No. 872,223. PATENTED NOV. 26, 1907.

F. B. CONVERSE, Jr.

JUSTIFYING MECHANISM.

APPLICATION FILED JAN. 30, 1900. RENEWED DEC. 10, 1902.

6 SHEETS—SHEET 1.

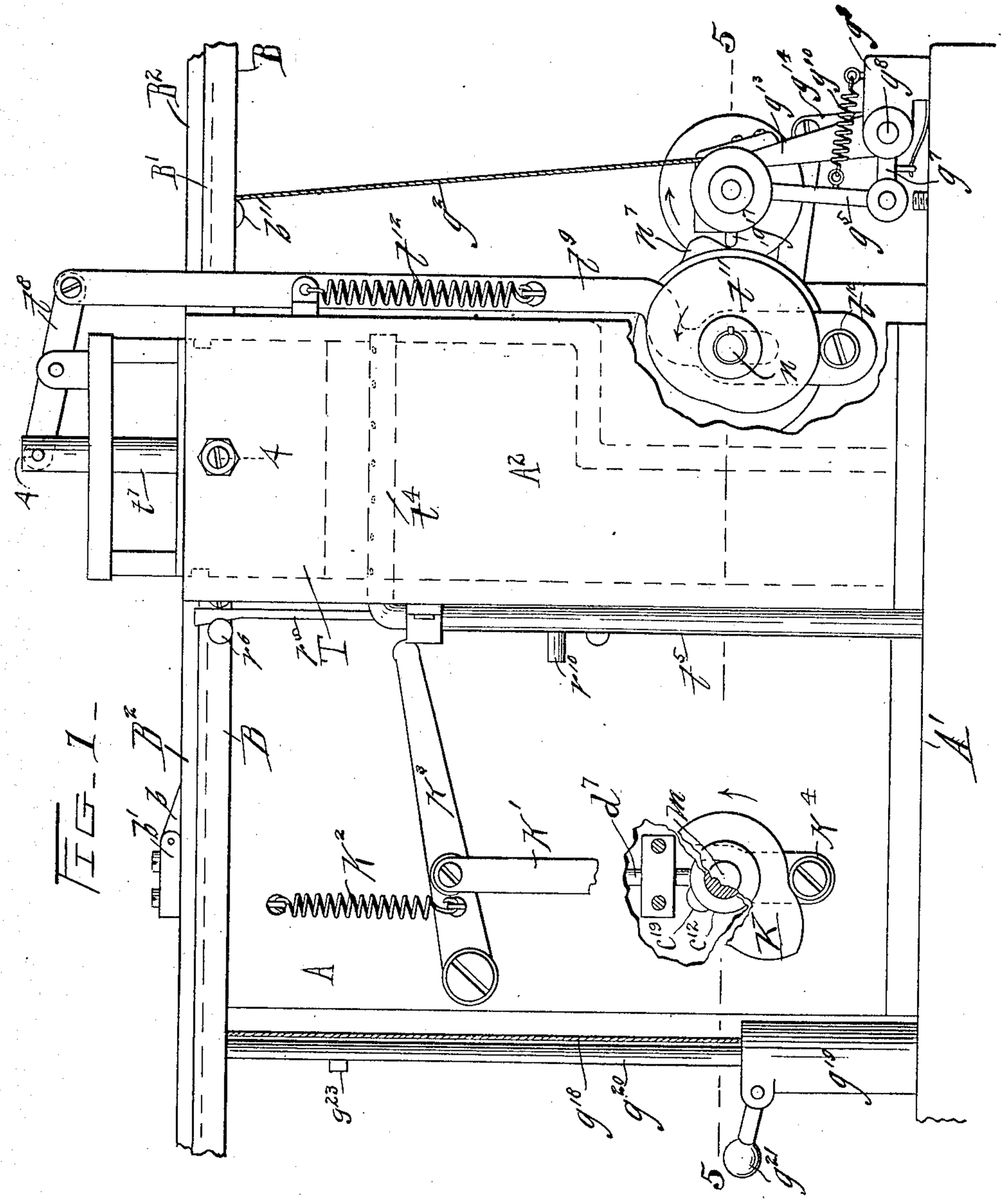

FIG. 1.

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6 SHEETS—SHEET 2.

FIG. 12.

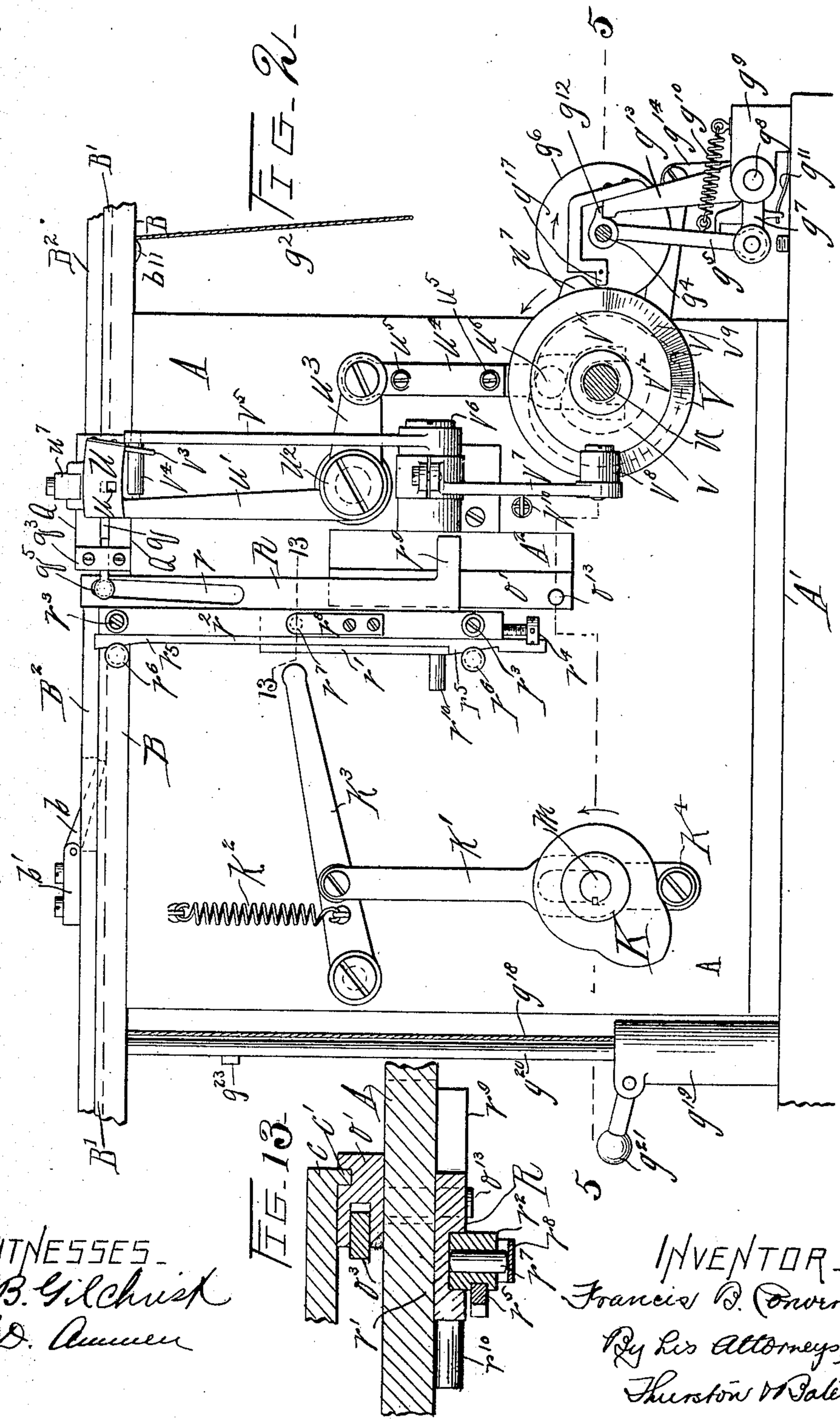

FIG. 13.

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6 SHEETS—SHEET 3.

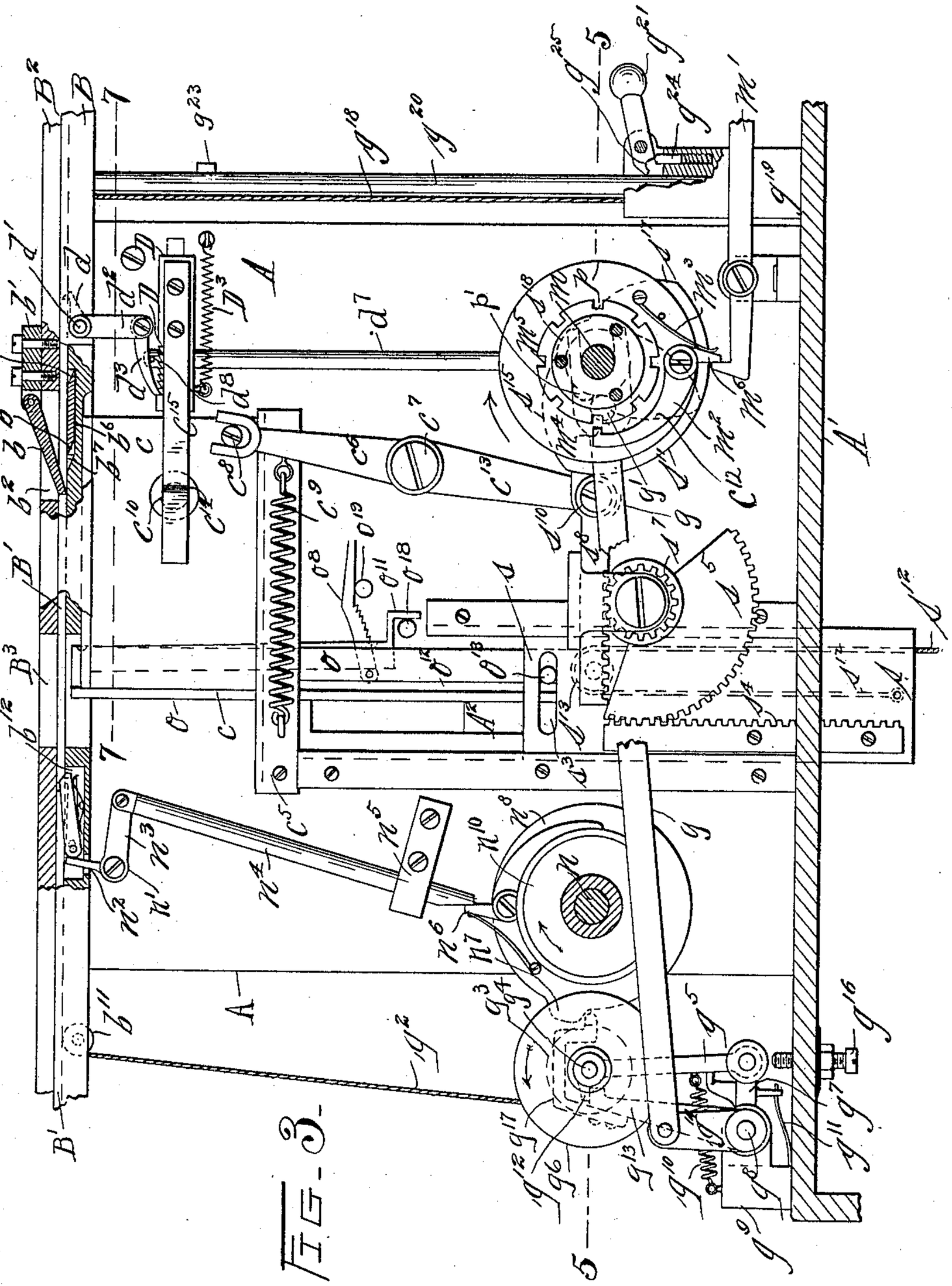

FIG. 3.

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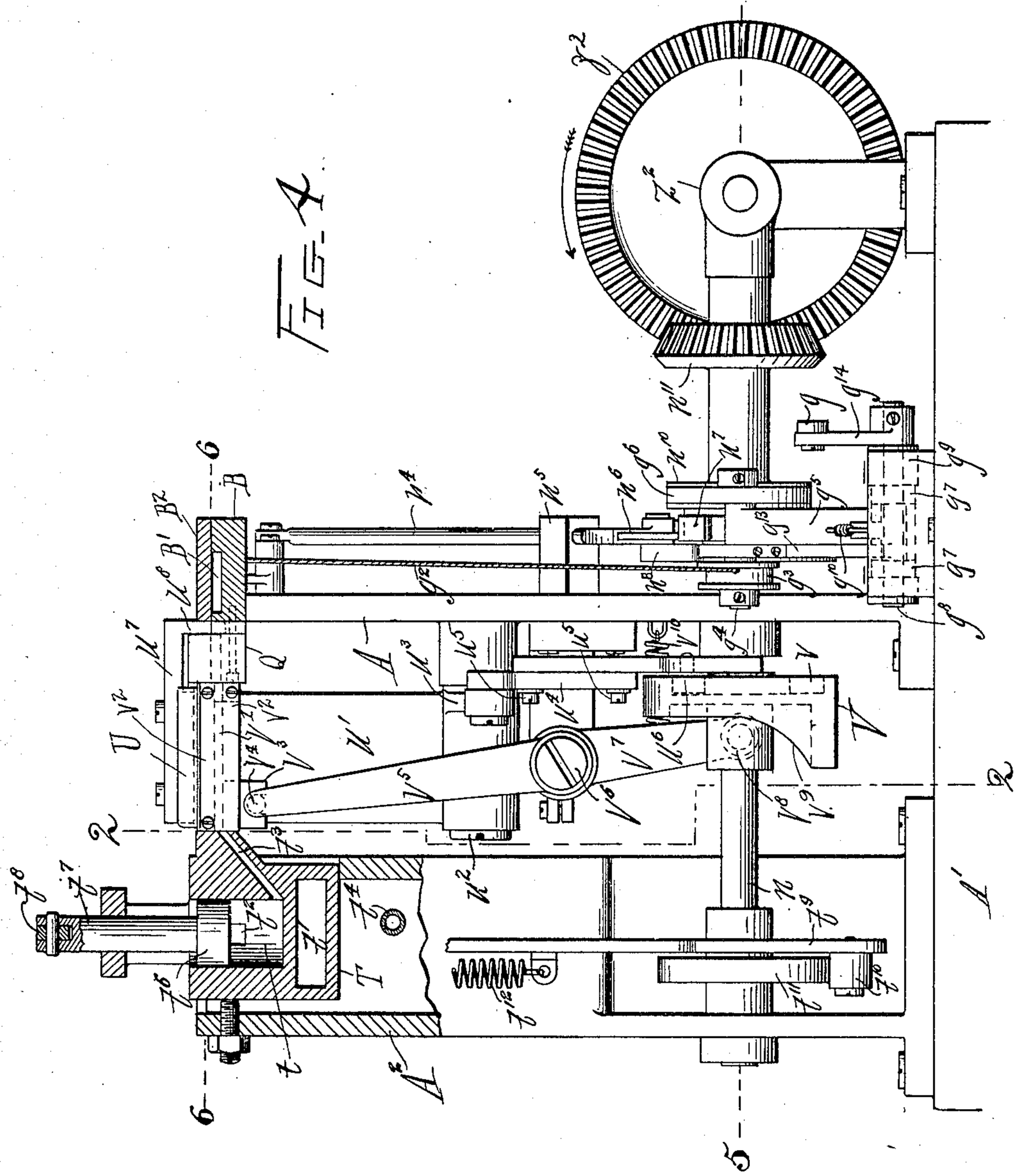
6 SHEETS—SHEET 4.

FIG. 4



WITNESSES
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6 SHEETS—SHEET 5.

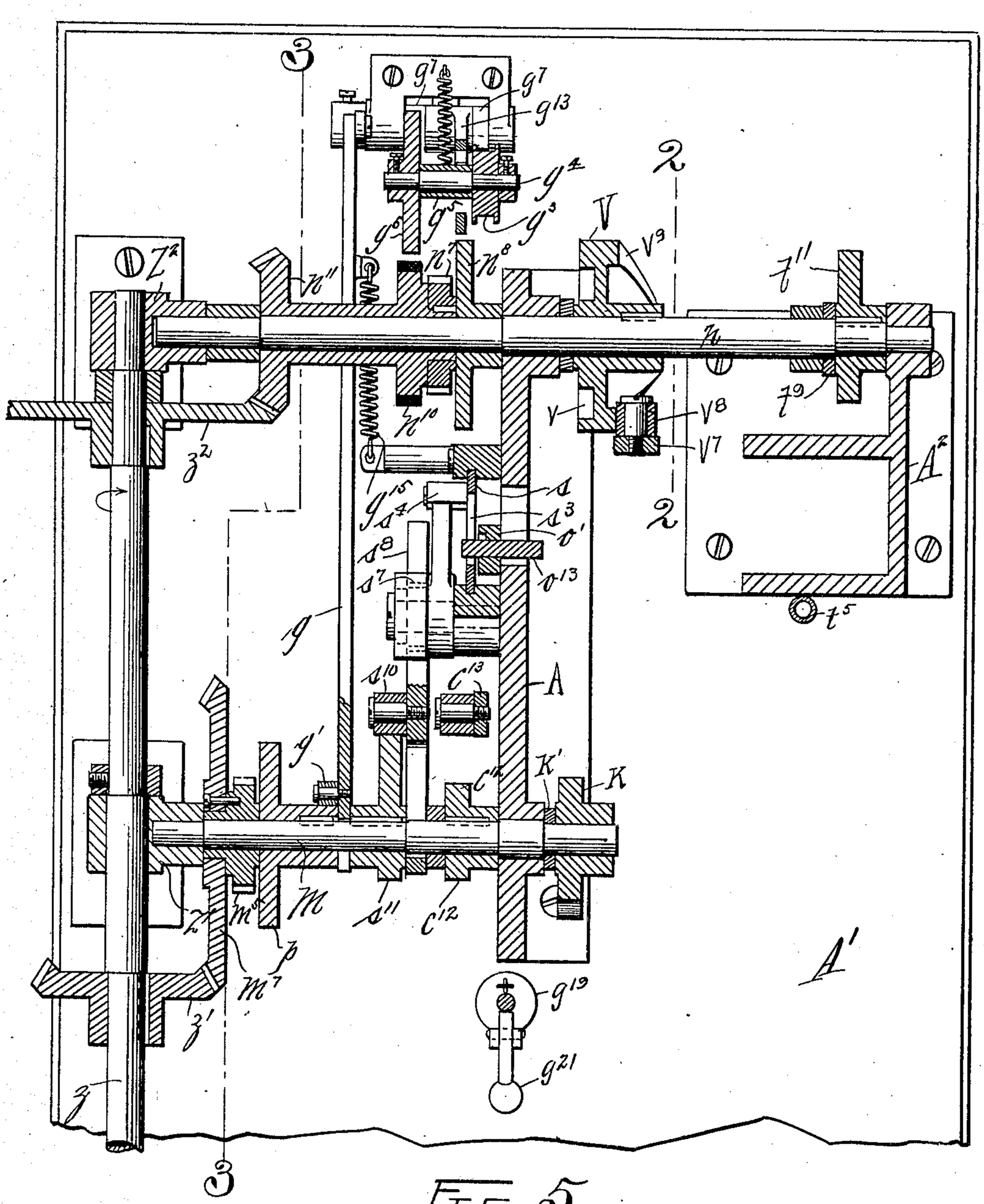

FIG. 5.

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APPLICATION FILED JAN. 30, 1900. RENEWED DEC. 10, 1902.

6 SHEETS—SHEET 6.

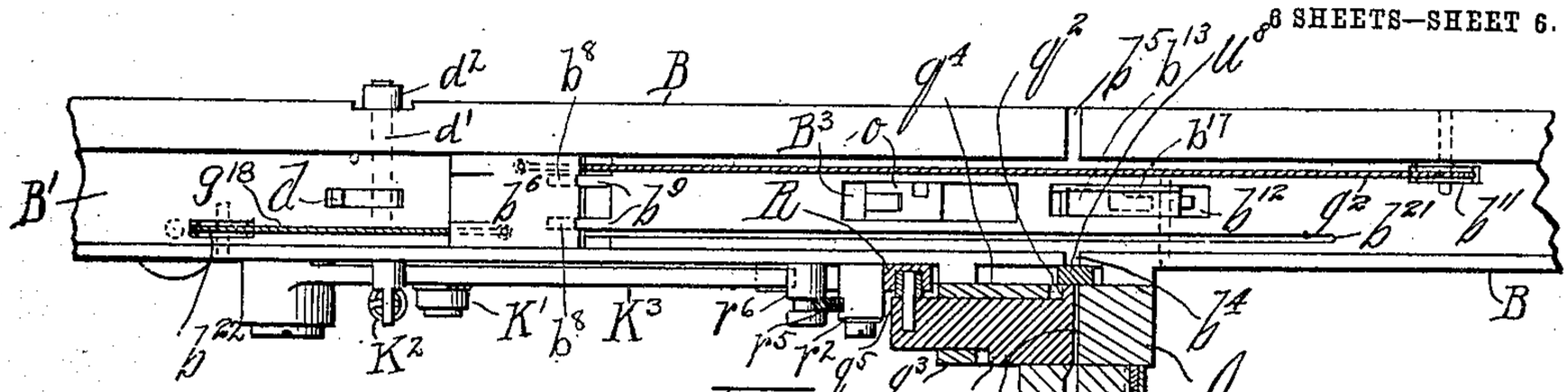


FIG. 12.

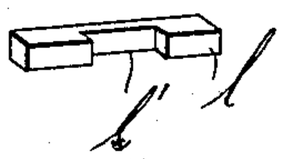


FIG. 6.

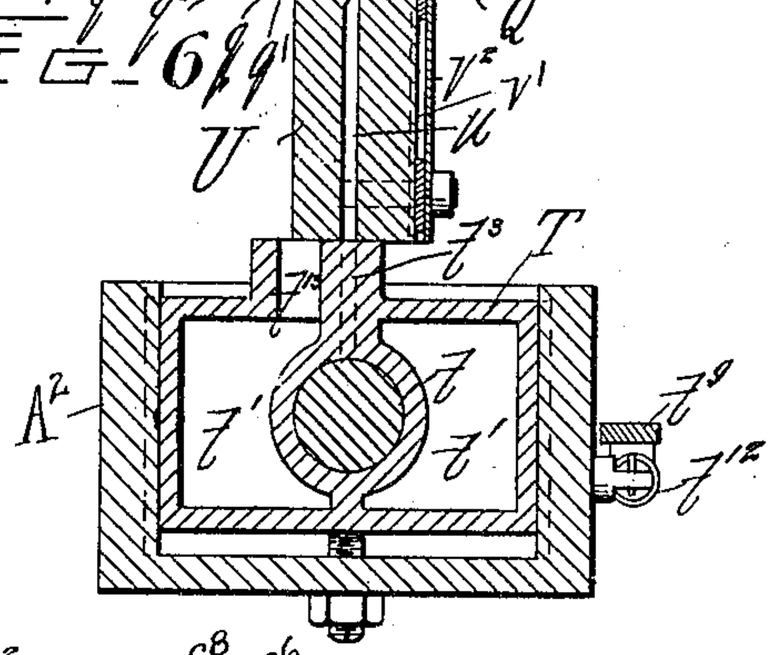


FIG. 8.

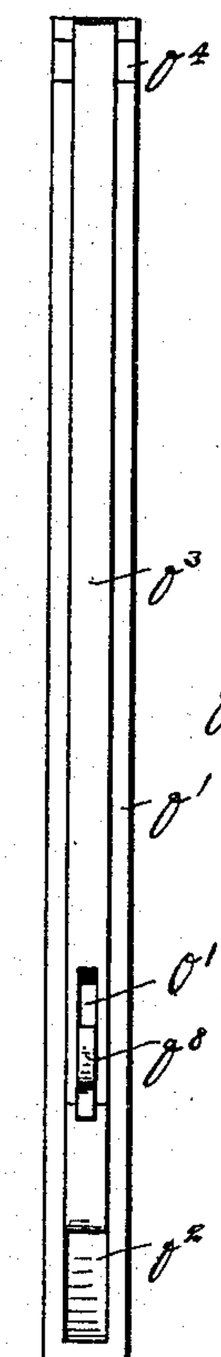


FIG. 9.

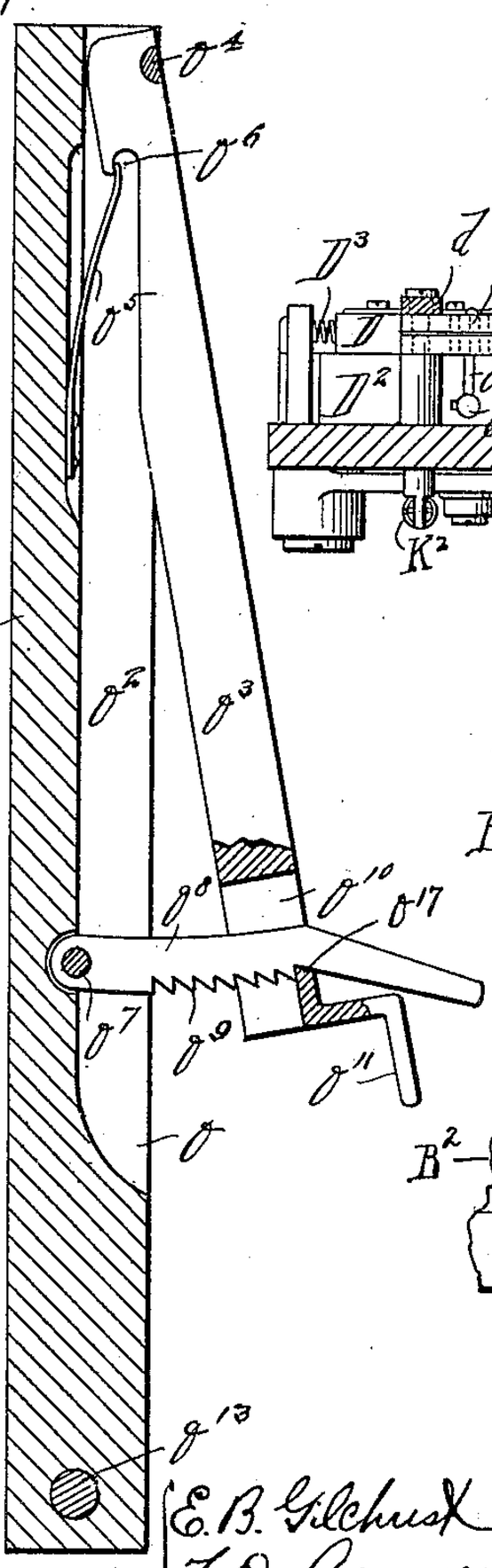


FIG. 7.

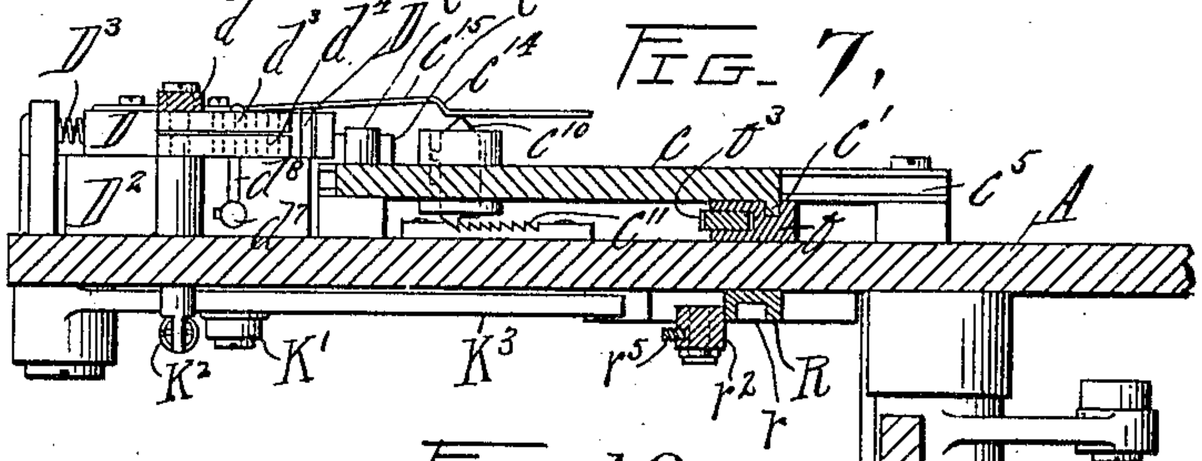


FIG. 10.

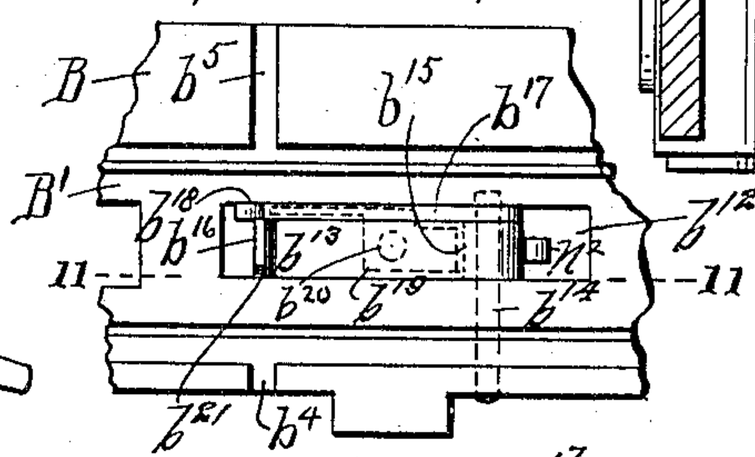
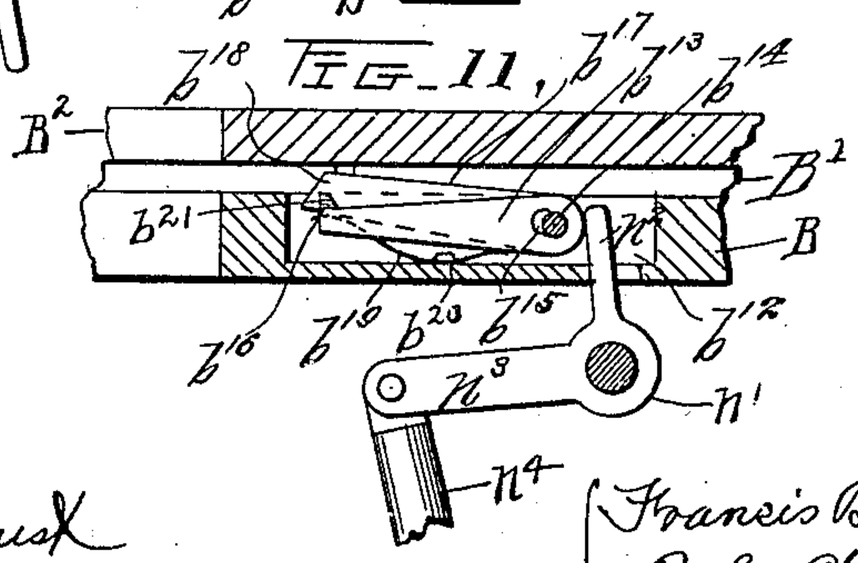


FIG. 11.



WITNESSES. E. B. Gilchrist, F. D. Cummins.

INVENTOR. Francis B. Converse, By his Attorneys, Thurston & Bates.

UNITED STATES PATENT OFFICE.

FRANCIS B. CONVERSE, JR., OF LOUISVILLE, KENTUCKY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO MERGENTHALER LINOTYPE COMPANY, A CORPORATION OF NEW YORK.

JUSTIFYING MECHANISM.

No. 872,223. Specification of Letters Patent. Patented Nov. 26, 1907.

Application filed January 30, 1900, Serial No. 3,280. Renewed December 10, 1902. Serial No. 134,703.

To all whom it may concern:

Be it known that I, FRANCIS B. CONVERSE, Jr., a citizen of the United States, residing at Louisville, in the county of Jefferson and State of Kentucky, have invented a certain new and useful Improvement in Justifying Mechanisms, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of my invention is to provide a machine for the justification of type which shall be cheap in construction, efficient and accurate in operation, and not liable to get out of order.

A machine constructed on the basis of my broad invention is adapted to justify any kind of type,—which word herein includes both the printer's type (cameo) and the matrices of a line casting machine. The justifying mechanism operates to select the size of space required to properly justify any given line. Spaces of the selected size may be formed at the time by casting or by cutting off from space timber, or they may be chosen by subsequent mechanism from previously existing sizes of permanent spaces varying in each direction from the theoretic size. In the machine herein shown I employ the first of these methods of embodying the selection in permanent spaces, and the mechanism for doing this is of my invention, but the invention comprehends broadly the mechanism for selecting the theoretic size of space required irrespective of the subsequent operations performed.

The invention consists broadly of means for taking account of the number of spaces for justification in any line, combined with an adjustably inclined blade, the angle of which is varied according to such number of spaces, and whose travel is therefore dependent upon the individual size of space required, as will hereinafter more fully appear.

The invention comprehends also the means whereby I am able by one movement to vary the angle of the blade, and eliminate from the calculation the thickness of temporary spaces employed. The mechanism for taking account of the number of spaces, for advancing the line, for regulating the space mold and for casting the space therein, are also (whether individually or as concatenated in the machine) of my invention; wherefore the invention may be conveniently summarized as consisting of the combinations of parts herein illustrated and specified in the claims.

The drawings clearly disclose my invention embodied in a machine which casts the permanent spaces,—the line of type and interspersed temporary spaces being fed to this machine in any suitable manner, and the justified line being removed from it as desired, neither of which operations are herein shown.

Figure 1 is a front elevation of the machine. Fig. 2 is a similar sectional elevation thereof, being on the lines 2—2 of Figs. 4 and 5. Fig. 3 is a rear elevation, sectional through the operating shafts on the line 3—3 of Fig. 5. Fig. 4 is an end view, (partly sectional on line 4—4 of Fig. 1) looking from the right hand end of Fig. 1. Fig. 5 is a horizontal section through the operating shafts, being on the lines 5—5 of each of the preceding figures. Fig. 6 is a plan in horizontal section on the line 6—6 of Fig. 4. Fig. 7 is a horizontal section on the line 7—7 of Fig. 3, showing the space-accounting mechanism. All these figures are on the same scale, which is one half the scale of the succeeding figures. Figs. 8 and 9 are respectively an edge view and a side elevation of the measuring wedge. Figs. 10 and 11 are respectively a plan and a sectional elevation of the trip governing the line advancing mechanism,—Fig. 11 being on the line 11—11 of Fig. 10. Fig. 12 is a perspective view of the temporary space employed in this particular machine. Fig. 13, on the same sheet with Fig. 2, is a horizontal section on the line 13—13 of that figure.

Frame.—The mechanism for the most part is supported on a vertical plate A which rises from the bed A′ and carries upon its upper edge the plate B in which is formed the type channel B′ through which the type passes in the operations of justification. This type channel is intended to connect at the left of Fig. 1 with any suitable type setting machine which feeds into the channel lines of type with interspersed temporary spaces.

Space-accounting mechanism.—The temporary spaces, contained between the words as they are fed into the machine, are of a form shown in Fig. 12 being of invariable size and having on their under side the notch *l′*. As many words and syllables having been assembled as will fill out the column, when

spaced by the proper size of permanent spaces supplied by the machine, such line comes into the machine along the channel B′ passing beneath the pawl *b* (Figs. 1, and 3) which is pivoted to the block *b′* and lies in an opening b^2 in the plate B^2 which covers the justifying channel. The line comes to rest in advance of this pawl *b* which drops behind the line and forms a fixed stop against which the line is compacted as it is being measured. As the line is coming into such position however, it operates the space accounting mechanism which takes account of the number of temporary spaces in the line. This is accomplished by the following mechanism.

Secured to the rock shaft *d′* (Figs. 3 and 6) at one end is the rock arm *d*, and at the other the arm d^2, the former arm having a nose projecting up into the type channel, and the latter arm a pawl d^3 engaging with the rack D slidable on the face of the guide-block D^2 Fig. 7. When the first type in the line engages with the nose it rocks the shaft *d′* and moves the rack D to the left in Fig. 3 one tooth. The rack D is held in this position by the pawl d^4 (Fig. 7), by the side of the pawl d^3, and as soon as a temporary space comes over the nose of the pawl *d* the latter springs up into the notch *l′* therein, and the pawl d^3 engages with the next tooth of the rack, which it advances as the succeeding type engages the nose of the arm *d*. Thus the rack is advanced one more tooth than there are temporary spaces in the line. But the rack in its initial position (shown in Fig. 3) stands one tooth to the right of its true zero position and being advanced one more tooth than the number of the temporary spaces in the line, it will be left standing as many teeth to the left of its zero position as there are temporary spaces. Fig. 7 shows the rack as left by a line containing one temporary space. At the same time that the line is advanced to the position ahead of the pawl *b*, the lever arm *m′*, Fig. 3 (which may be operated from the setter) has its outer end raised, which releases the tail m^6 of the pawl m^2 which is carried on the back side of the disk *p* secured to the shaft *m*. This shaft (Fig. 5) is journaled in the plate A and in a bearing Z′, and has loosely surrounding it a bevel gear m^7 continuously revolved by the bevel gear *z′* on the continuously driven power-shaft *z*. As soon as released, the pawl m^2 is pressed by the spring m^3 so that its nose m^4 engages with the notched disk m^5 which is secured to the bevel gear m^7. Thus whenever the lever *m′* is actuated, as it is for each line fed into the machine, the shaft *m*, which I term the "line shaft," is caused to rotate. Before it completes a rotation however, the end of the lever *m′* returns into the path of the tail m^6 of the pawl, and thus as that pawl comes into engagement with it, its nose becomes withdrawn from the notched disk and the shaft *m* comes to rest, making just a complete rotation.

The rotation of the shaft *m* accomplishes several results: First (in logical order), it carries the measuring wedge *o* away from the pawl *b*, which forms the measuring abutment in the type channel, a distance equal to the aggregate thickness of the temporary spaces in the line to be justified, thus eliminating those temporary spaces from the calculation. The line-shaft does this by causing movement of the plate *c* (Figs. 3 and 7) which carries the wedge *o*. This plate is held in a vertical position beneath the plate B, being guided to move in a horizontal path by the rail c^5 and in a groove in the under side of the plate B, and it is advanced to the left of Fig. 3 by the spring c^9 (acting through the lever c^6 and stud c^8) whenever allowed by the cam c^{12} (Figs. 3 and 5) which bears against the roller carried by the arm c^{13} which is a rigid prolongation of the arm c^6, this lever being journaled at c^7. When thus allowed to move to the left of Fig. 3, the plate *c* does so until the detent pin c^{10} carried by the plate engages the beveled shoulder c^{14} of the spring c^{15} which is carried by the rack D. As soon as such engagement does take place however, the incline c^{14} forces the detent c^{10} inward into engagement with the rack c^{11} (Fig. 7) on the frame A. Thus the plate *c* is locked a distance from its initial position, proportional to the number of temporary spaces in the line. In the present machine, *this distance is just equal to the aggregate of the thickness of those temporary spaces.*

Measuring wedge.—The measuring inclined blade is preferably a part of the composite measuring wedge *o* which is shown in detail in Figs. 8 and 9. It consists of the bar *o′* of rectangular cross section with a groove o^2 on its narrow edge into which fits a blade o^3 which is pivoted thereto at its upper end. This pivoting is accomplished by the use of the half-cylindrical pin o^4 fixed to the blade flush with its edge and occupying corresponding semi-cylindrical depressions in the edge of the bar *o′*, a spring o^5 fixed into the bottom of the groove o^2 and engaging in a notch o^6 in the blade holding the two parts together. The wedge is provided with a locking mechanism consisting of the segmental piece o^8, having a series of teeth o^9 accurately cut upon its lower face, pivoted to the bar *o′* at o^7 and passing through an opening o^{10} in the blade, the lower end of which opening is formed into a tooth o^{17} to engage with the segment and locks the blade at a corresponding angle to the bar o^2. These teeth o^9 are so spaced as to be capable of holding the blade o^3 at various angles to the bar *o′*, the tangents of which angles are respectively in the ratios of 1:2:3:4, and so on, according as the first, second, third, fourth, etc. tooth is

engaged. Thus a variable wedge is formed which has its pivot at the axis of the semi-cylindrical pin o^4 and which has a taper expressed by the ratios 1:L, 2:L, 3:L, etc., where L is the length of the blade, and the blade is engaged by the first, second, third, etc. tooth of the segment o^8. This variable wedge stands with its upper end in an opening B^3 in the bottom of the justifying channel B′ and lies between the frame plate A and the plate *c*, being held there against horizontal movement by the rib *c′* (Fig. 7) carried by the plate taking into the groove o^{12} in the side of the wedge. Thus as the plate is moved toward the left of Fig. 3 a distance equal to the aggregate thickness of the temporary spaces, as heretofore stated, the blade's pivot is thereby moved parallel with the line the same amount, and this movement varies the taper of the wedge a corresponding amount by reason of the lower end of the blade of the wedge being held stationary by the downward projection o^{11} which takes over the stationary pin o^{18}. *Thus by the same movement, the room occupied by the temporary spaces in the line is eliminated from the measuring calculation, and the measuring wedge is varied in taper according to the number of spaces to be justified.*

Setting the wedge and measuring the line.—While the preceding operations were taking place the concentric face of the cam s^{11} (Figs. 3 and 5) was passing the roller s^{10} on the slidable link s^8. When a decreasing face s^{17} however comes opposite this roller the latter is allowed thereby to move to the right in Fig. 3, and thereupon a suitable force (as a spring or weight not shown) pulling down on the cord s^{12}, which passes over the sheave s^{13} and is secured at its end to the slide *s*, raises the latter, the rack s^4 carried thereby rotating the segment s^5, the pinion teeth s^7 of which mesh with the teeth on the link s^8 carrying the roller s^{10}. Now this slide *s* is connected with the wedge by means of a horizontal slot s^3 into which takes a pin o^{13} from the wedge. From this construction it results that the slide does not interfere with the horizontal movement of the wedge according to the number of temporary spaces, but operates to elevate the wedge when the cam s^{11} permits. Now as the wedge begins to rise, the tooth o^{17} formed on the under side of the opening o^{10} of the blade o^3 engages the segment, the end of which has been resting on a stationary pin o^{19}, and the blade is thereby held at an angle determined by the tooth of the segment engaged, and during the remainder of the elevation the blade and back of the wedge are rigid with each other. The wedge in this condition rises until it is stopped by compacting the line of type and temporary spaces between its inclined blade o^3 and the end of the pawl *b*. Since the taper of the wedge is proportionate in every case to the number of spaces for justification in the line measured, and since the space measured in the aggregate is equal to the product of the number of spaces by their proper theoretic thickness, it follows that for a definite size of space required to justify the line the wedge will rise a definite distance irrespective of the number of spaces in the line. Thus if a line which can be exactly justified by the insertion of spaces three units in thickness, for example, requires six such spaces, it will be short by an amount six times as great as if it required but one such space; but the taper of the wedge will be, for the six-space line, six times as great as for the one-space line. *It follows therefore that the wedge rises proportionately to the size of the spaces required between words, and independently of the number of such spaces.*

It follows as a corollary of the above statement, that if proportionate movement be communicated by the longitudinal travel of the wedge to some space-producing or selecting mechanism the latter may be thereby automatically adjusted for causing spaces of the proper size for justification of the line. Thus in the present machine the longitudinal travel of the wedge varies the width of the space-mold, whereby the proper size of permanent space may be cast. This will be presently described. As bearing on the wedge's movement, however, it should be first remarked that the mold's adjustment takes place contemporaneously with the rise of the wedge, and is completed when the wedge, compacting the line against the pawl *b*, comes to rest; and thereafter, as soon as the increasing face s^{15} of the cam s^{11} meets the roller s^{10} of the rack s^8, the cam thereby causes the depression of the plate *s* which draws down the wedge to its initial position, freeing the line of type.

Space-mold and its connection with the wedge.—The space-mold, which is designated Q (Figs. 2 and 6), is located on the front side of the justifying channel being secured to the front edge of the plate B opposite the injection opening b^4. This mold consists of a block of a width equal to the length of the space to be cast, and having a kerf equal to the thickness of the space. An adjustable blade *q* lies in this kerf and by its distance from the end thereof determines the thickness of the space to be cast. As shown, the end of the blade adjacent to the mold opening is the full width of the mold-block Q, and suitable flanges q^3 q^4 on the block Q guide the blade to keep the edge thereof parallel with the opposite side of the mold. This plate *q* carries a shoulder (preferably roller q^5) which takes into a diagonal groove *r* in the longitudinally slidable bar R. This bar R (Fig. 13) lies against the front side of the plate A, and is guided by a gib r^2 which lies in a vertical groove on the front side of an in-

tegral wing r' extending from the bar. This gib in operation is stationary, but may be nicely adjusted by loosening its clamping screws r^3, and turning the adjusting nut r^4 which shifts the strip r^5 which occupies a groove in the side of the gib and has inclines bearing against the stationary pins r^6. The gib r^2 carries a pin r^7 which is pressed against the wing r' by a spring r^8 and thus holds the bar R in any position in which it may be left.

At the lower end of the bar R is a foot r^9 which extends across the opening A^2 in the frame. Now the pin o^{13} carried by the wedge projects through this opening A^2 beneath the foot r^9, and engages with that foot as the wedge is elevated, raising the bar R, and thus, by reason of the inclined slot r, drawing the plate q outward, and thereby increasing the opening in the mold. The amount which the slot r is out of plumb is equal to the difference between the smallest and the largest spaces which the machine may cast. The gap between the pin o^{13} and the foot r^9 corresponds to the theoretic size of spaces smaller than I deem it desirable to use. The smallest size space cast corresponds to the position which the wedge occupies when the pin o^{13} has just engaged the foot r^9. It is to be understood that there is no limit, except convenience, to the size of the space in either direction, and the bar R could be coupled directly to the wedge if desirable. It thus appears that the wedge sets the mold so that the exact size of space required to justify the line may be cast therein.

Advancement of line to bring first temporary space into substituting position.—Following the operations above described, a lug p' (Fig. 3) on the hub of the disk p, acting upon the roller g' (Figs. 3 and 5) on the link g, throws into action mechanism to advance the line along the justifying channel until stopped with the first temporary space alined with the opening b^4 (Fig. 6), through which a permanent space may be moved into the line, and a coöperating opening b^5 on the other side of the channel through which the temporary space may be ejected. This mechanism is as follows: A follower b^6 (Figs. 3 and 6), of the same thickness as the body of the type, rests in a depression b^7 in the bottom of the type channel B'. Inclined grooves b^8 are cut in the forward end of this follower into which extend corresponding projections b^9 (Fig. 6) from the bottom of the channel forming inclines upon which the follower may rise when advanced, and bridging over the gap in front of the follower to permit a smooth passage of the type along the channel. A cord g^2 (which term I use as including any flexible pulling member) attached to this follower lying in a groove in the type channel runs over a roller b^{11} and is fastened to a winding drum g^3.

The drum g^3 (Figs. 1 to 5, omitted for clearness from Fig. 2) is on a shaft g^4 journaled intermediately in the upper end of an arm g^5 and carrying at its other end a disk g^6 designed to be rotated by the continuously revolving disk n^{10} when brought into contact with it. This disk n^{10} has a friction surface of rubber or other material and is carried on the hub of the beveled gear n^{11} which loosely surrounds the shaft n (journaled in the bearing Z^2, in the plate A and the standard A^2) and is continuously revolved by the meshing bevel gear z^2 on the power shaft z.

The arm g^5 is pivoted on a horizontal arm g^7 (Fig. 3) which in turn is journaled on the shaft g^8 carried in the stationary bearing block g^9. A spring g^{10} tends to draw the arm g^5 away from the shaft n and normally holds the disk g^6 out of contact with the revolving disk n^{10}, while a leaf spring g^{11} pulls downward on the arm g^7. A lug g^{12} on the arm g^5 overhanging the end of a detent arm g^{13} holds the parts in the position shown, the disks being out of contact and the arm g^7 being held up against the tension of its spring g^{11}. The detent arm is fixed to the rock shaft g^8 to which is also fixed the rock-arm g^{14} connected by the link g with the roller g', with which the cam-lug p', heretofore referred to, engages; a spring g^{15} (Fig. 5) drawing the link toward the cam.

Now as the lug p' (Fig. 3) on the hub of the disk p passes the roller g', toward the end of the rotation of the line shaft m, the detent arm g^{13} is swung from under the lug g^{12} and the spring g^{11} draws the arms g^7 and g^5 down as far as permitted by the adjusting screw g^{16}. This brings the lug g^{12} on the arm g^5 opposite the end of the detent g^{13}, and the lug p' having passed the roller on the link g, the spring g^{15} draws the detent and with it the arm g^5 toward the shaft n, forcing the disk g^6 into engagement with the disk n^{10} and causing the former to rotate.

The rotation of the disk g^6 rotates the shaft g^4 and the drum g^3, and thus winds the cord g^2 upon the drum, advancing the follower b^6 along the justifying channel. The follower rises out of the depression b^7 and passes under the pawl b, and thus engages the rear end of the line of type and shoves it along until it is stopped positively by the first temporary space in the line coming between the injection and ejection openings b^4 and b^5 and engaging the word-shaft-trip b^{13} (which initiates the action of the space-casting and inserting mechanisms as hereinafter described) whereupon the line thus comes to rest. The continued pull of the winding drum g^3 upon the now locked cord g^2 causes the drum to lift itself until the lug g^{12} rises above the end of the trip g^{13}, whereupon the spring g^{10} draws the disk g^6 out of engagement with the disk n^{10}.

Seated within a recess b^{12} (Figs. 3, 6, 10 and 11) in the bottom of the justifying channel

B′, is a trip b^{13} fulcrumed on a horizontal stationary pin b^{14} which passes through a slotted hole b^{15} in the trip. This trip rests normally with its upwardly turned nose b^{16} below the bottom of the channel. Pivoted on the pin b^{14} by the side of the trip b^{13} is a dog b^{17} the beveled end b^{18} of which projects into the channel being sustained in its raised position by a double ended leaf spring b^{19} loosely held at b^{20} concave upward and having one end beneath the dog and the other beneath the trip. As the type advances, the dog is depressed pressing down one end of the leaf spring and thereby causing the other end to press the trip upward against the under side of the line of type.

As the first temporary space in the line comes over the nose of the trip, the trip springs into the notch in the temporary space and is engaged by the next succeeding type, the movement of which advances the trip the length of the slot b^{15} when the line is thereby stopped positively, and the frictional advancing mechanism throws itself out of engagement, as heretofore described. The line now stands with a temporary space registering with the injection and ejection openings b^4 b^5 in the side of the justifying channel, while the movement thus given to the trip initiates, as hereinafter explained, the space casting and inserting operations.

Summarizing the operations of the line shaft, a single rotation thereof operates (1) to vary the taper and lateral position of the wedge according to the number of spaces in the line, (2) to move the wedge longitudinally to measure the line with the consequent adjusting of the space mold, and (3) to throw into engagement the mechanism (operated by the constantly rotating part of the word shaft) to cause the advancement of the line into position to receive the first permanent space, thereby initiating the casting and inserting operations,—the line shaft mechanisms returning to their normal position by the end of its rotation.

Space Casting and Substituting and Subsequent Advancement of Line.

The trip b^{13} (Figs. 3, 10 and 11) as it moves with the advancing type, the distance allowed it by the slot b^{15}, swings the vertical arm n^2 of a bell crank lever n' causing the other arm n^3 to draw up the rod n^4 pivoted to it, which, passing through a suitable guiding block n^5, forms a lock for the pawl n^6 of the clutch on the shaft n, which, from its function, I call the "word shaft." This clutch is similar to the one on the line shaft m, and consists of a notched disk n^7 (Fig. 5) continuously rotating (being loose on the shaft and secured on the hub of the bevel gear n^{11} which is loosely journaled on the shaft n), and a disk n^8 keyed to this shaft and carrying a pawl n^6. When the bell crank lever n' is actuated by the trip, the rod n^4 is withdrawn from engagement with the tail of the pawl n^6 permitting the nose of the pawl to engage the notched disk and causing a rotation of the word shaft n. The word shaft in rotating performs continuously three successive operations for each space in the line—each group of these three operations being performed in one rotation of the shaft. These operations are (1) casting the permanent space in the mold, (2) ejecting that space into the line and shoving therefrom the temporary space in front of it, and (3) actuating the advancement of the line to bring the next temporary space into the substituting position—or after the last substitution to a suitable point where the justified line may be delivered. I will now take up, in order, the description of these operations.

Space casting.—The molten metal from which the space is cast is contained in a melting-pot T (Figs. 1, 4 and 6) which is supported within the box-standard A^2 which rises from the bed of the machine. This melting-pot has a cylindrical pumping chamber t surrounded by spaces t' for the reception of surplus metal. The pumping chamber communicates with this space through the opening t^2 in the side of the cylinder. An exit opening t^3 leads diagonally upward from the lower end of this cylinder. The pot is heated in a suitable manner, as by the gas burner t^4 below it, which is communicated to by the pipe t^5. A plunger t^6 stands within the cylinder and has its rod t^7 connected through a walking beam t^8 with the link t^9 which carries a roller t^{10} engaged by the cam t^{11} on the word shaft n.

The plunger is normally at the upper end of its stroke, but a spring t^{12}, pulling upward on the link t^9, tends to depress the plunger, and thus force the molten metal within the cylinder through the exit opening t^3, and it accomplishes this operation when the decreasing face of the cam t^{11} in the rotation of the word shaft allows it. Thereafter when the increasing face acts on the roller, the plunger is forced upward uncovering the opening t^2 in the wall of the cylinder allowing the molten metal to flow into the cylinder ready for the next depression.

Between the rear edge of the melting-pot and the front edge of the mold Q is a gate U, which has an opening u which may aline with the mold-opening q' and the exit opening t^3 of the melting-pot, and thus form a conduit between them. An arm u^7 overhanging from the gate has a downwardly projecting end or bar u^8 which closes the rear side of the mold opening when the conduit u is alined therewith, as shown in Fig. 6. This is the normal position of the parts, and the position they occupy when the word shaft n begins to rotate. In this rotation the first operation of the word shaft is to bring a decreasing face of the cam t^{11} in apposition with the

roller t^{10} whereby the spring t^{12} forces the plunger downward and forces molten metal through the gate into the mold. Immediately following this casting of the space the end of the jet is separated therefrom by the movement of the gate U by mechanism which will now be described.

The gate U is carried on the upper end of an arm u' journaled on the stud u^2 projecting from the frame-plate A. An arm u^3 extends rigidly from the hub of the arm u' and has at its end a link u^4 (adjustable by the screws u^5) which carries a roller u^6 taking into the inside cam groove v formed in the rear face of the cam V on the word shaft n. During the casting of the space, the concentric portion v^{11} of this groove is passing the roller u^6, but immediately following the casting the part of the groove v^{12} of greater radius acts on the roller u^6 elevating the same and swinging the gate U across the mold and the exit opening t^3 from the melting pot, that is, to the left of Fig. 6. This separates the jet from the cast space closing the entrance to the mold and connects the conduit u with the passage t^{13} back to the melting-pot outside the pumping cylinder t whereupon the liquid metal in the conduit runs back into the melting-pot.

Space-substituting.—The shifting of the gate also brings an ejector blade v' which is slidable in the ways v^2 on the side of the gate into alinement with the mold-opening, carrying, at the same time, the arm u^8 away from the front end of that opening. Projecting downward from the ejector is a yoke v^3 which slidably takes around a pin v^4 carried by the arm v^5 whereby the ejector is always in engagement with the arm irrespective of the position of the gate. This arm v^5 is pivoted on a stud v^6 projecting from a bracket on the frame A; and adjustably secured to the hub of the arm v^5 is the arm v^7 carrying a roller v^8 engaging with the crown face of the cam V, the arm v^7 being drawn in that direction by the spring v^{10}. As soon as the ejector blade v' is brought into alinement with the mold-opening by the shifting of the gate, the increasing crown face v^9 of the cam V acts on the roller v^8, moving the ejector into the mold and shoving the cast space therein out through the ejection opening b^4 into the line against the end of the temporary space therein, and shoving the latter out of the line through the ejection opening b^5. These operations of casting the space, shifting the gate U, and shoving the cast space into the line are completed in perhaps three fourths of the rotation of the word shaft n.

Immediately following the injection of the cast space into the line (and after the ejector blade has returned to its normal position under the influence of the spring v^{10} cooperating with the decreasing face of the crown cam V), the line is advanced to bring the next temporary space in the line into the substituting position, by mechanism about to be described; and the same sequence of operations is performed for the next space, and so on throughout the line.

Advancement of the line, following the insertion of a permanent space.—In the ejection of the temporary space from the line, the corner of the notch l' in the temporary space l (Fig. 12) is forced against the inclined corner b^{21} (Fig. 10) of the trip b^{13} and this trip is thus depressed flush with the under side of the line of type. This releases the trip and the weight of the rod n^4 causes the latter to drop to its initial position into the path of the tail of the pawl n^6, whereby the rotation of the word shaft is adapted to cease at the end of a complete rotation. Before the rotation is completed however, a lug n^7 (Figs. 1 and 3) on the periphery of the disk n^8 presses against the arm g^{17} overhanging from the detent g^{13} and throws this detent from beneath the lug g^{12}, allowing the latter to drop as heretofore explained, whereby the two disks g^6 and n^{10} come into engagement and the drum g^3 is again rotated to advance the line of type. This advancement of the line brings another temporary space into the ejection position which again withdraws the lock-bar n^4 from the path of the pawl n^6 and allows another rotation of the shaft whereby another permanent space is cast and substituted for a temporary one. This sequence of operations is continuous until all of the temporary spaces have been replaced by permanent spaces when the succeeding advancement of the line, now unimpeded by the trip p^{13}, continues until the line is brought to rest at the extreme position of the follower b^6, from whence the line, now justified, may be delivered by any suitable means. The stoppage of the follower causes the drum g^3 to lift itself up by the cord g^2 disengaging the advancing mechanism.

Return of Parts to Normal Positions.

The operations so far described have completely justified the line and left it ready for delivery. There remains therefore but to return to their normal positions those parts which have not been already returned. These are the follower block b^6 which the description has left at the end of the justifying channel, the mold shifting bar R which remains in the position last used until the beginning of the next line, and the space-accounting rack D, which as a matter of fact was returned to its position at the end of the operation of the line-shaft, but which, for convenience, has not been earlier described. First, as to the return of the follower block b^6 to its normal position in the recess b^7: A cord g^{18} (Figs. 1, 2, 3 and 6) is attached to the follower b^6 (lying in a groove b^{21} as the follower

ure the line, means for shifting bodily the pivot of the blade a distance equal to the aggregate thickness of the temporary spaces, and means for turning said blade on its pivot a distance proportionate to the number of temporary spaces, substantially as described.

8. In a justifying mechanism, means for holding a line of type and temporary spaces, the latter of which are to be replaced by permanent spaces, a pivoted inclined blade, means for moving the free end of said blade circularly a distance dependent upon the aggregate thickness of the temporary spaces in the line whereby its angle is changed accordingly, and means for causing relative movement between the blade bodily and the line whereby the blade may compact the line, substantially as described.

9. In a justifying mechanism, a wedge variable in its taper combined with means for varying such taper and means for compacting a line of type by such varied wedge, substantially as described.

10. In a justifying mechanism, in combination, means for holding a line of type, a variable wedge, means for varying the taper of the wedge according to the number of spaces to be justified, and means for causing the wedge to engage the line of type and move relative thereto until stopped by compacting it, substantially as described.

11. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a composite wedge consisting of a bar with a blade pivoted thereto, means for moving said bar a definite distance for each temporary space in the line, means for swinging said blade on its pivot for each temporary space, and means for moving the composite wedge relative to the line of type, substantially as described.

12. In a justifying mechanism, in combination, means for holding a line of type to be justified, a pivoted inclined blade, means for shifting the pivot bodily in a direction parallel to the line dependent upon the aggregate thickness of the temporary spaces in the line, means for varying the angle of the blade according to the number of temporary spaces in the line, and means for moving the wedge longitudinally until stopped by compacting the line against a suitable stop, substantially as described.

13. In a justifying mechanism, in combination, a wedge consisting of a bar and a blade pivoted thereto, means for holding said blade at different angles to the bar, the tangents of said angles constituting a regular arithmetical series, means for selecting said tangents according to the number of spaces in the line to be justified, and means for moving the wedge to measure the line, substantially as described.

14. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a measuring wedge, means for varying the taper of the wedge according to the number of spaces in the line, and for varying its lateral position according to the aggregate thickness of the temporary spaces, means for moving such adjusted wedge with reference to the line to measure the same, a space determining mechanism, and means for communicating movement from the measuring movement of the wedge thereto, substantially as described.

15. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a variable measuring wedge including a bar and a blade pivoted thereto, means for moving the bar laterally proportionately to the aggregate thickness of the temporary spaces, means for retaining the free end of the blade against such movement whereby the blade is swung on its pivot and the taper increased proportionately to the number of temporary spaces, means for holding the blade at such adjusted taper, and means for moving the wedge to measure the line, substantially as described.

16. In a justifying mechanism, in combination, a measuring wedge consisting of a bar, a blade pivoted thereto and a segment bar pivoted to one of said members and movable with reference to the other and having teeth on it, means for taking account of the number of spaces in a line to be justified and means for opening the wedge accordingly and allowing the teeth to hold the blade at the angle thus made, substantially as described.

17. In a justifying mechanism, a measuring wedge consisting of a bar having a groove along its edge, a blade occupying said groove and carrying a semi-cylindrical pin which lies in a corresponding recess in the bar, a spring secured to one of said members and bearing against the other to swing it on its pivot into the groove, and means for holding the blade at various angles to the bar, substantially as described.

18. In a justifying mechanism, in combination, a wedge consisting of a bar and a blade pivoted thereto, means for locking said blade at varying angles to said bar, means for holding said locking mechanism out of engagement, and means for changing the angle of said wedge when said locking mechanism is out of engagement, means for thereafter allowing said locking mechanism to come into engagement, substantially as described.

19. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, accounting mechanism for taking account of the number of said temporary spaces, a pivoted measuring blade, means governed by said accounting mechanism for moving the pivot of said

is advanced) and runs over a roller b^{22} and has attached to its other end a weight g^{19} which slides on a vertical rod g^{20}, the weight being thus lifted as the follower is advanced. The end of a detent g^{21} fulcrumed in the weight forms a diagonally downward strut against the rod g^{20} wherefore it does not impede the raising of the weight, but grips the rod sufficiently to prevent the weight from descending. Now as the line is advanced this weight is raised, maintaining itself when the advancing mechanism is inoperative by means of this detent, until the type is advanced to the end of the justifying channel, when the detent is brought into engagement with a stop g^{23} on the rod g^{20}, which relatively depresses the inner end of the detent until the spring actuated plunger g^{24} (Fig. 3) engages the recess g^{25} therein, and holds the detent out of coöperation with the rod. Thus when the advancing mechanism throws itself out of operation by the justified line coming into its final position, the weight has become free and drops by gravity returning the follower b^6 to its initial position in the depression b^7, a bevel b^{23} on the upper side of the follower permitting it to pass under the pawl b as it returns. As the weight strikes the bed of the machine at the end of its descent the momentum of the weighted free end of the detent g^{21} causes this detent to be thrown back into engagement with the rod g^{20} ready for the succeeding line.

The last act of the line shaft, just before it ceased its rotation after drawing down the wedge, was to release the rack D of the space accounting mechanism, whereby the latter returned to its initial position ready for use on the succeeding line fed to the machine. This the shaft accomplished by reason of the lug c^{19} on the hub of the cam c^{12} (shown in Fig. 1 behind the cam K and plate A) engaging and elevating the rod d' (Figs. 3 and 7) a projecting pin d^8 of which raised the pawls d^3 d^4, whereupon the spring D^3 drew the rack back to its initial position. At the beginning of the next rotation of the line shaft (when the lever m' is actuated as a new line is fed into the machine) the first operation is by the cam K (Figs. 1 and 2) an increasing face of which acts on the roller K^4 of the link K', and thus draws down (against the spring K^2) the arm K^3. The end of this arm engages the pin r^{10} projecting from the mold-adjusting bar R (which was retained in the position last used by the frictional plunger r^7) and draws down the bar to its lowest position, whereby it may be again elevated the proper amount by the rising wedge.

Having described my invention, I claim:

1. In a justifying mechanism, in combination, means for holding a line of type to be justified, an adjustably inclined blade, means for guiding it in a path whereby its incline may compact the line, and means for varying the angle of the blade to its path according to the number of spaces in the line, substantially as described.

2. In a justifying mechanism, in combination, means for holding a line of type to be justified, an adjustably inclined blade, means for varying said incline according to the number of spaces in the line and independently of the line measurement, means for moving said blade until stopped by the type in the line becoming compacted, and a space determining mechanism varied by such movement of the blade, substantially as described.

3. In a justifying mechanism, in combination, means for holding a line of type to be justified, an inclined measuring blade, means for moving said blade to compact said line and measure its shortage, means for varying the angle of said blade to its path according to the number of spaces in the line to be justified whereby a single blade may measure different lines, and a space-determining mechanism varied by said blade, substantially as described.

4. In a justifying mechanism, in combination, means for holding a line of type and interspersed temporary spaces, an adjustably inclined pivoted blade adapted to measure the line, means for shifting bodily the pivot of the blade and for changing the angle of the blade each according to the number of the temporary spaces, substantially as described.

5. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a pivoted measuring blade adapted to have various positions on its pivot and adapted to have its pivot shifted bodily, means for so shifting said pivot according to the thickness of the temporary spaces in the line, there being provided means for varying the angle of said blade on its pivot according to the number of such spaces, means for moving the blade to compact the line and measure it, and a space determining mechanism varied by the measuring movement of the blade, substantially as described.

6. In a justifying mechanism, in combination, means for holding a line of type and interspersed temporary spaces, an adjustably inclined pivoted blade adapted to measure the line by compacting it, means for causing and compacting means for moving the measuring end of said blade with reference to the line proportionately to the thickness of the temporary spaces and thereby turn the blade on its pivot, substantially as described.

7. In a justifying mechanism, in combination, means for holding a line of type and interspersed temporary spaces, an adjustably inclined pivoted blade adapted to meas-

blade and for varying the angle of the blade, and means for moving said adjusted blade to measure the line's shortage, substantially as described.

20. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a suitably guided plate, means for moving the plate proportionately to the thickness of the temporary spaces in the line, a pivoted measuring blade whose pivot is moved bodily with said plate, means for restraining said blade against movement at some other point, whereby its movement swings it on its pivot, means for holding the blade at the angle thus made, and means for causing the blade thus adjusted to measure the line's shortage, substantially as described.

21. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a suitably guided plate, means for shifting said plate proportionately to the thickness of the temporary spaces in the line, a wedge consisting of a bar and a blade pivoted thereto, said bar being guided by said plate but movable longitudinally with reference thereto, there being provision for varying the angle of said blade to said bar so that the tangent of the angle shall be proportionate to the number of spaces in the line, and means for moving said adjusted wedge with reference to said plate, substantially as described.

22. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a suitably guided plate, means for moving said plate proportionately to the aggregate thickness of temporary spaces in the line, means for locking said plate in the position thus assumed, a variable wedge consisting of a bar and a blade pivoted thereto, said bar being slidably connected with said plate, a projection stationary in operation engaging said blade whereby the movement of the pivot by means of the bar and plate varies the angle of the blade, means for locking said blade at the angle thus made, and means for moving said wedge relative to the plate to measure the line's shortage, substantially as described.

23. In a justifying mechanism, in combination, a type channel, a pawl having a beveled nose spring-pressed into said channel, space-accounting mechanism actuated by the movement of said pawl, whereby when a temporary space having a notch in it comes into apposition with the pawl the latter may spring into such notch and the subsequent type may shove the pawl back again, thus actuating the accounting mechanism, substantially as described.

24. In a justifying mechanism, in combination, a type channel, a measuring mechanism for measuring a line of type in the channel, a pawl adapted to be actuated by temporary spaces in the type channel, a rack actuated by said pawl independently of the measuring mechanism, means for moving the measuring mechanism to a position determined by the position of said rack, and means for thereafter returning said rack to its initial position, substantially as described.

25. In a justifying mechanism, in combination, means for holding and guiding a line of type and temporary spaces, a suitably guided rack, a pawl engaging said rack and adapted to advance it and governed in its operation by the number of temporary spaces in the line, a stationary rack having teeth corresponding to the teeth of the movable rack, a suitably guided plate carrying a pin adapted to engage said stationary rack, and means governed by said movable rack for causing said pin to pass into the corresponding tooth of the stationary rack, substantially as described.

26. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a suitably guided plate, a pivoted blade whose pivot is movable bodily with said plate but is also adapted to move with reference to said plate at an angle to its bodily movement, a movable rack, means for moving the same according to the number of temporary spaces in the line, a corresponding stationary rack, means governed by the position of the movable rack for locking said plate to the corresponding point of the stationary rack, means for varying the angle of said blade, and means for moving said blade bodily with reference to said plate to measure the line's shortage, substantially as described.

27. In a justifying mechanism, in combination, means for holding a line of type and temporary spaces, a pivoted blade, means for varying the position of said pivot according to the aggregate thickness of the temporary spaces, means for varying the angle of said blade according to the number of such temporary spaces, means for moving said blade thus adjusted until stopped by compacting the line, and a space mold varied in its opening according to the movement of said blade, substantially as described.

28. In a justifying mechanism, means for holding a line to be justified, means for taking account of the number of spaces therein, a pivoted measuring blade, means for varying the angle thereof according to the number of spaces and independently of the line measurement, means for moving the blade so varied until stopped by compacting the line, a space mold having an adjustable opening, and connection between said mold and the blade whereby the amount of said opening is dependent upon the position or movement of said blade, substantially as described.

29. In a justifying mechanism, in combi-

nation, means for holding a line to be justified, a mold adapted to determine the size of a cast space, said mold having a slidable blade for varying its opening, a pivoted measuring blade, means for varying the angle of said measuring-blade according to the number of spaces in the line, means for moving the blade so varied until stopped by compacting the line, means for communicating motion from said measuring blade to the mold-blade, substantially as described.

30. In a justifying mechanism, in combination, means for holding a line of type to be justified, means for taking account of the number of spaces therein, a pivoted measuring blade, means for swinging said blade on its pivot according to the number of spaces, means for moving said blade so adjusted across the line of type until it is stopped by compacting the same, a variable space mold, means for communicating motion from said blade to the mold to vary the same according to the movement of the blade, means for retaining the mold in the adjustment thus given, and means for withdrawing the blade from its measuring engagement, substantially as described.

31. In a justifying mechanism, measuring mechanism which moves to compact the line until stopped thereby, combined with a space mold, a blade for varying the opening thereof, a suitably guided bar having an incline with which said blade engages previous to the casting operation whereby the opening of the mold for casting is dependent upon the position of said bar, and a connection between said bar and the measuring mechanism whereby the latter determines the position of the bar, substantially as described.

32. In a justifying mechanism, measuring mechanism which moves according to the size of individual space required to justify a given line, combined with a space-mold, a blade for varying the opening thereof, a suitably guided bar adapted to move said blade, a connection between said bar and the measuring mechanism whereby the latter determines the position of the bar, a spring bearing against said bar and tending to hold the bar in any position in which it may be left, and means operated once for each line to be justified returning said bar to an initial position, substantially as described.

33. In a justifying mechanism, in combination, a mold for determining the size of the space to be cast, a blade for varying the opening of said mold, a longitudinally slidable rod having an incline engaging said blade whereby the position of the rod determines the size of the opening, a guide for said rod, means for simultaneously adjusting both ends of said guide, and means for shifting said bar according to the size of individual space required, substantially as described.

34. In a justifying mechanism, in combination, means for holding a line of type to be justified, a variable mold adapted to cast the proper size of space, a melting pot, a shiftable gate having a conduit connecting the melting pot with the mold, an ejector carried by said gate, means for forcing metal from the melting pot through the conduit into the mold, means for shifting the gate to bring the ejector in line with the mold opening, and means for thereafter moving said ejector to shove the cast space from the mold into the line, substantially as described.

35. In a justifying mechanism, in combination, a justifying channel, an entrance opening thereto, a mold having a variable opening alined with said entrance opening, a bar between the mold and entrance opening adapted to close the mold, a melting pot, means for connecting the same with the mold opening when said bar closes the other side of the mold, an ejector, means for bringing it into alinement with the cast space and for moving said bar away from the other side of the mold, and means for thereafter moving said ejector into the mold to shove the cast space therein through the entrance opening into the justifying channel, substantially as described.

36. In a justifying mechanism, in combination, a mold having a variable opening, means for varying the said opening, a melting pot, a shiftable gate between the melting pot and mold carrying a conduit connecting the two, an arm carried by said gate closing the other side of said mold opening, means for forcing molten metal from the melting pot through the conduit into the mold, means for thereafter shifting said gate to cut off the jet of metal and open the front side of the mold, and means for thereafter ejecting the cast space from the mold, substantially as specified.

37. In a justifying mechanism, in combination, a justifying channel, a mold at the side thereof alined with an entrance opening, a melting pot, a shiftable gate carrying a conduit adapted to connect said pot with the mold opening, means for forcing molten metal from the pot through said conduit into said opening, means for thereafter shifting said conduit out of alinement with the mold opening and into alinement with a return passage to the melting pot whereby the molten jet in the conduit may pass back into the melting pot, and an ejector adapted to be brought into alinement with the cast space, and means for then moving the ejector to shove the cast space into the justifying channel, substantially as described.

38. In a justifying mechanism, a winding drum, a flexible member running therefrom and adapted to advance a line of type, said drum being journaled on a movable axis, means for rotating said drum, and means for

stopping the advancing line of type and thereby cause the drum to wind onto the new locked flexible member and withdraw itself from driving engagement.

39. In a justifying mechanism, in combination, a justifying channel, a follower, a cord adapted to draw said follower along behind a line of type and thus advance it in the channel, a winding drum to which said cord is secured, said drum being journaled on a movable axis, means for rotating said drum, and means for stopping the advancing line of type, whereby the drum winding onto the now locked cord may withdraw itself from driving engagement, substantially as described.

40. In a justifying mechanism, the combination of a channel adapted to receive a line of type, a follower in the channel behind the line, a cord adapted to advance said follower along the channel, a drum to which said cord is secured, a member rigid with said drum and adapted to be brought into driving engagement with a continuously revolving member, means for normally maintaining said such driven member out of engagement with such driving member, means for shifting the axis of said driven member relative to said driving member to bring it into such engagement, and means whereby when the line of type is stopped the continuation of the pull of the drum on the cord shifts the axis thereof permitting said driven member to pass out of such engagement, substantially as described.

41. In a justifying mechanism, a continuously revolving member, a member adapted to be driven thereby and on a movable axis, a detent arm spring-pressed against a projection between it and said axis to hold the driven member in engagement with the revolving member, and means whereby retardation of the driven member causes the projection to pass from such engagement with the detent arm to permit the disengagement of the driven member and revolving member, combined with a type channel, and means whereby the rotation of the driven member advances the type along the same, substantially as described.

42. In a justifying mechanism, in combination, a continuously rotating member, a member adapted to be brought into engagement therewith and driven thereby, a movable arm on which such driven member is journaled, a drum rigid with said driven member, a detent adapted to engage a projection on said arm and hold the driven member in engagement with the revolving member, means for giving the projection a tendency to move into such engagement, a type channel, a follower, a cord running from the follower to said drum, whereby a line of type and temporary spaces may be advanced along the channel, and means thrown into operation by said temporary spaces for permitting the projection to pass into engagement with the detent, substantially as described.

43. In a justifying mechanism, in combination, a type channel, a flexible member for drawing the type along the channel, means for pulling said flexible member, and two mechanisms for throwing said means into actuation, one of said mechanisms being operated once for each line and the other once for each word to be justified.

44. In a justifying mechanism, in combination, a type channel, a rotatable drum, a cord running therefrom to a follower adapted to engage the type, mechanism operating once for each line and adapted to actuate the rotation of said drum, and means operating once for each word and adapted to actuate the rotation of said drum.

45. In a justifying mechanism, in combination, a type channel, a rotatable drum, a cord running therefrom to a follower adapted to engage the type, mechanism operating once for each line and adapted to actuate the rotation of said drum, and means operating once for each word and adapted to actuate the rotation of said drum, means for stopping the advancing line of type, said drum being journaled on a movable axis with reference to the driving mechanism whereby such stoppage causes the drum to automatically withdraw itself from driving engagement.

46. In a justifying mechanism, in combination, a line shaft, means for giving the same a rotation for each line to be justified, a word shaft, means for giving it a rotation for each space in the line, a justifying channel, mechanism for advancing the line of type along the same, a continuously revolving member into engagement with which said mechanism is adapted to be brought, means operated by said line shaft and means operated by said word shaft for causing said engagement by a rotation of either shaft, substantially as described.

47. In a justifying mechanism, in combination, a justifying channel, a follower, a winding drum, a cord connecting said drum and follower, a member rigid with said drum, a continuously revolving member into engagement with which said member first mentioned is adapted to be brought whereby the drum is rotated and the type advanced, a line shaft, means for rotating the same for each line to be justified, a word shaft, and means for rotating it for each space to be justified in the line, means whereby said disk is thrown into engagement with said revolving member once for each rotation of the line shaft and once for each rotation of the word shaft, substantially as described.

48. In a justifying mechanism, in combination, a type channel, a follower therein,

an advancing cord adapted to draw the same along the channel to advance the type therein, a returning cord running from said follower adapted to draw it in the other direction, a weight attached to this last mentioned cord and guided on an upright rod, means for pulling on the advancing cord thereby advancing the follower and elevating the weight, a counterweighted strut carried by said weight and engaging said rod with sufficient friction to prevent the descension of said weight, a lug adapted to throw said strut out of engagement with the rod at the extreme elevation of the weight whereby said weight is free to descend and return the follower, means for abruptly stopping the weight at the completion of its return whereby momentum throws said strut into engagement with the rod when the weight has descended, substantially as described.

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

FRANCIS B. CONVERSE, Jr.

Witnesses:

Albert H. Bates,

E. L. Thurston.