

40. In the type casting and setting machine, substantially as described, the combination with the strip, the switch, the several circuit connections described, the normally idle cam-wheel 6, with cam-slide 7, under the control of said strip over the trip-circuit, of the justifier comprising the contact p, in the return branch of the escapement-circuit, the traveling contact p', the escapement therefor, with its magnet in the escapement-circuit, under the control of said strip at word-spaces, the shifter p^{14}, with the pair of contacts p^2, the sectional contacts p^3, the branch board p^7, the spring-retracted blocks p^6, with finger-contacts p^5, the shifter spring-held lever p^{15}, the projections p^{28} and p^{29} on the cam-slide 7, for action on said escapement, said blocks and said shifter, the two series of electric stop devices p^{11} p^{12} p^{13} for said blocks and the series of stop devices p^{17} p^{18} p^{19} for said shifter, with all of said electric stop devices located at the setting-circuit connections, all for coöperation, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE ARTHUR GOODSON.

Witnesses:

JAS. F. WILLIAMSON,

LILLIAN C. ELMORE.