J. C. GRANT.
TYPE CASTING AND COMPOSING MACHINE.
APPLICATION FILED DEC. 16, 1909.

1,054,838.

Patented Mar. 4, 1913.

33 SHEETS—SHEET 1.

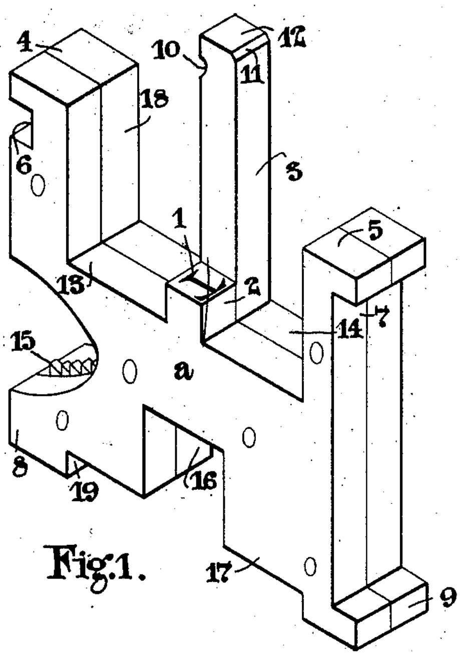

Fig. 1.

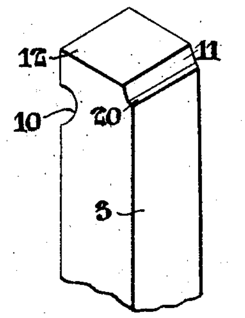

Fig. 2.

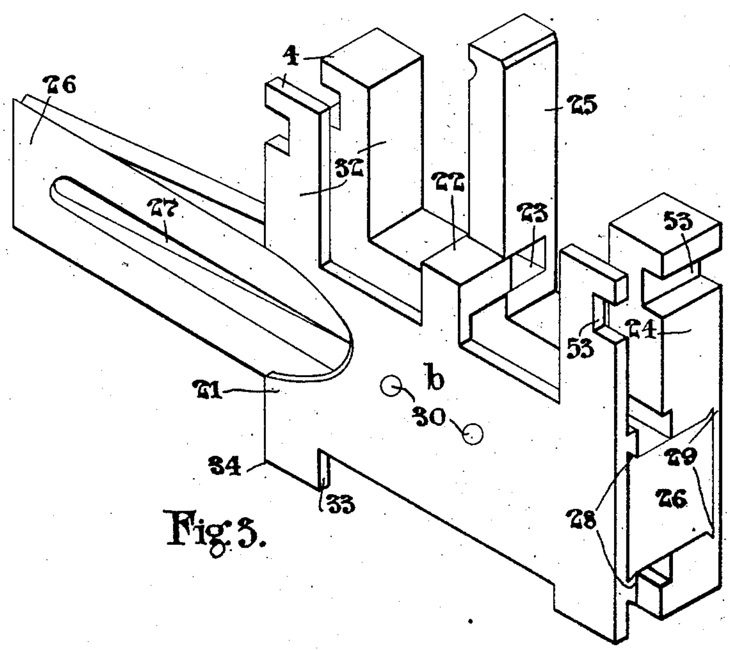

Fig. 3.

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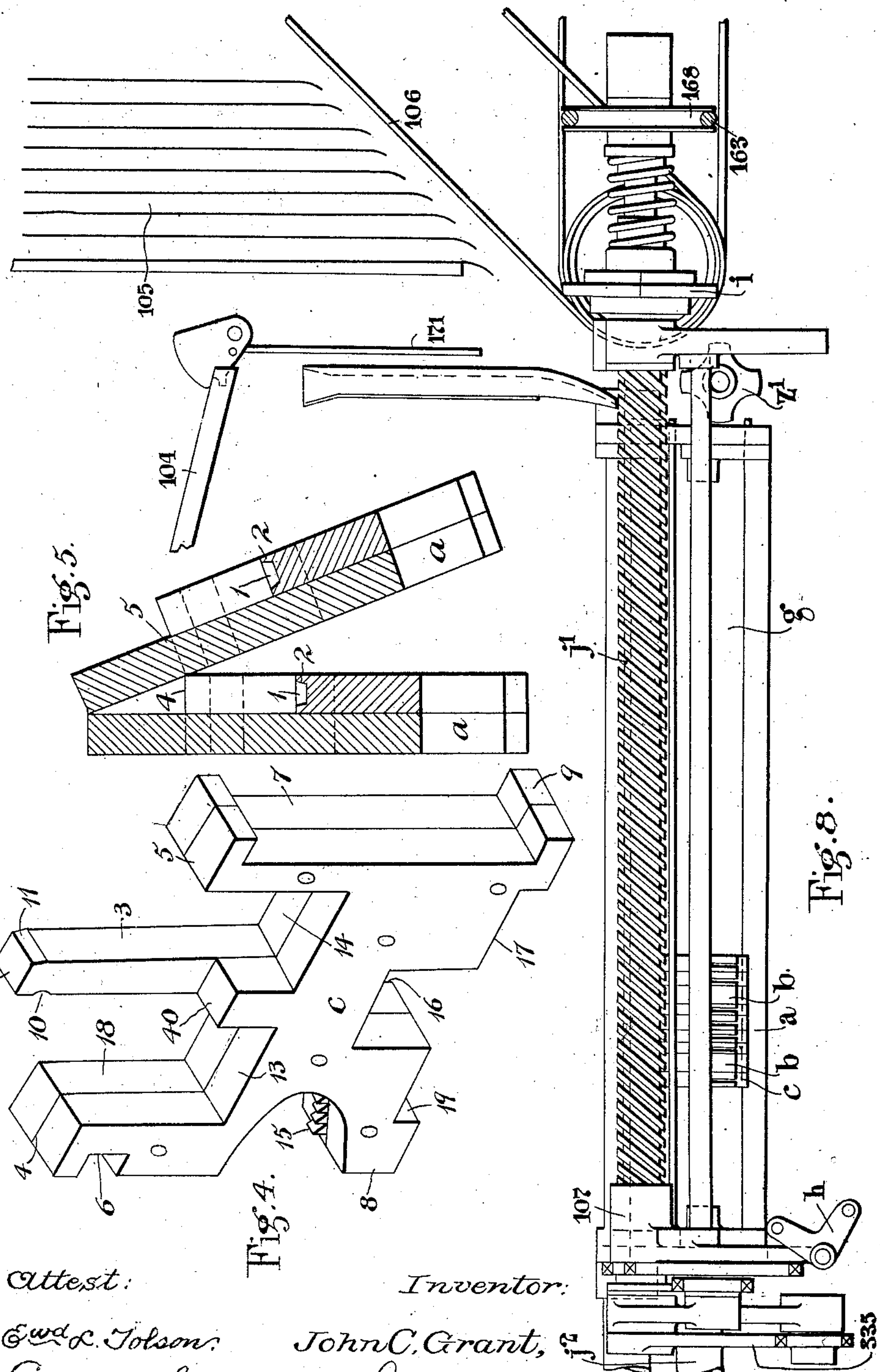

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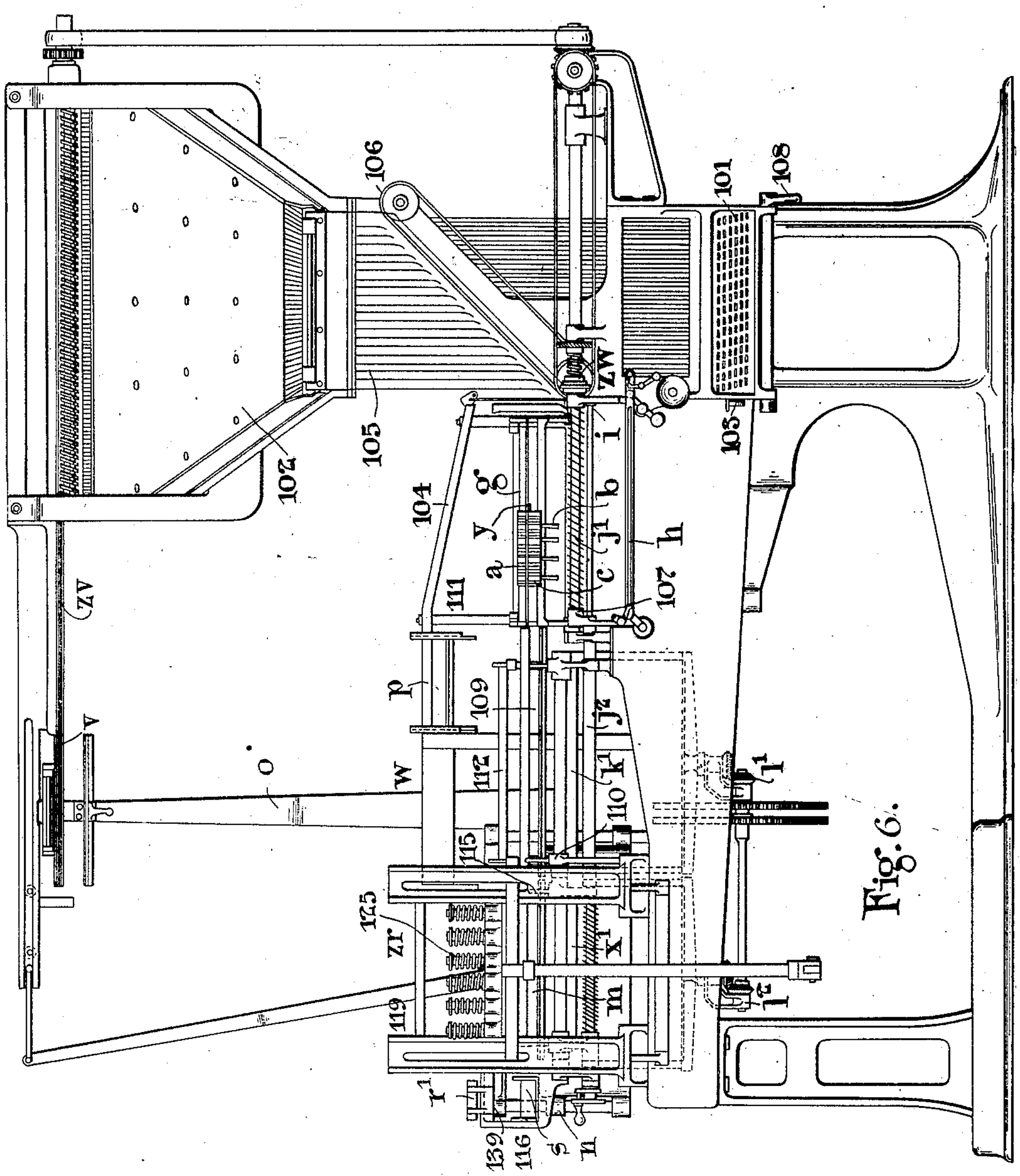

Fig. 6.

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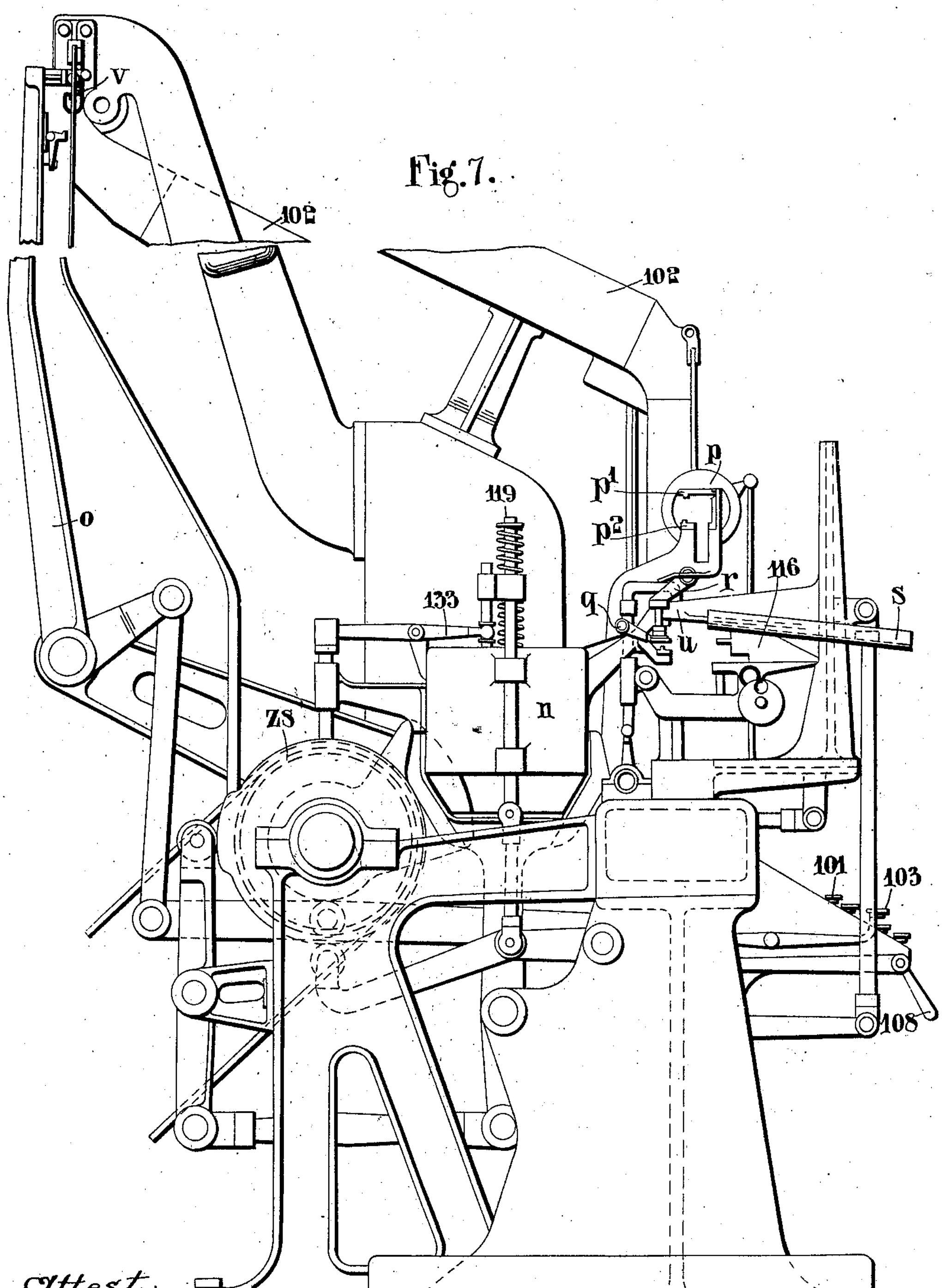
Fig. 7.



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33 SHEETS—SHEET 5.

Fig. 9.

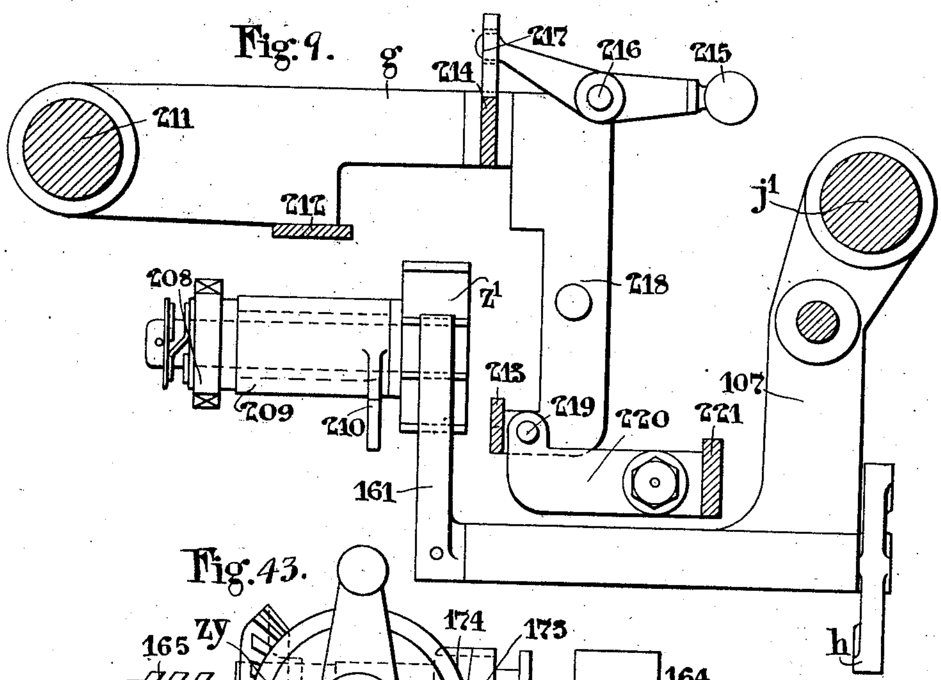
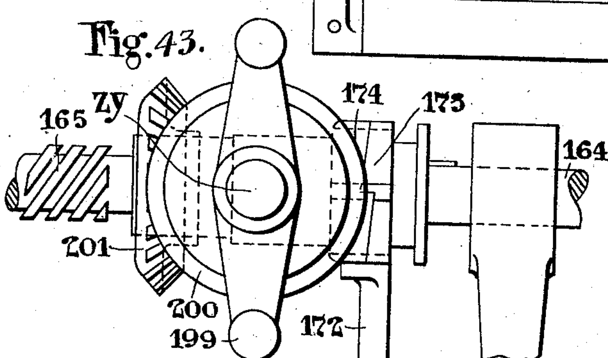


Fig. 43.



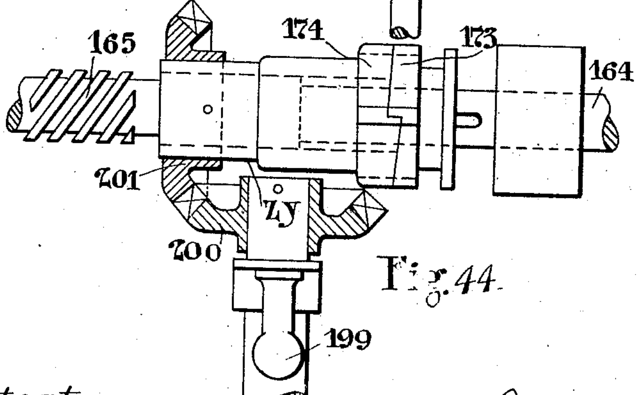


Fig. 44.

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33 SHEETS—SHEET 6.

Fig. 10.

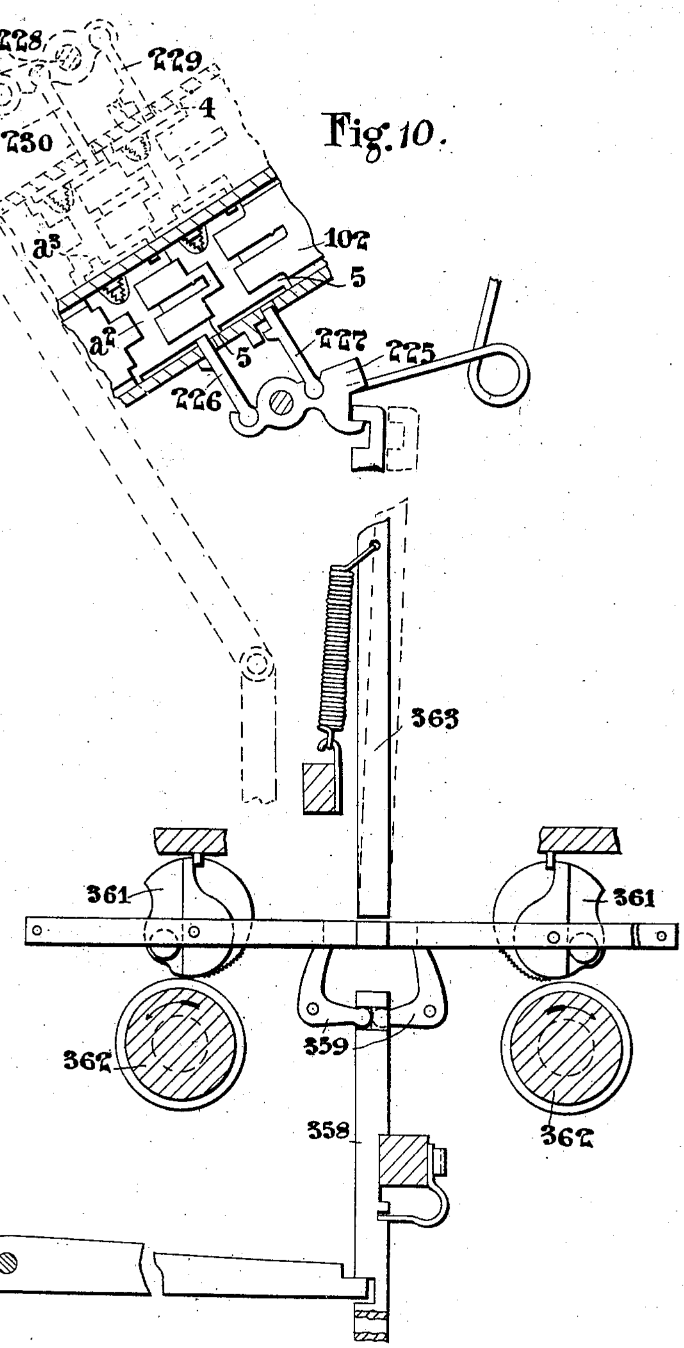
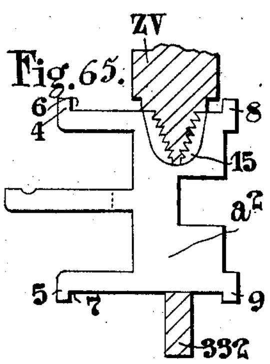


Fig. 65.



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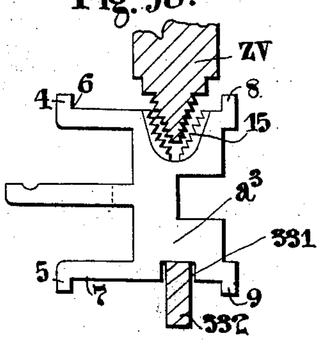

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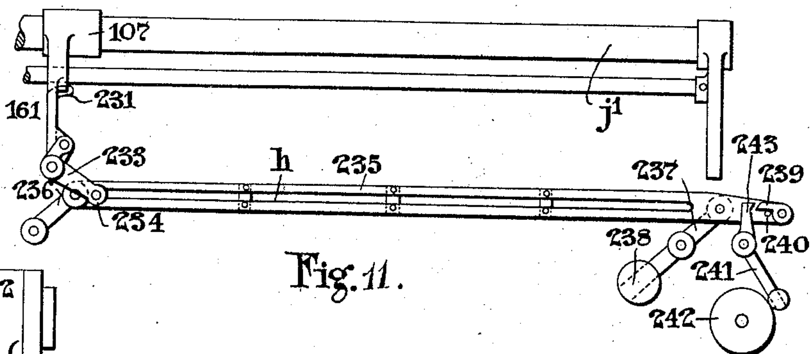

Fig. 11.

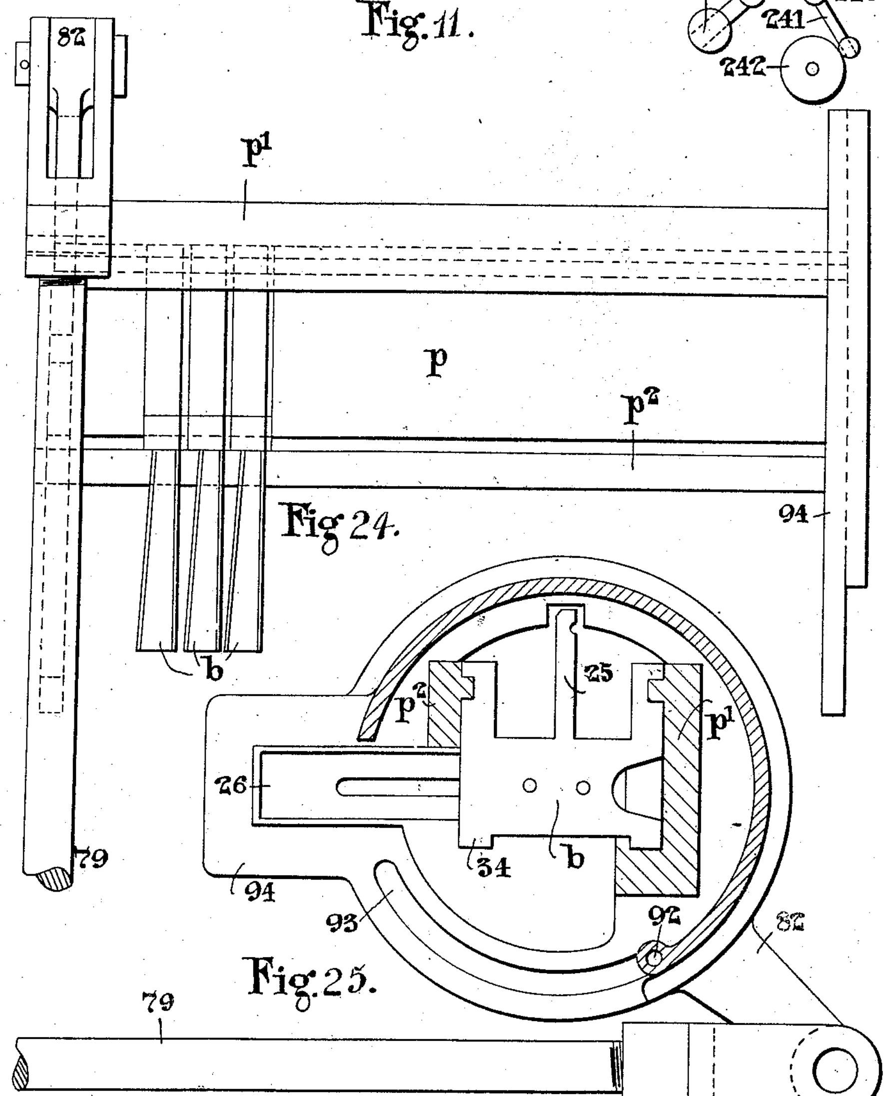

Fig 24.

Fig. 25.

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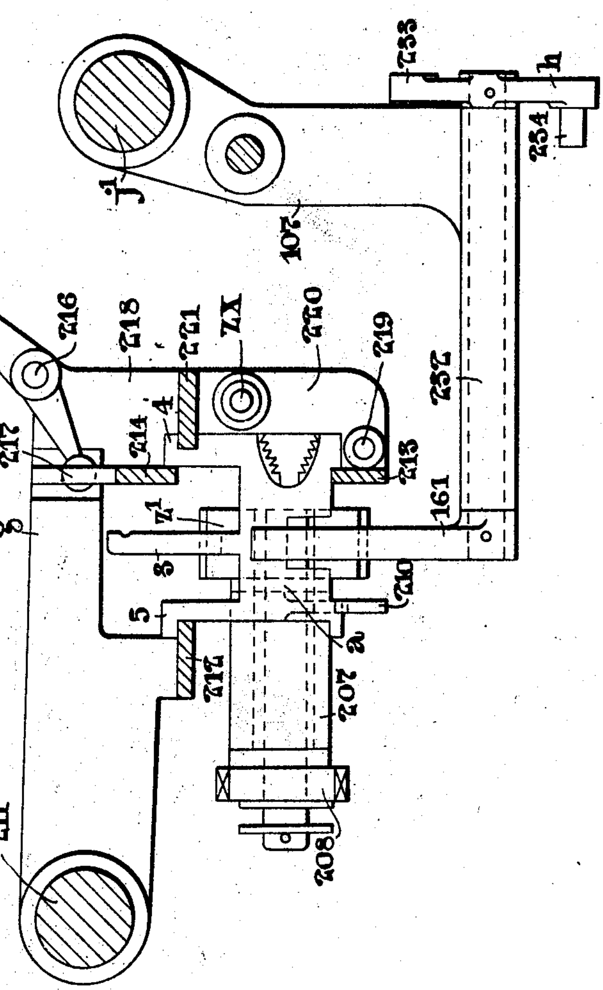

Fig. 12.

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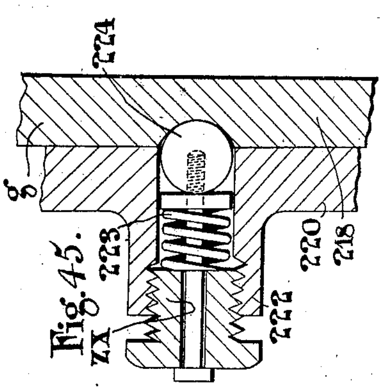

Fig. 45.

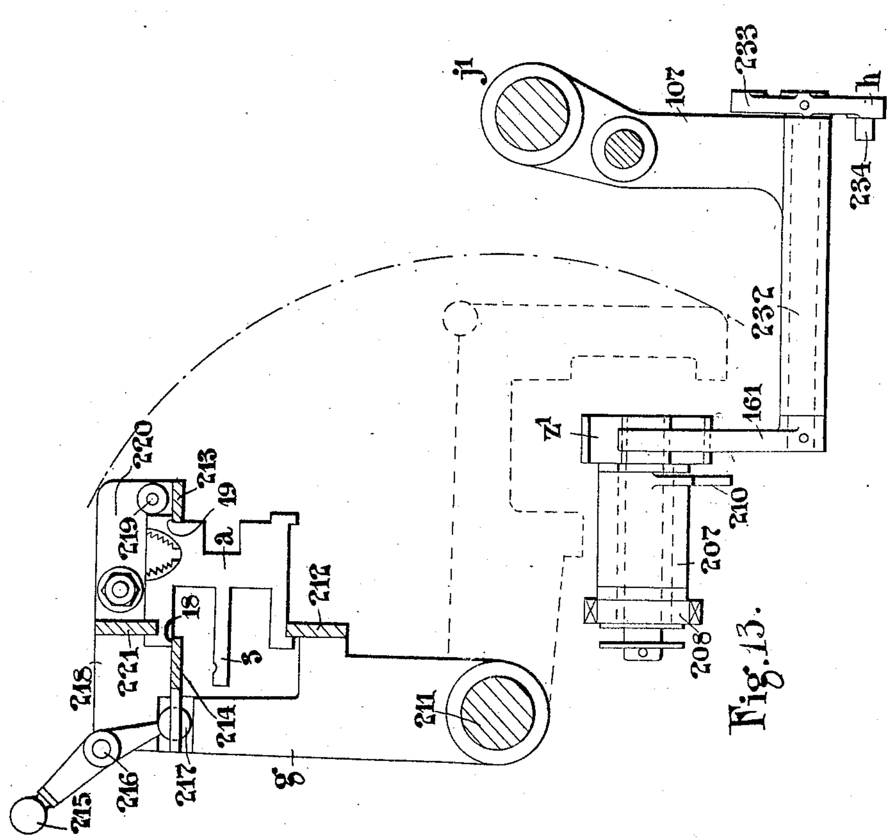

Fig. 13.

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33 SHEETS—SHEET 10.

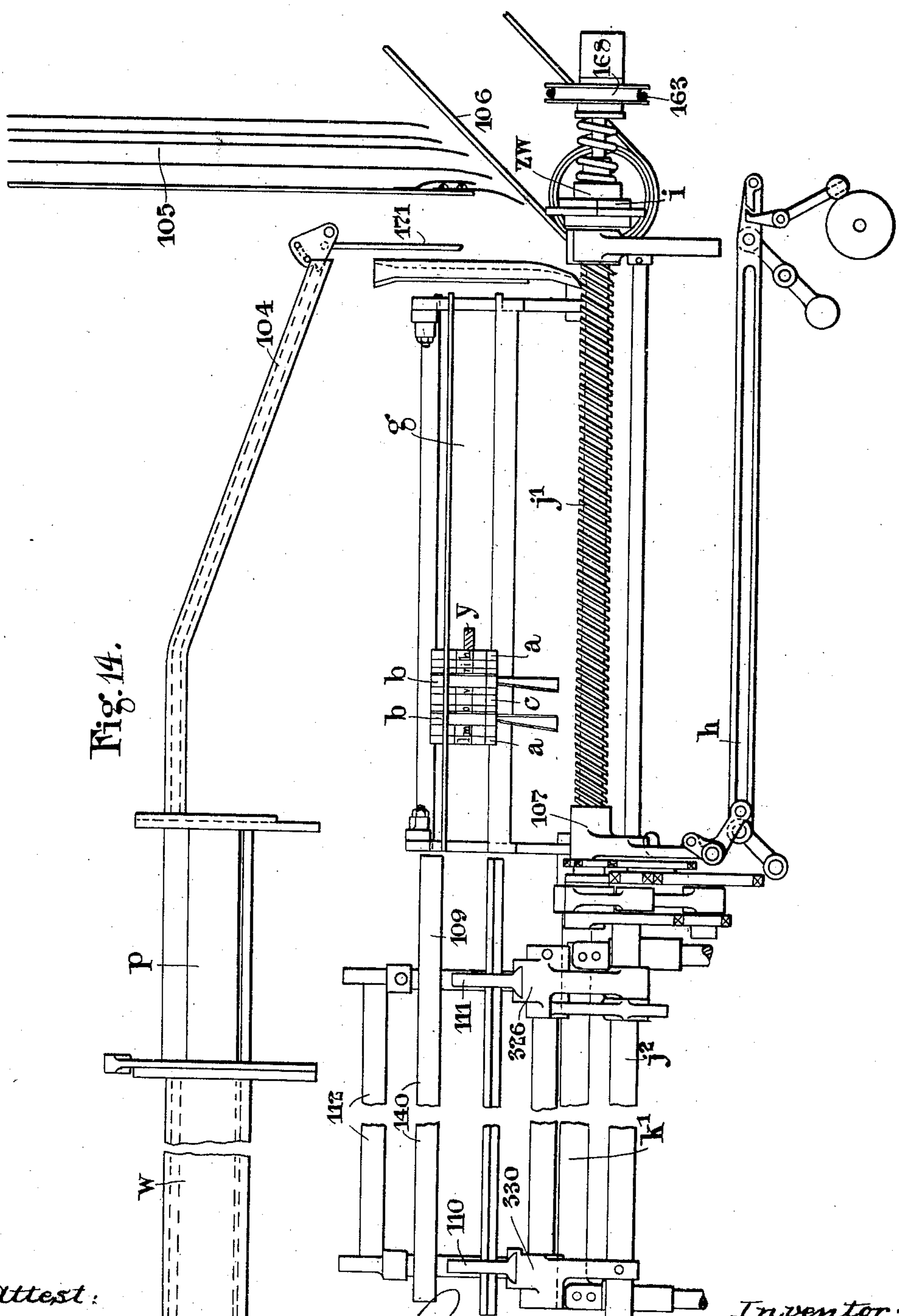

Fig. 14.

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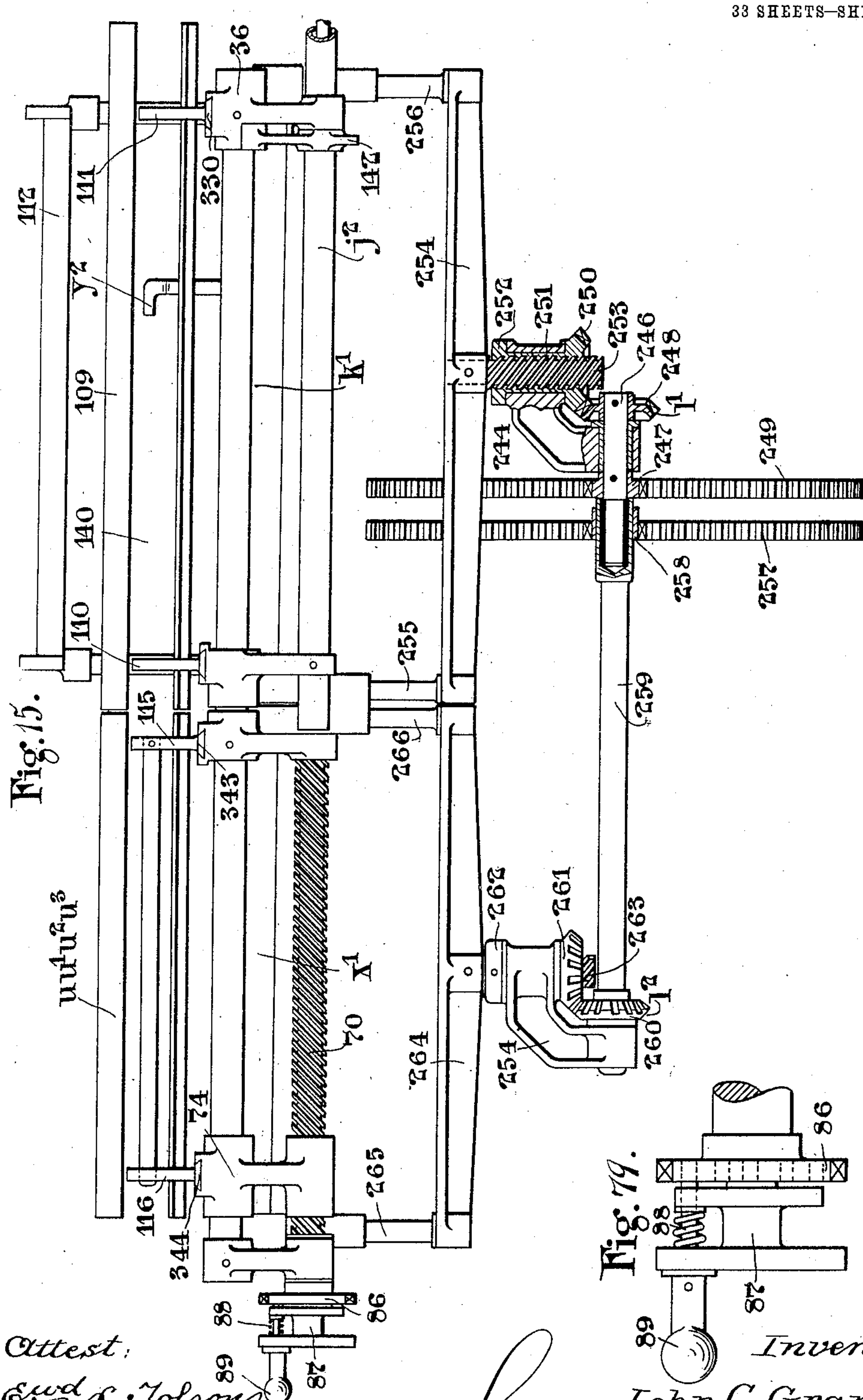

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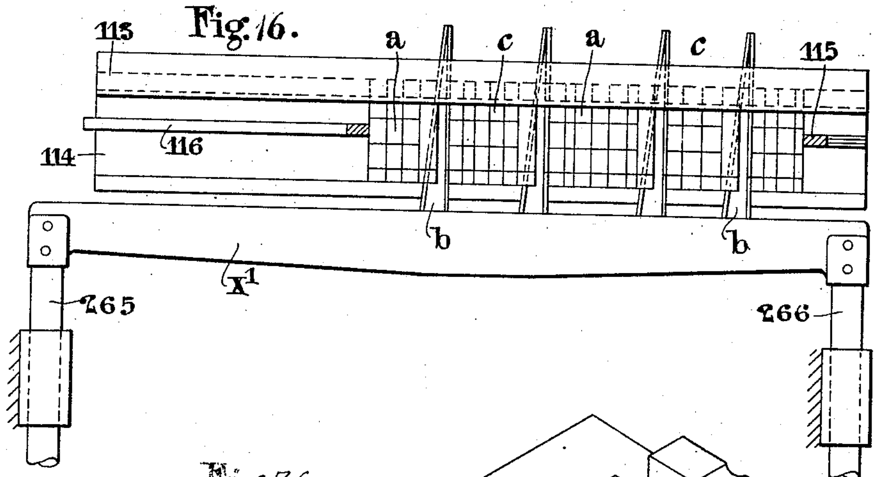
Fig. 16.



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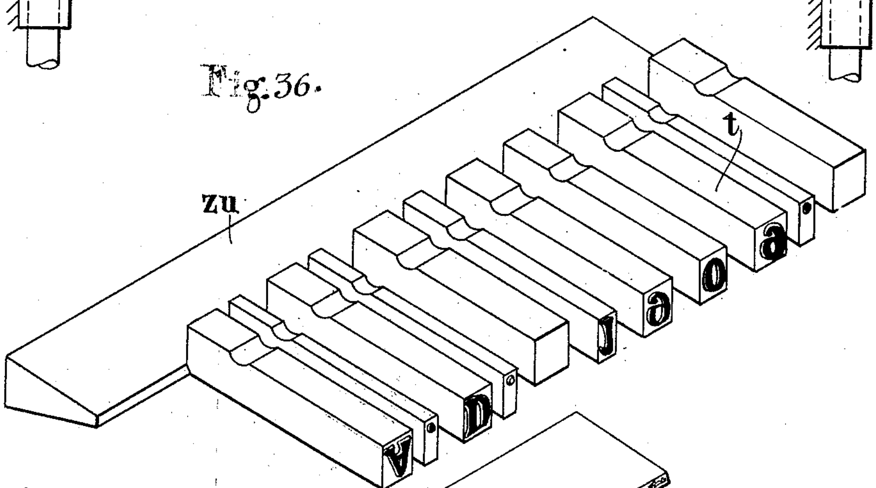

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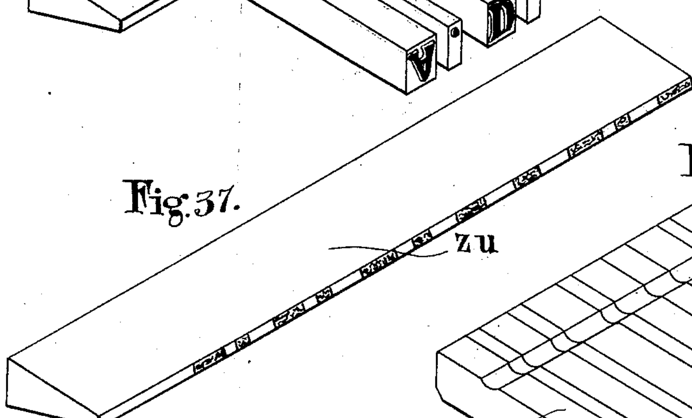

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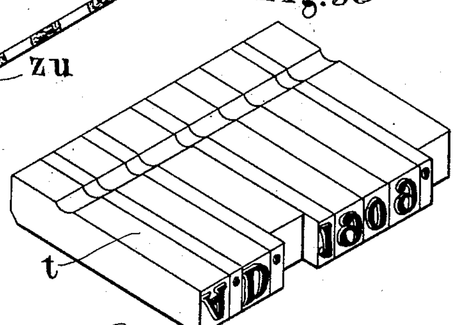

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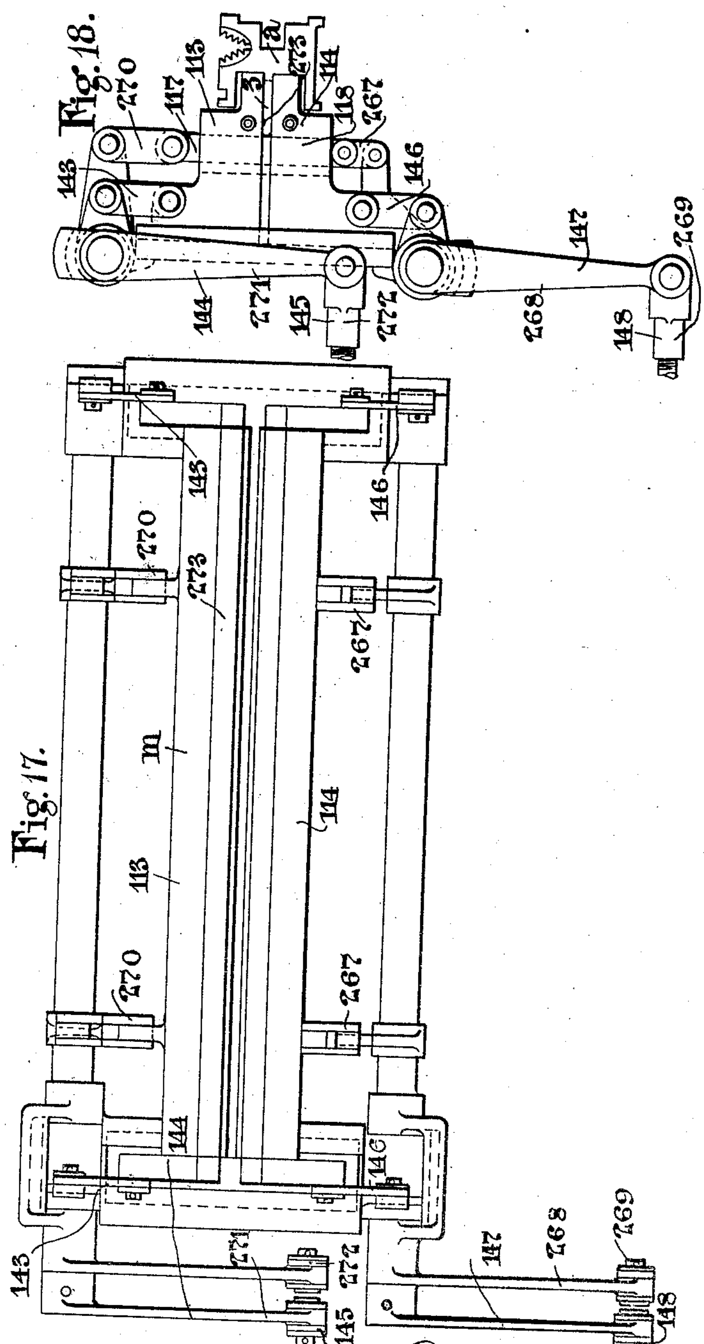

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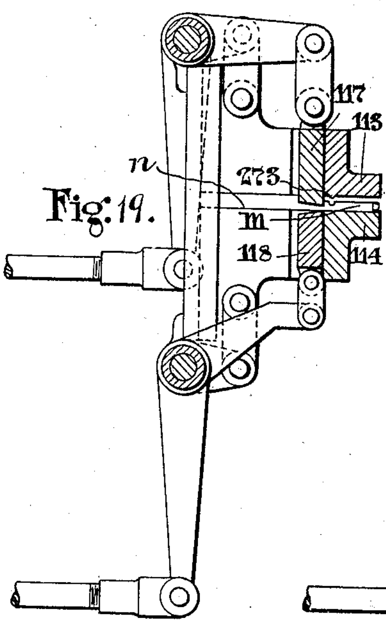
33 SHEETS—SHEET 14.

Fig. 19.



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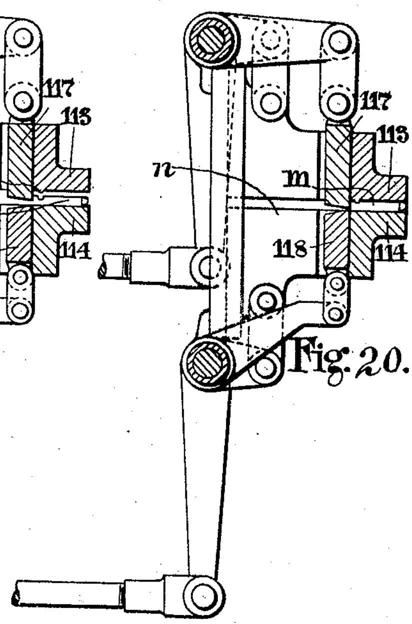

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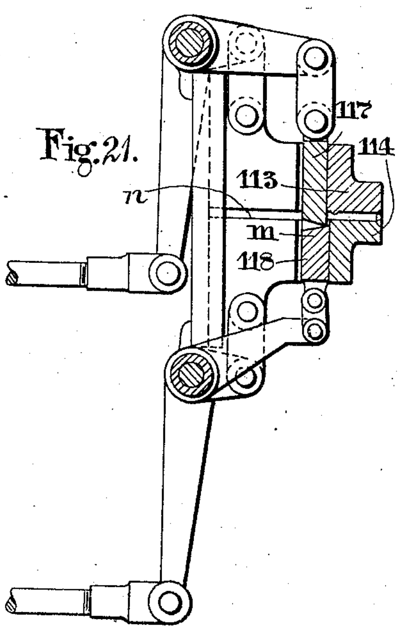

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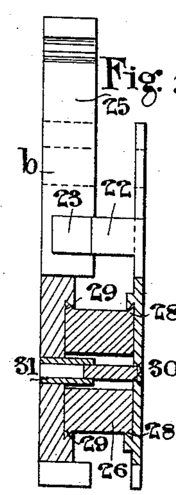

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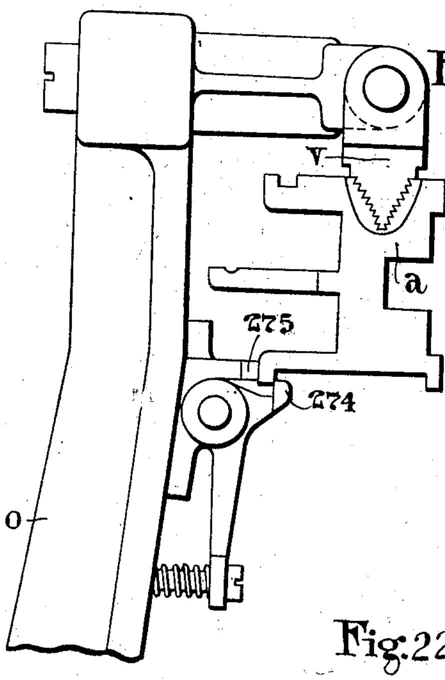
Fig. 23.



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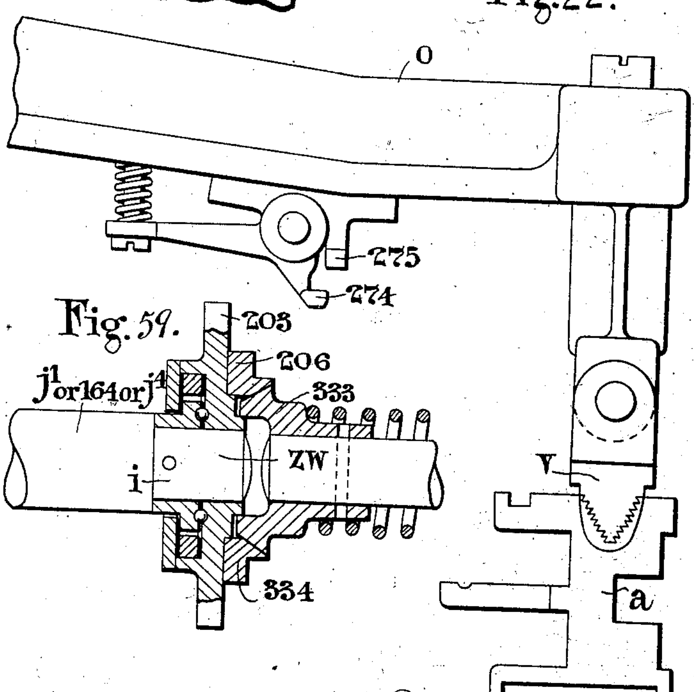

Fig. 59.

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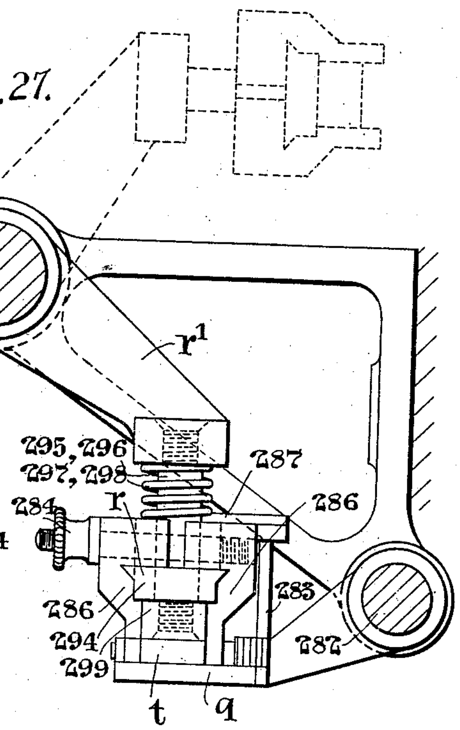
33 SHEETS—SHEET 16.

Fig. 27.



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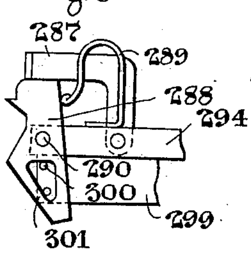

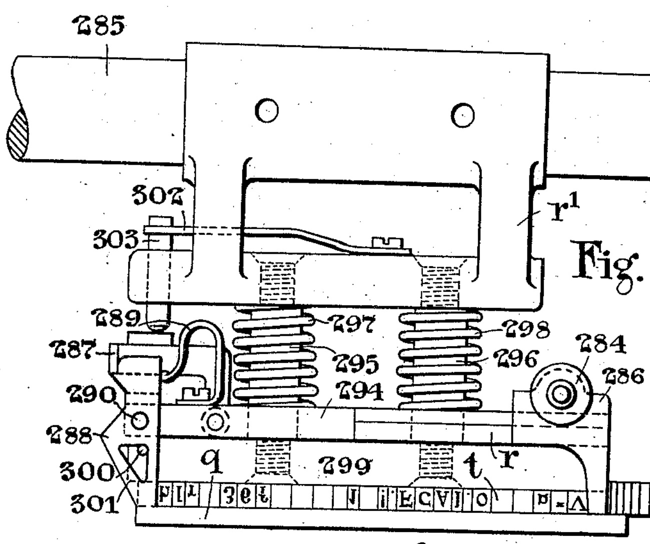

Fig. 26.

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Fig. 28.

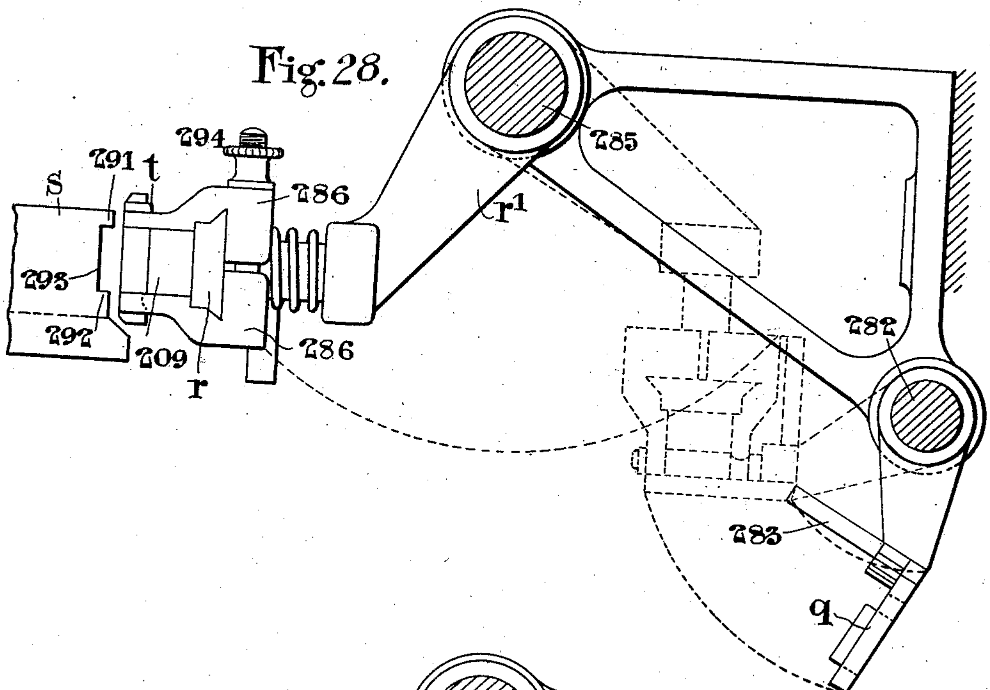

Fig. 29.

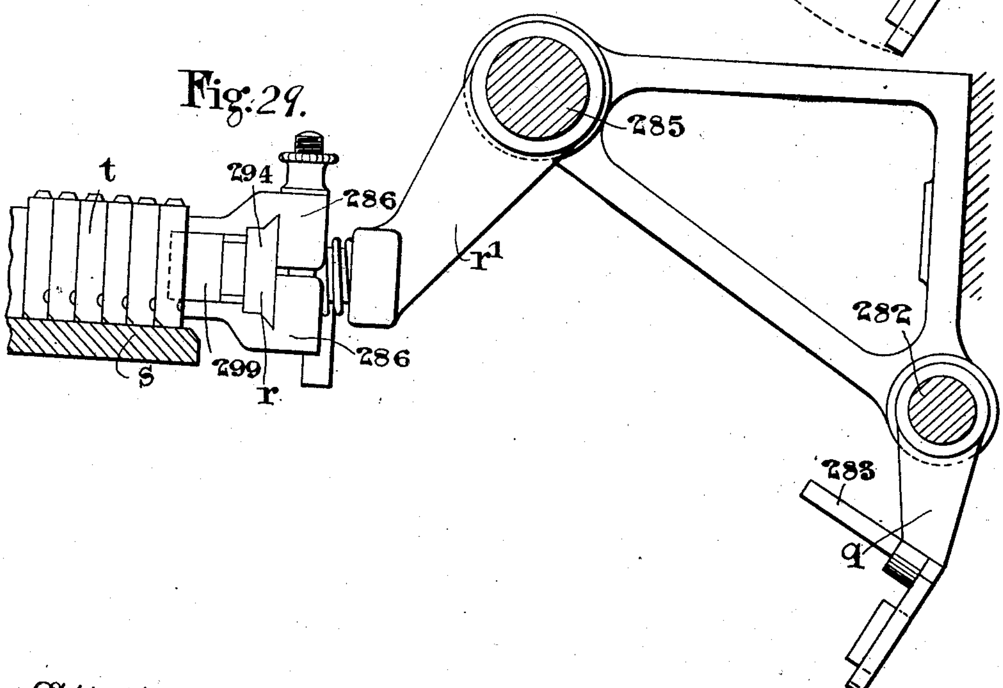

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Fig. 30.

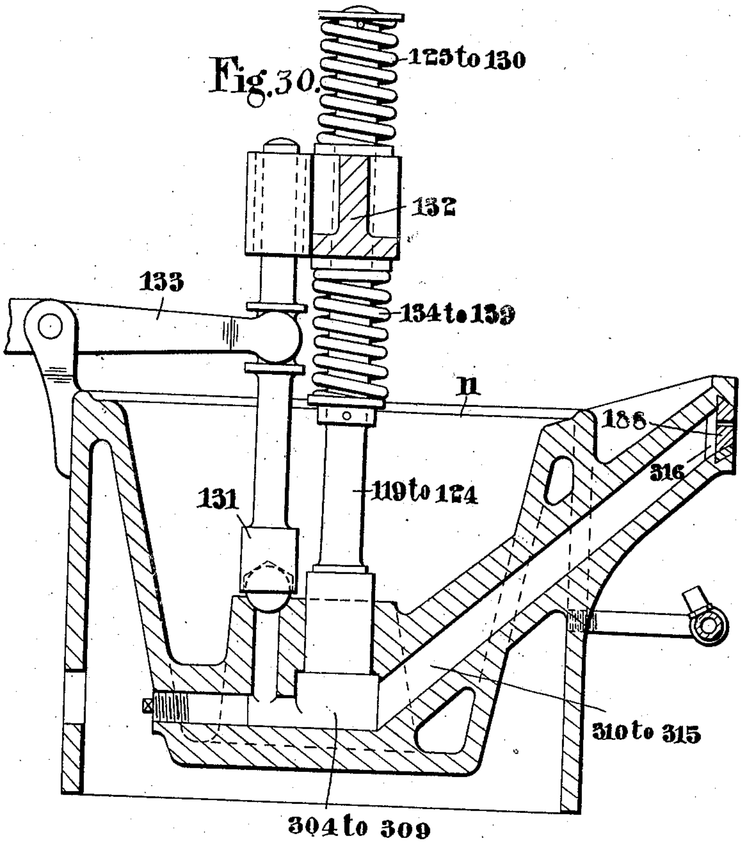
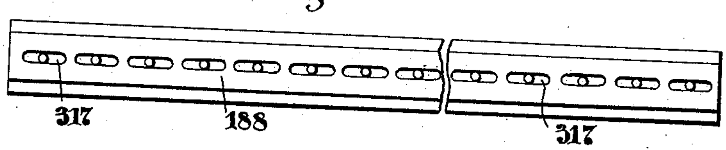


Fig. 32.^a



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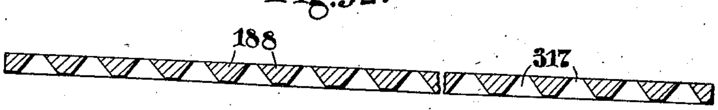

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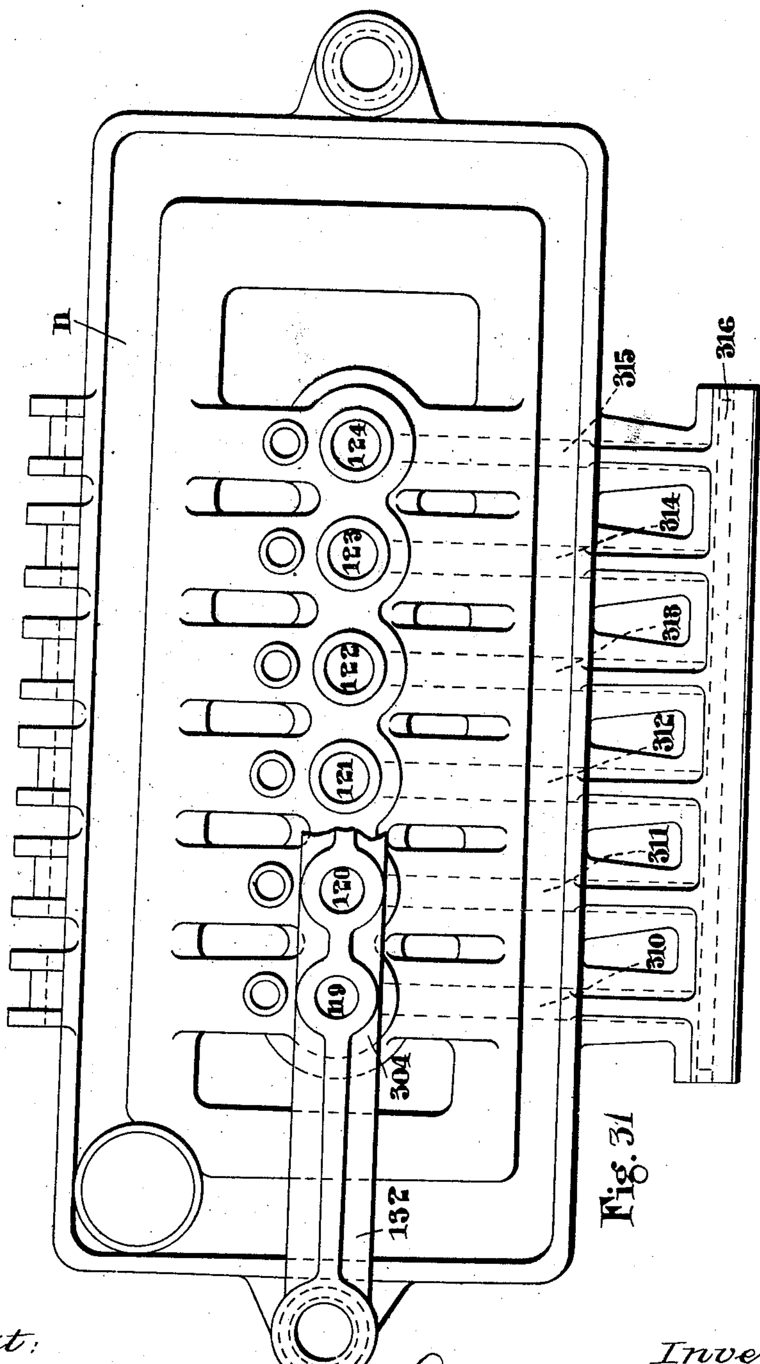

Fig. 31

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33 SHEETS—SHEET 20.

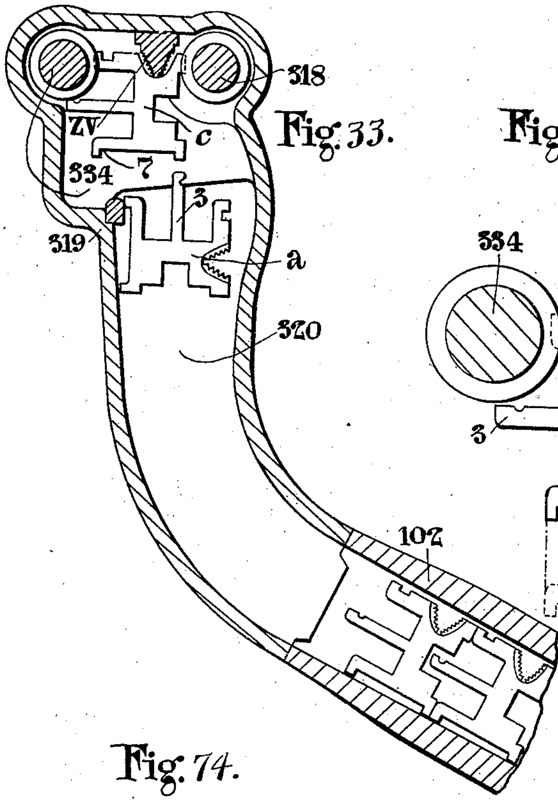


Fig. 33.

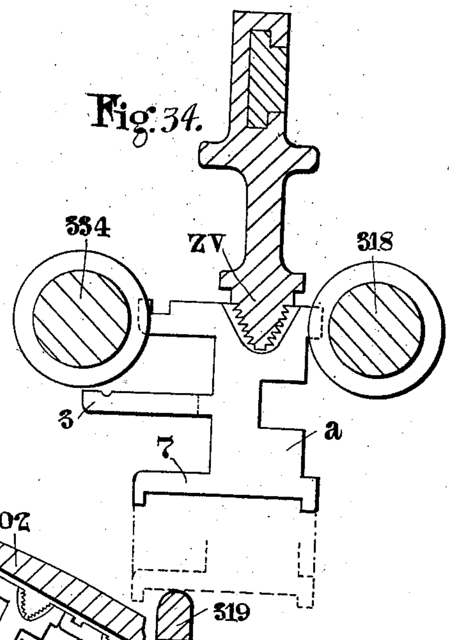


Fig. 34.

Fig. 74.

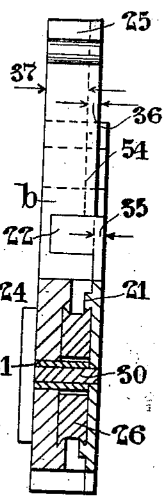
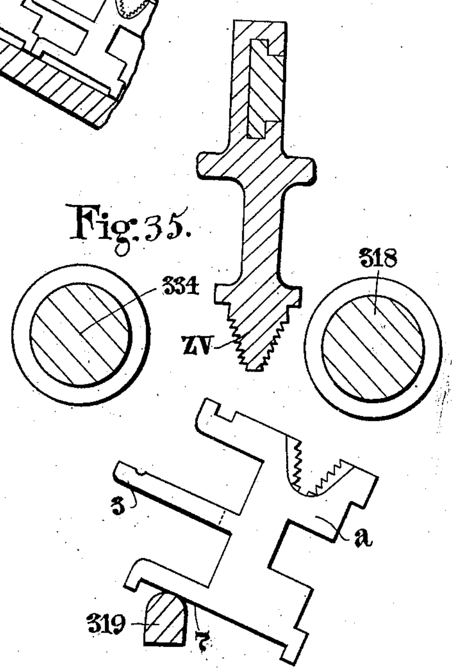


Fig. 35.



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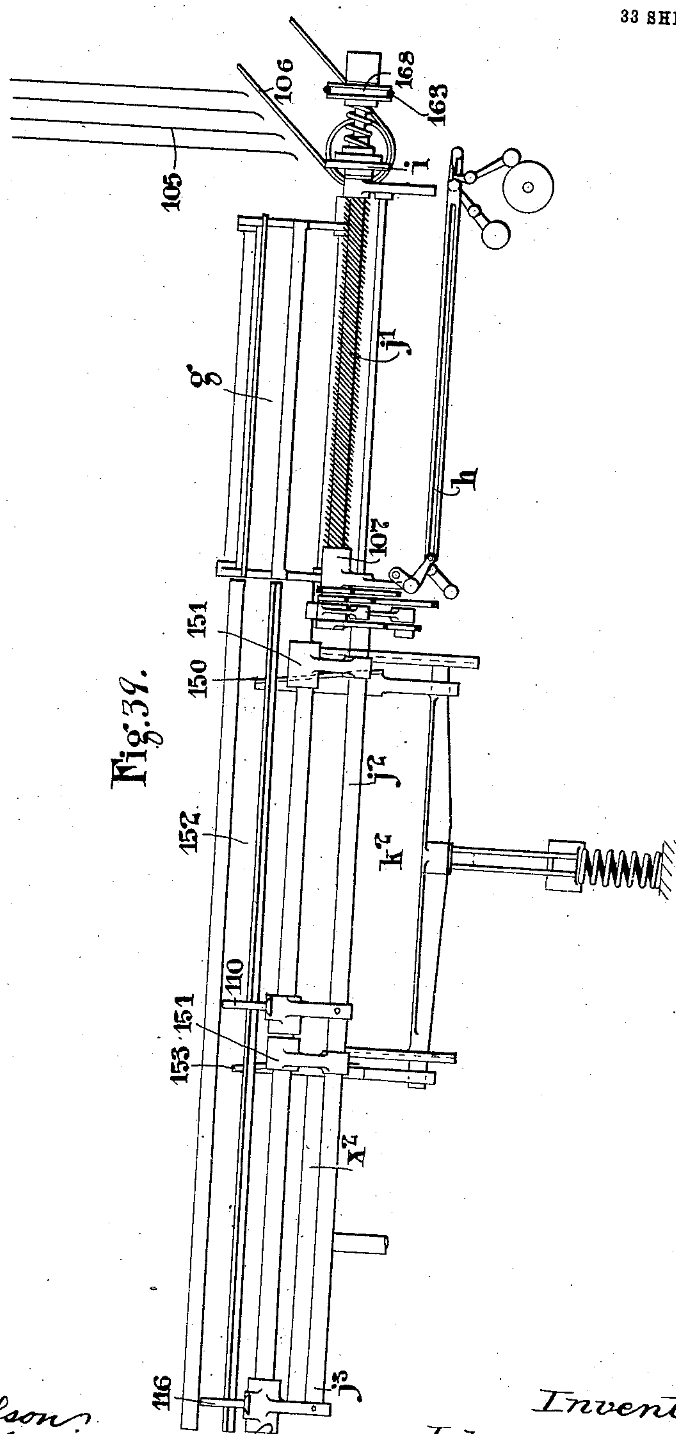

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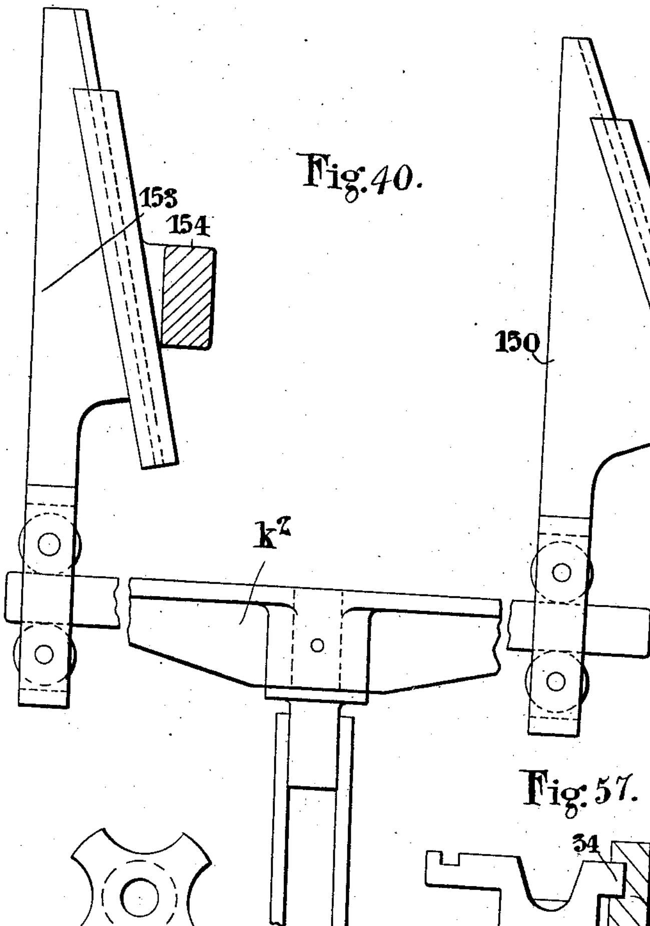
33 SHEETS—SHEET 22.

Fig. 40.



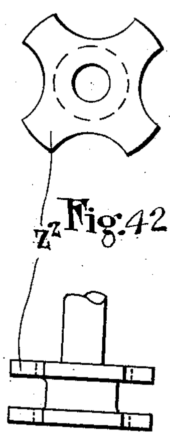
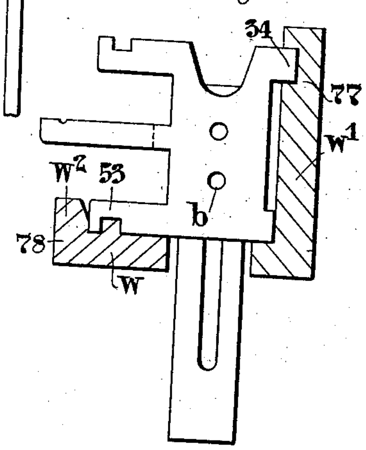


Fig. 42.

Fig. 57.



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33 SHEETS—SHEET 23.

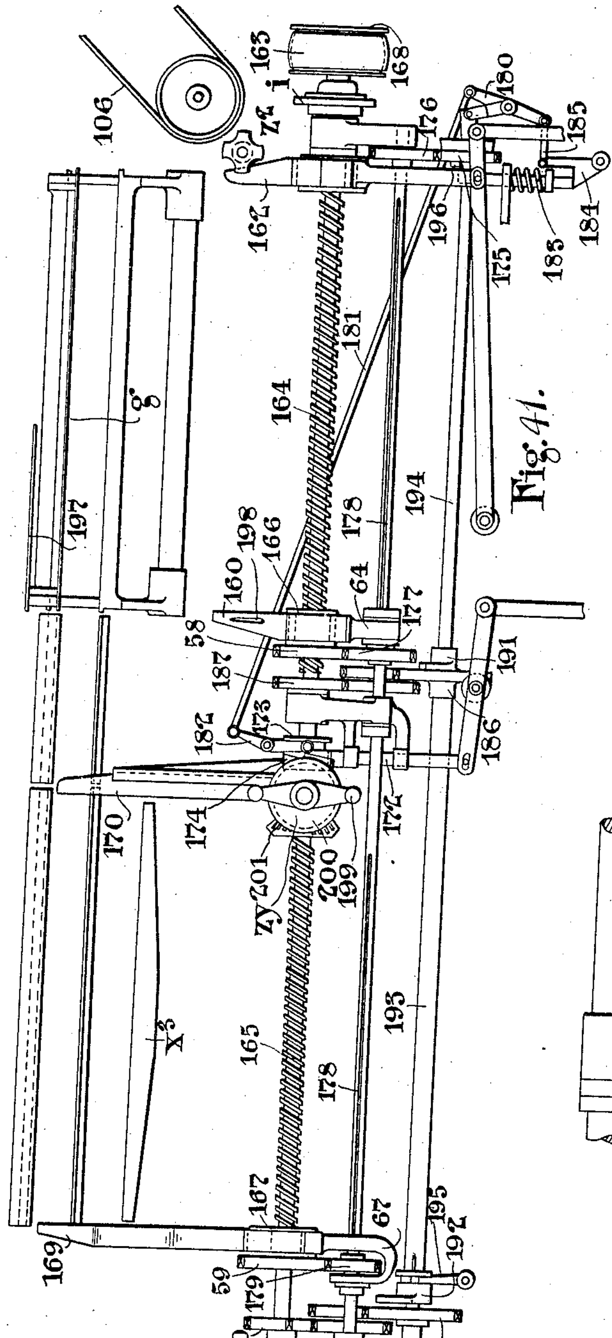

Fig. 41.

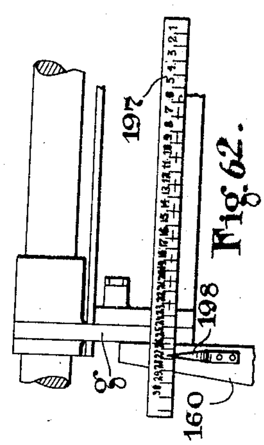

Fig. 62.

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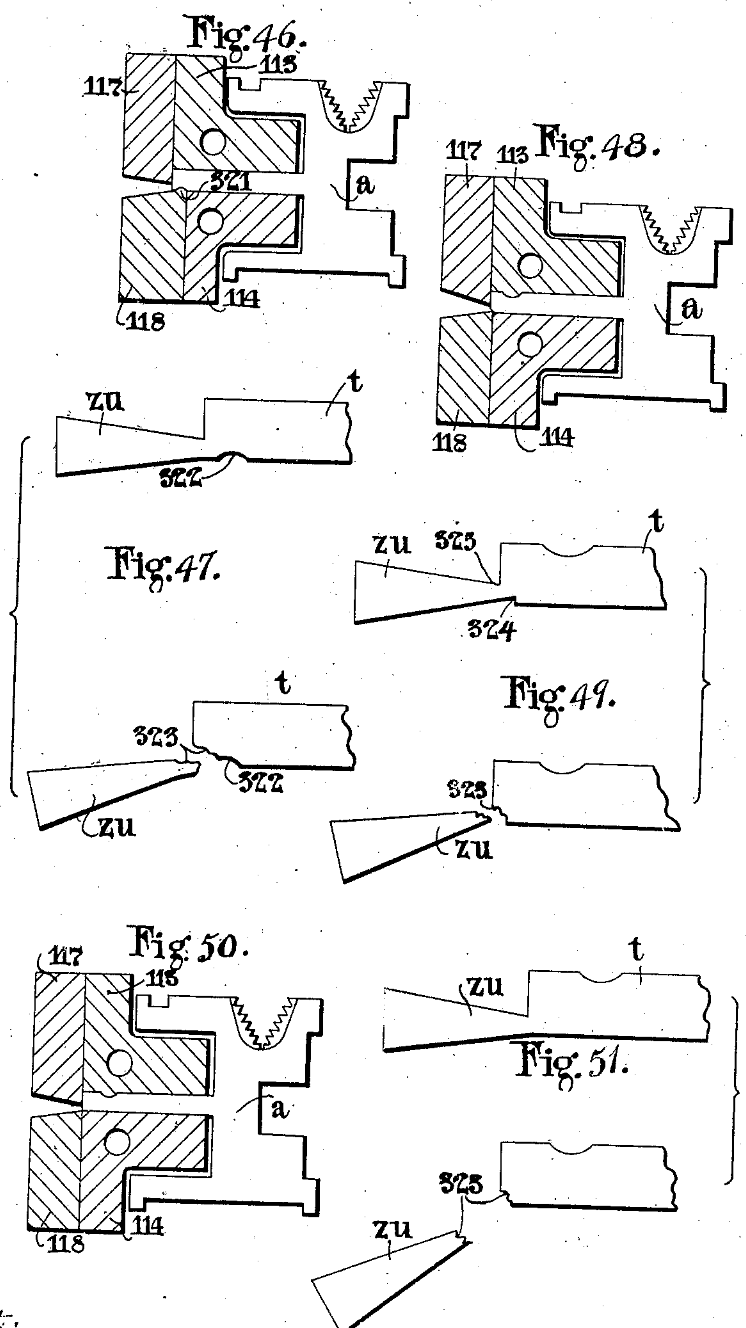
1,054,838. Patented Mar. 4, 1913.

33 SHEETS—SHEET 24.



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TYPE CASTING AND COMPOSING MACHINE.
APPLICATION FILED DEC. 16, 1909.

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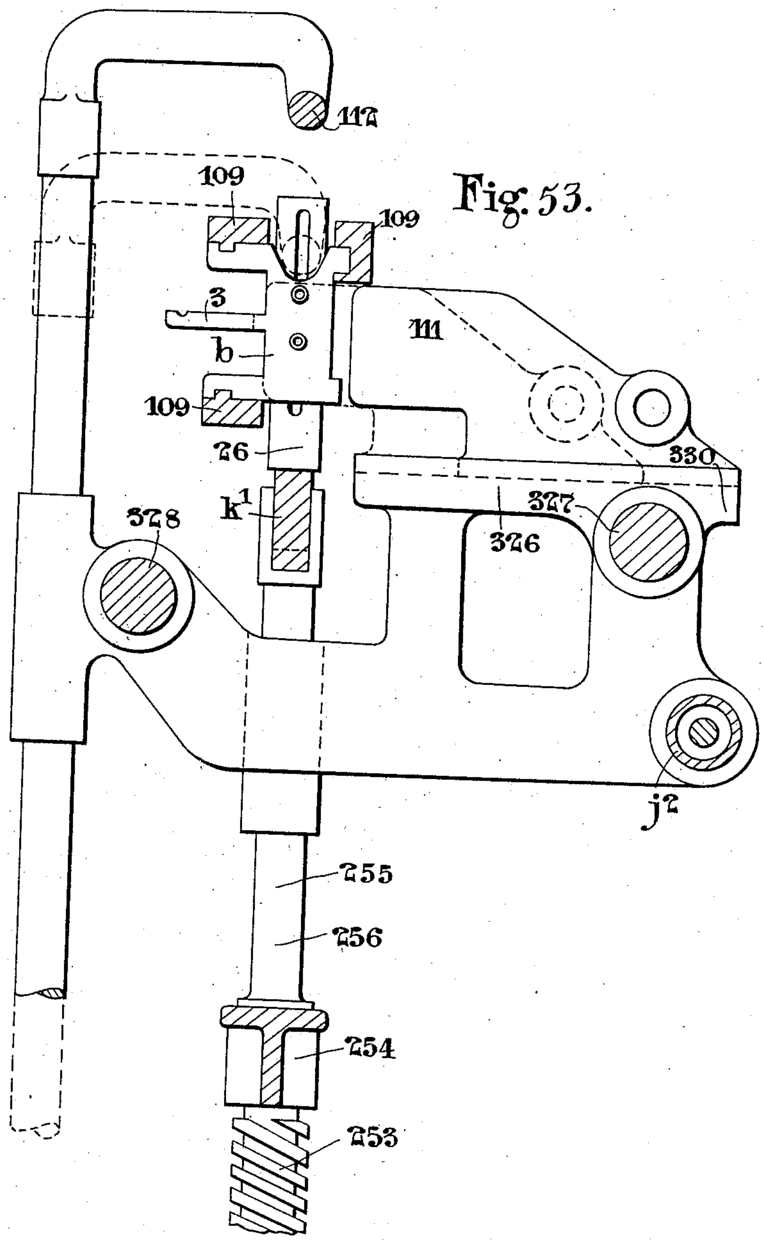
33 SHEETS—SHEET 25.

Fig. 53.



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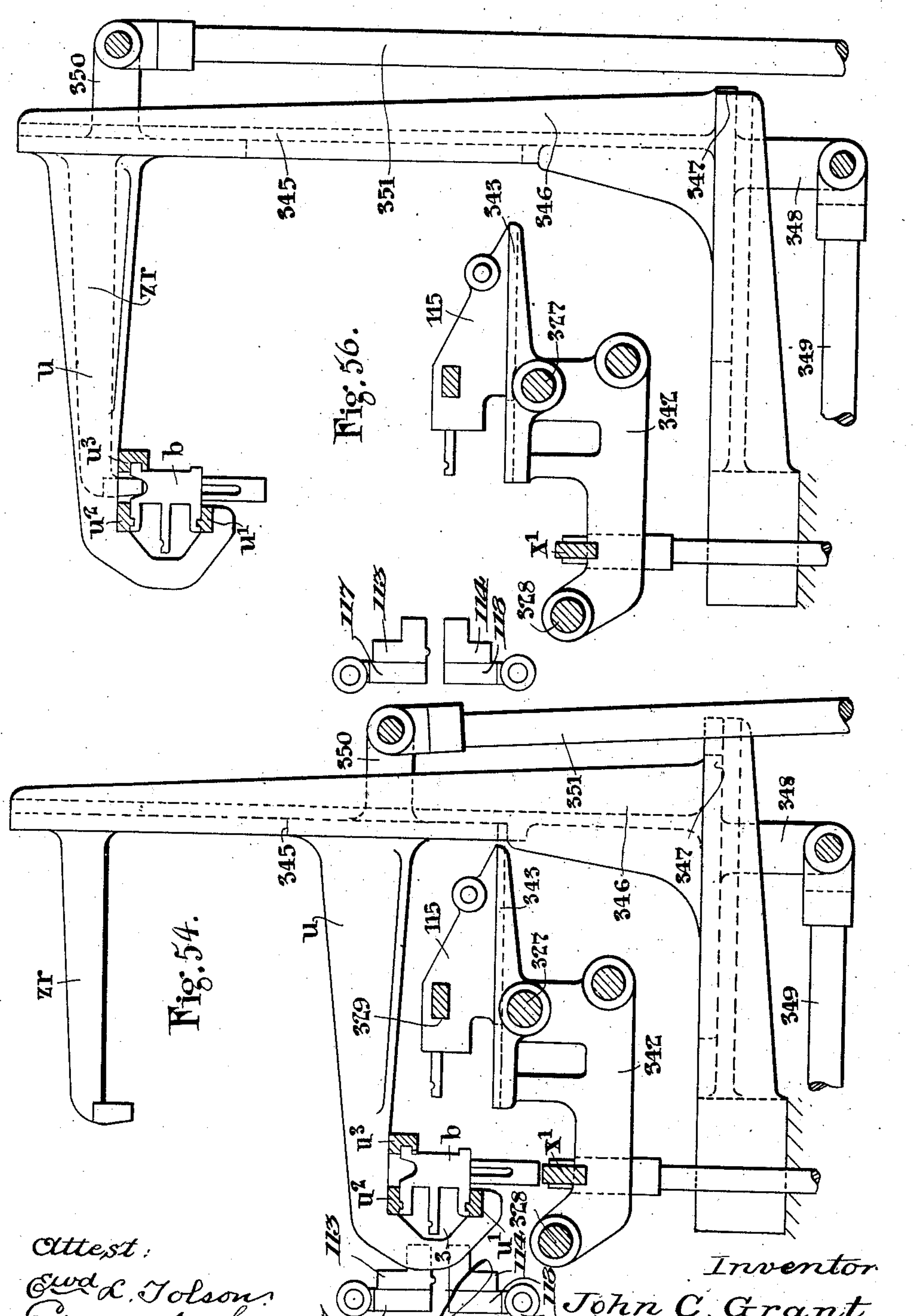

Fig. 56.

Fig. 54.

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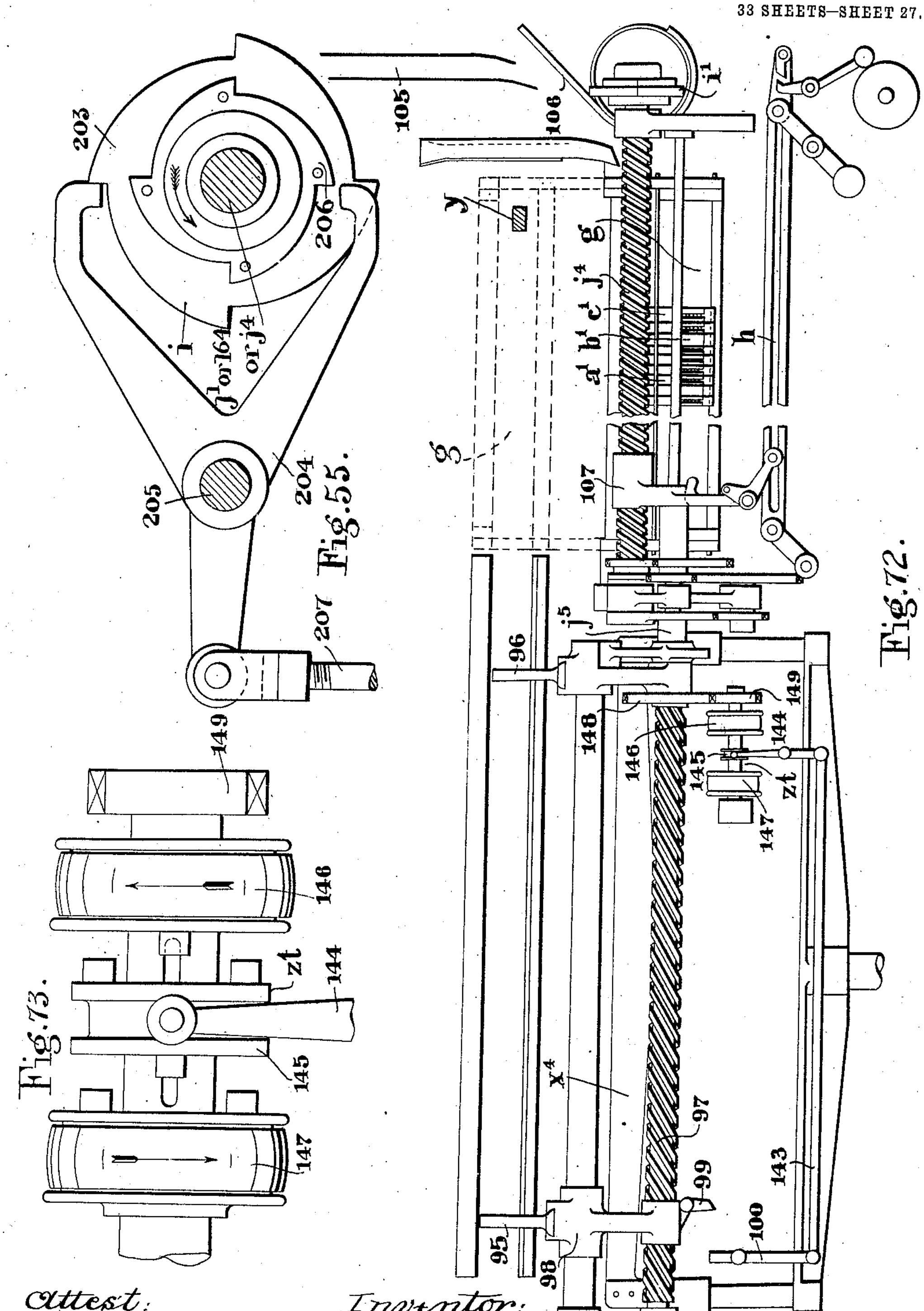

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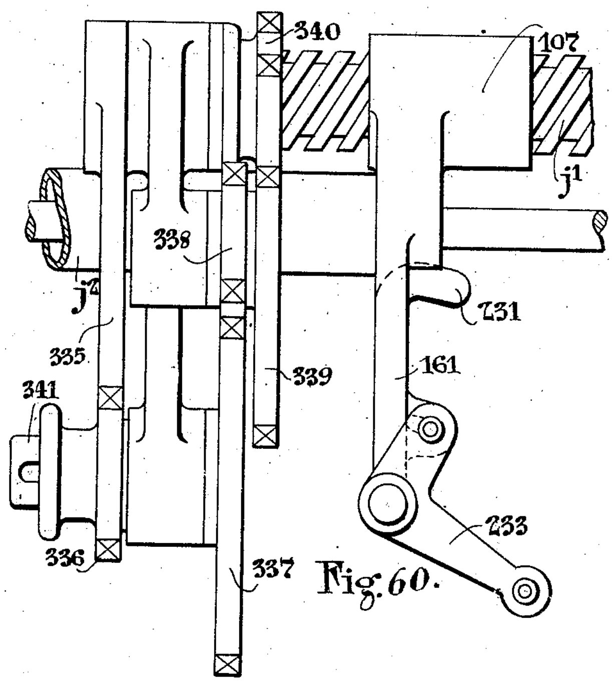

Fig. 60.

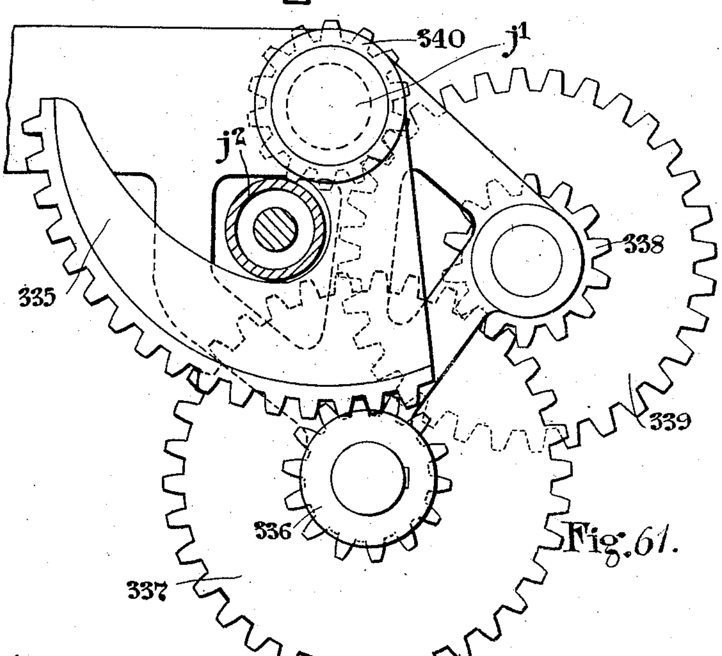

Fig. 61.

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Fig. 63.

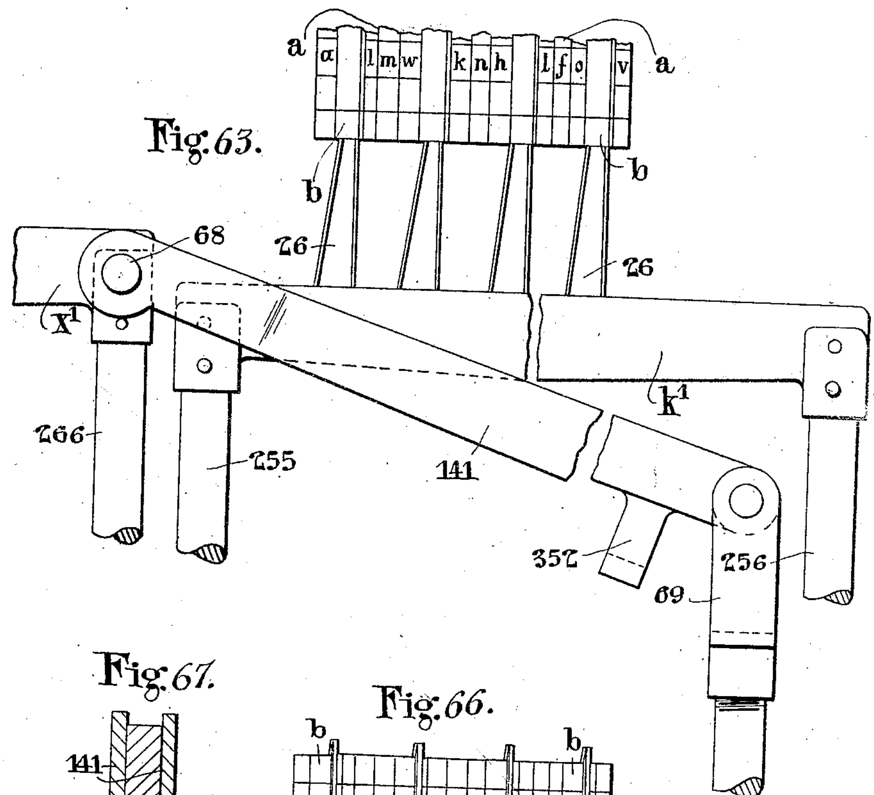

Fig. 67.

Fig. 66.

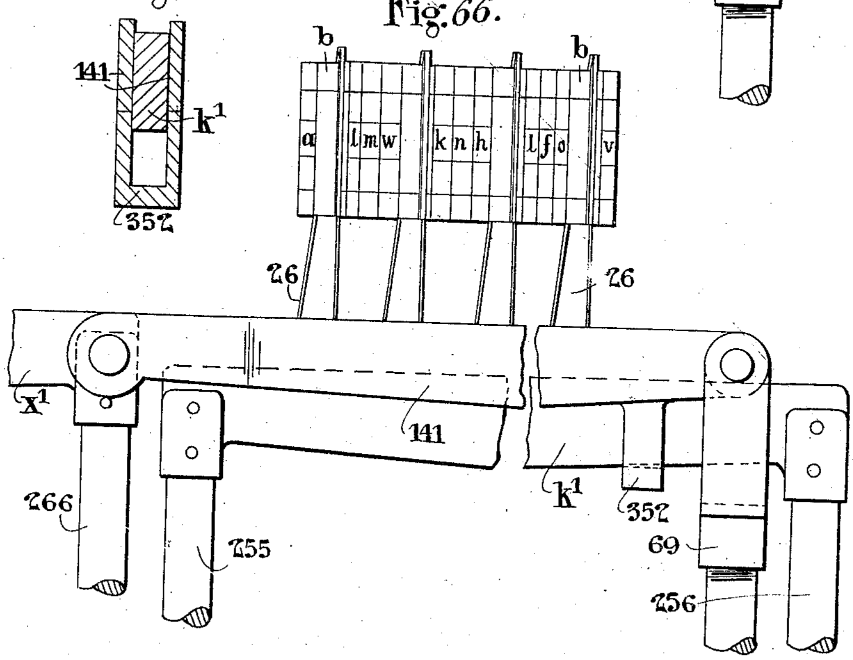

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Fig. 69.

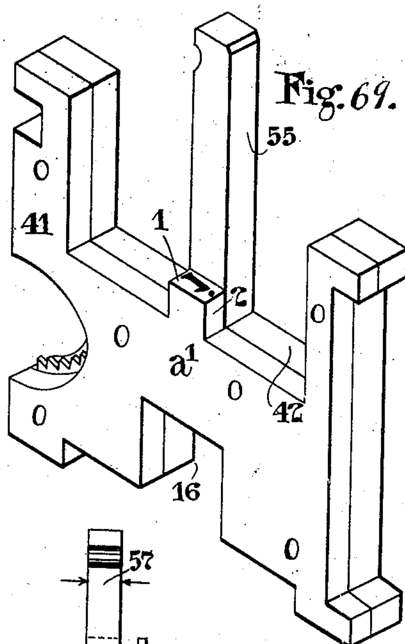


Fig. 70.

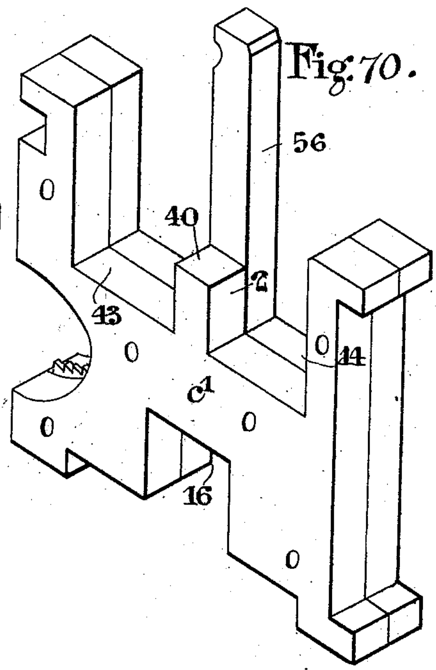


Fig. 68.

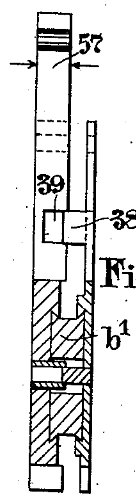
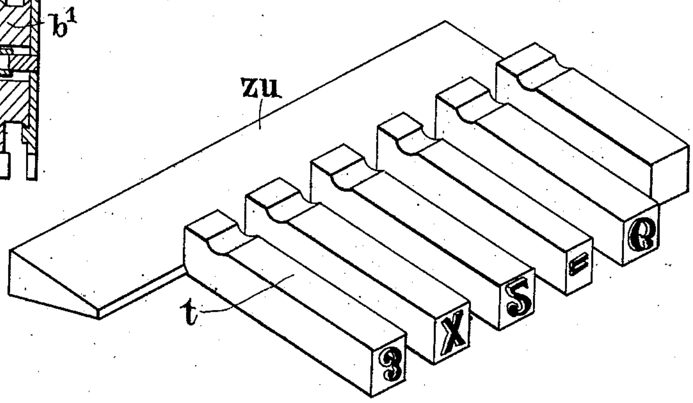


Fig. 71.



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1,054,838. Patented Mar. 4, 1913.

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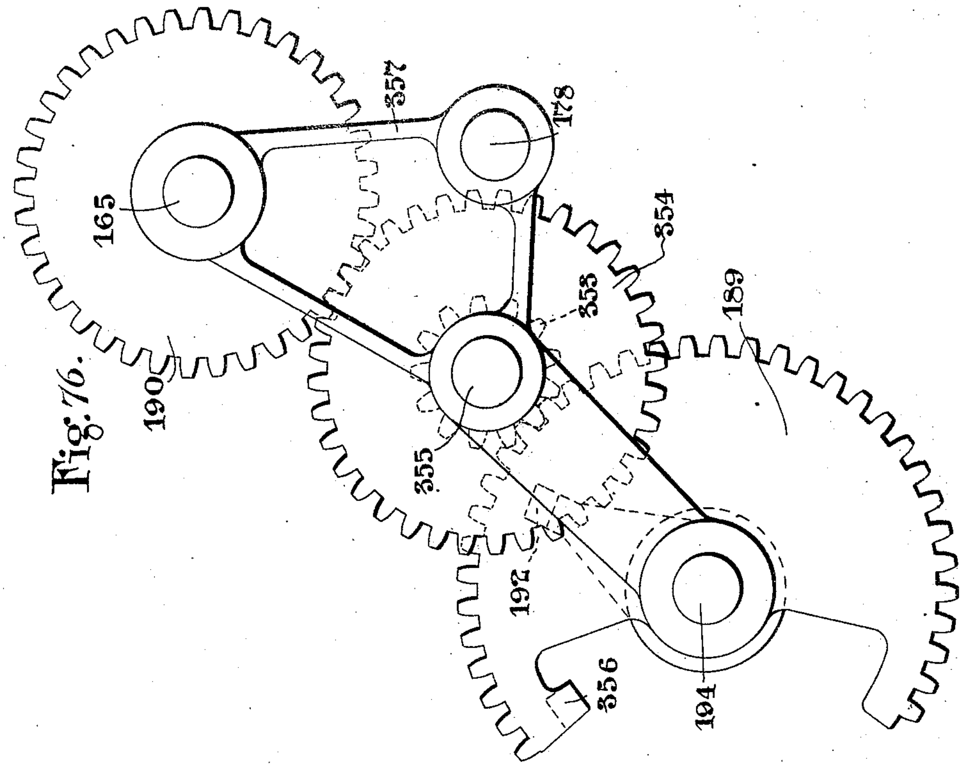

Fig. 76.

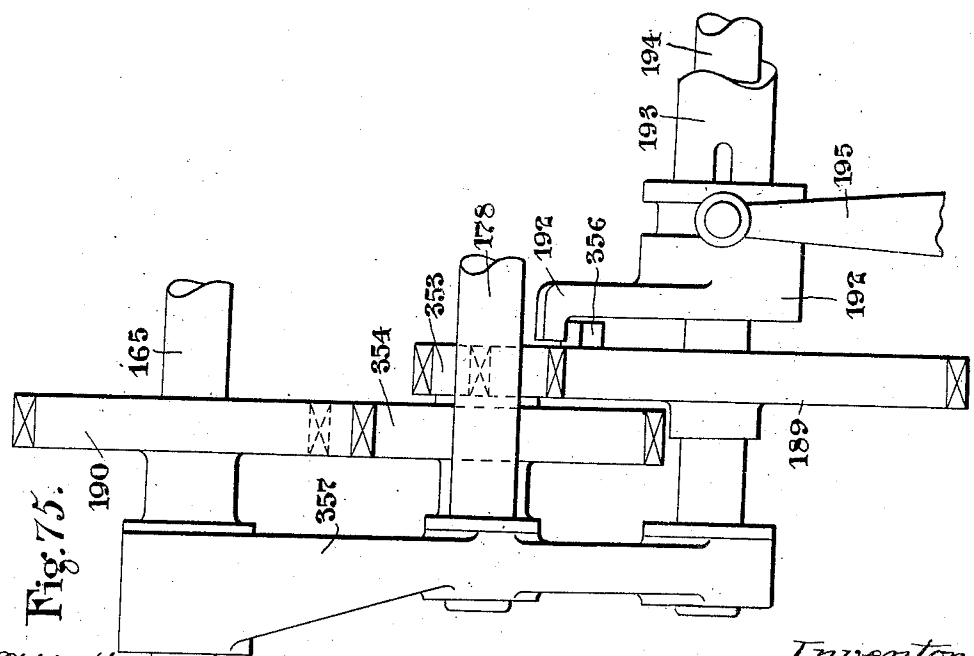

Fig. 75.

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APPLICATION FILED DEC. 16, 1909.

1,054,838.

Patented Mar. 4, 1913.

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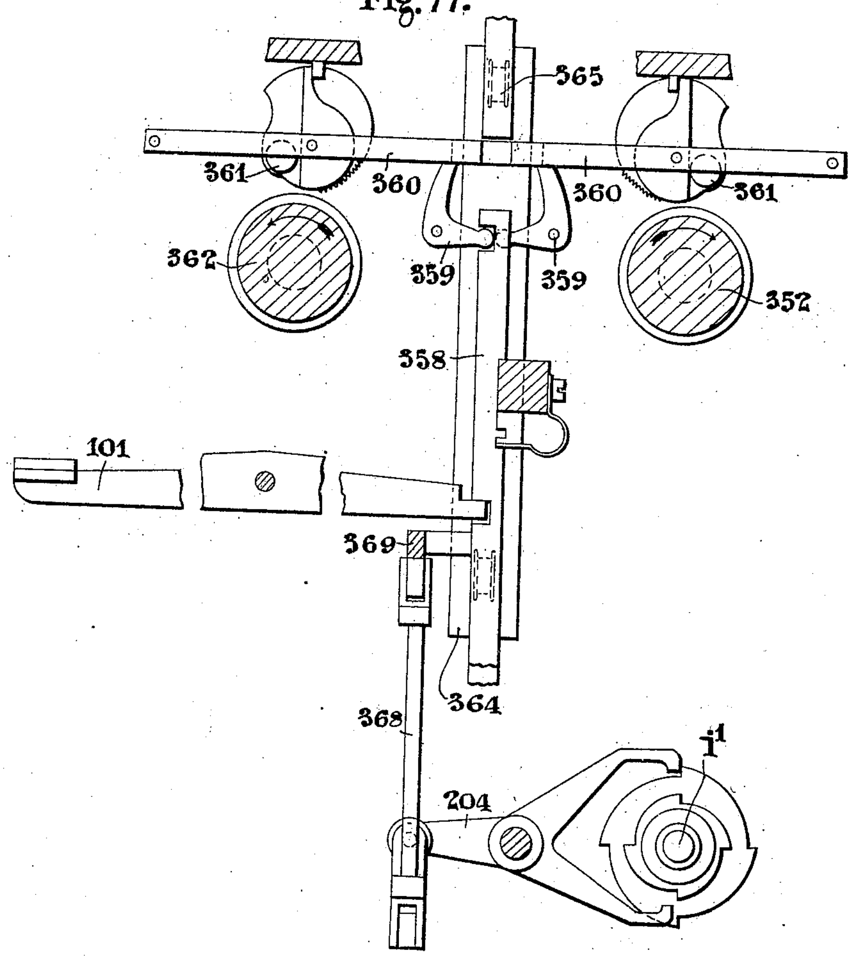
Fig. 77.



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Patented Mar. 4, 1913.

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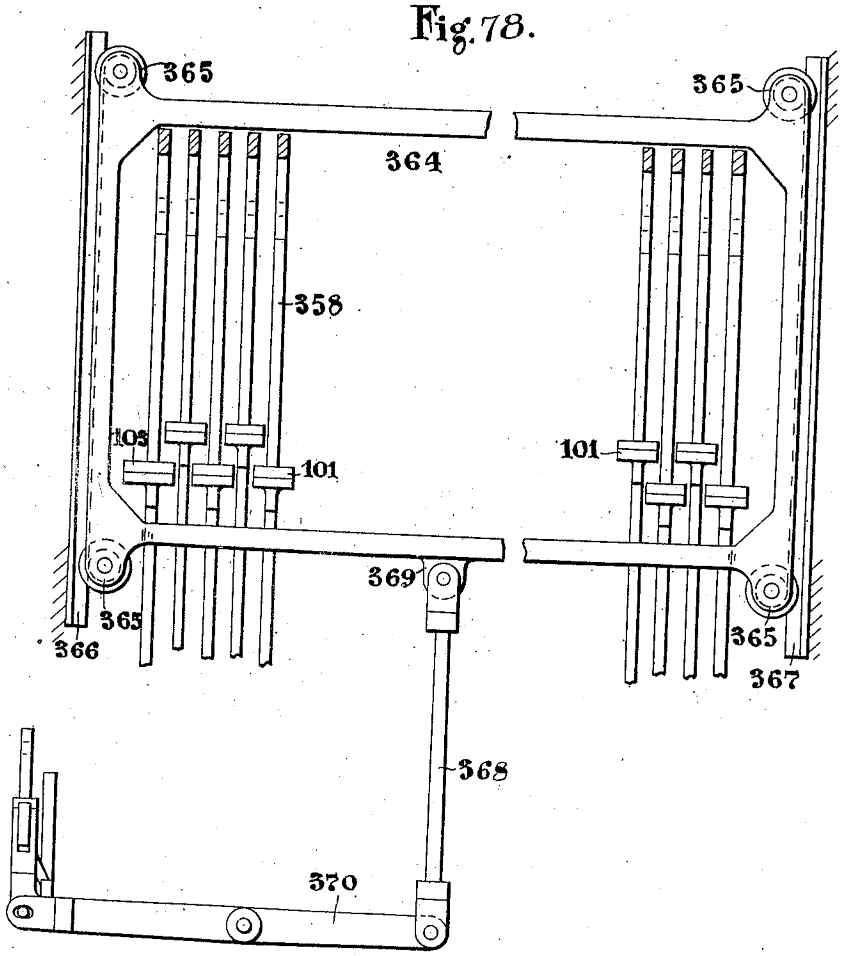
Fig. 78.



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UNITED STATES PATENT OFFICE.

JOHN CAMERON GRANT, OF LONDON, ENGLAND.

TYPE CASTING AND COMPOSING MACHINE.

1,054,838. Specification of Letters Patent. Patented Mar. 4, 1913.

Application filed December 16, 1909. Serial No. 533,405.

To all whom it may concern:

Be it known that I, JOHN CAMERON GRANT, a subject of the King of Great Britain and Ireland, residing at Albert Lodge, Albert Place, Victoria Road, Kensington, London, W., England, have invented certain new and useful Improvements in and Relating to Type Casting and Composing Machines, of which the following is a specification.

My invention relates to type casting and composing machines, and has for its object to produce in such machines a line of individual type, as opposed to a bar or slug, in an improved manner.

The production of a line of individual type by a type casting and composing machine has been proposed and carried out, but the process requires separation of the matrices after assembly and justification, and the metal to be poured for every character successively into a mold which must be successively set to correspond to each individual matrix, in which case a large number of consecutive operations are therefore required for the production of the line of type. It has also been proposed to cast a line of separate type at a single pouring, but this has rendered necessary the use of separate mold walls or divisions between each type or logotype cast.

The present invention consists in the production in a type-casting and composing machine at one operation or pouring in a single or continuous mold of a line of individual type as opposed to a bar or slug from a line of previously assembled or previously assembled and justified character matrices and space matrices without the use of separate dividing members between the matrices.

The invention further consists in producing such a line of type from a line of previously assembled or previously assembled and justified character matrices and distensible space matrices, an integral portion of the said character matrices or distensible space matrices forming one or more of the mold walls between which is produced the line of separate type cast.

The invention further consists in the improved apparatus for producing a line of individual type hereinafter described.

According to the invention the whole operation of casting the type is carried out without the employment of separate or removable walls, division slips, or mold ends between the individual matrices.

In carrying the invention into effect according to one modification I employ matrices somewhat similar to those employed for the linotype except for a unique and absolute difference in the fact that as the width of the type is no longer dependent upon the thickness of the matrix, each matrix is either made double, or otherwise proportionately greater than the set width it would otherwise have, or carries a constant additional thickness, one part of this set width being taken up with a portion of the matrix devoted to bearing the intaglio character upon a prominence and the other part, at the point where the intaglio impression occurs, being raised or extended to form a projection equal to the height of the body of the type required, and also to form at the same time a practical portion of the mold in which the line of separate types are cast, as will hereafter be more minutely explained with reference to the accompanying drawings. In addition to ordinary non-distensible space matrices and quad matrices, I employ space matrices also similar in form to the character matrices, for the purpose of line justification, these space matrices, or, as they are sometimes called, "wedge spaces," being provided with sliding wedges, but, unlike the character matrices and ordinary quad and space matrices, their normal or unextended set width is not always one-half or otherwise proportionately narrower than the entire width, for in their case the rest of the width or proportion is a constant and not a proportional thickness, as presently will be more particularly described. As in the ordinary linotype process, I select, by means of finger keys, matrices for both characters and spaces from their magazines, assembling them in proper order to form a line, but as all the character matrices and space matrices taken together are generally at least double the width of a similar number of the ordinary linotype matrices, they form a line generally at least twice as long as the line of type to be cast.

As the distensible space matrices carry a constant addition, apart from any mere proportional thickening, such as I generally use for the character matrices, I employ an assembly gage vise or its equivalent, which moves away to increase the length of the line by the necessary constant every time the space key is operated to bring down a distensible space matrix. When the whole process of assembling the character matrices and space matrices is complete, and while the line is still slightly underset, a bell rings and warns the operator, who thereupon, as in the linotype, depresses a lever which brings automatic mechanism, the purely actuating part of which forms no part of this invention, into operation. This mechanism rotates the assembly box through 90°, thus bringing the matrices into the position necessary to them when the time comes for casting; and this being done, according to one form of mechanism, they are swept on to a measuring table and the assembly box is returned into place for the next line. The line of matrices having been swept on to the measuring table, a second vise gage, which has taken its measure from the first, or assembly vise gage, receives the line of character matrices and space matrices which are held while a platform advances the wedges of the space matrices to swell out the line twice (or other suitable proportion) as far as necessary for its ultimate justification. This measuring table is mechanically connected in such a manner with the mold table that when the wedges of the spaces are pushed back by suitable means on their progress toward it, and the line of character matrices and space matrices delivered on to the mold table, on the elevation of the mold table wedge-platform to half (or other suitable proportion) of the height that the wedge-platform was advanced in the prior or measuring table, on the advancing of the mold end jaws and their closing on the line, this is accurately justified, the mold closed up, the metal pot advanced, and the cast made. The metal pot being retired, the mold is then slightly slackened, and the line of character matrices and space matrices withdrawn and passed away by suitable mechanism for distribution of the matrices into their proper and respective magazines. The mold is then closed up again, the lower tang-piece moved down, and the upper tang-piece lowered, and the jet or surplus metal broken or sheared thereby from the line of type, which on the opening of the mold is pushed out on to a type table, received by a type stick and thereby transferred to the galley, a justified line of loose or independent type produced at a single or simultaneous casting or operation of pouring. The next line follows automatically on in the same series of operations and so on successively.

The method of justification above indicated is only one example of how such justification may be accomplished. As described in detail hereinafter with reference to the drawings the mechanism may be modified in its form and action and still produce the same result. The final object to be accomplished and therefore the scope covered by the main method is in all cases the same, viz., to so adjust the distance between the mold end jaws so that with the wedges of the space matrices raised a justified line of correct length will be cast.

Three modifications of the method are described which relate to the justification of matrices of which the non-distensible ones are proportionately wider than their set width, the fourth modification dealing with matrices having constant added width.

In the accompanying drawings, for the sake of clearness, much of the merely actuating mechanism is omitted, as well as details of locking, slacking, setting gears and cut outs, as they form no part of my invention and present no features that should not be perfectly familiar to any properly qualified mechanic accustomed to the class of machine described.

In the drawings reference letters apply to like portions throughout the different views.

Figure 1 is a perspective view of a character matrix. Fig. 2 is a perspective view on a larger scale of a modification of portion of the projection. Fig. 3 is a perspective view of a distensible space matrix, or, as it is sometimes called, a wedge space. Fig. 4 is a perspective view of a quad matrix: an ordinary space matrix being in all respects the same save for the lesser set width of the prominence and a corresponding reduction of the projection. Fig. 5 is a view drawn in section, of two matrices tilted together so as to show how the prominence would be protected from contact through the action of the lengthened lugs. Fig. 6 is a general front elevation of the machine. Fig. 7 is a general side elevation of the machine. Fig. 8 is a front elevation of the delivery channels of the magazine, together with the transporting belt, star wheel and assembly box. Fig. 9 is a vertical section through the assembly box shown open for inspection of the line of matrices. Fig. 10, is a vertical section through a magazine channel showing the matrix liberating escapement; the shaft and cams for operating it, and the key for putting the particular escapement in action. Fig. 11 is a front elevation of the mechanism for automatically ringing the warning bell when the line of matrices has nearly filled its measure to the movable jaw in the assembly box. Fig. 12 is a vertical section through the assembly box before rotation. Fig. 13 is a vertical section through the assembly box after rotation. Fig. 14 is a front elevation of the assembly box after rotation into position for the transference of the type to the measuring table, together with the measuring table. Fig. 15 is a front elevation of the measuring and mold tables and attached mechanism. Fig. 16 is a front elevation of the mold table and of the line of matrices with part of the mold in position for casting. Fig. 17 is a front elevation of the mold. Fig. 18 is an end view of the mold, with the mold end jaws removed and with matrices in the position occupied when casting. Fig. 19 is a cross section of the mold opened for withdrawal of the matrices. Fig. 20 is a cross section of the mold closed after withdrawal of the matrices. Fig. 21 is a cross section of the mold with the movable tang plates in the position they occupy after shearing off the tang. Fig. 22 is an end elevation showing the matrices received on the second elevator of the distributing mechanism. Fig. 23 is an end elevation showing the matrices on the second elevator after completion of the movement. Fig. 24 is a front elevation of the receiving box for the space matrices. Fig. 25 is a cross section through the space matrix receiving box in its rotated position ready for the space matrices to be returned to their magazine. Fig. 26 is a front elevation of the receiving stick for receiving the line of type after ejection from the mold and shows the line of type in position. Fig. 27 is an end elevation of the receiving stick with the line of type in the position occupied on ejection from the mold. Fig. 28 is an end elevation showing the galley, the receiving stick in its rotated position, and the receiving table in its rotated position. Fig. 29 is a section through the galley showing the line of individual type pushed into place and the receiving table still in its rotated position. Fig. 30 is a cross section of the metal pot and pump. Fig. 31 is a plan of the metal pot and pump. Fig. 32 is a longitudinal section of the nozzle plate of the metal pot mouth; Fig. 32ª is a front view of the nozzle plate of the metal pot mouth. Fig. 33 is a cross section of the distributer box and a magazine channel. Fig. 34 is a cross section of the distributer bar showing a matrix before its release. Fig. 35 is a cross section of the distributer bar showing a matrix after its release and partially rotated by the tilting bar. Fig. 36 is a perspective view of a line of type after casting, showing the tang in position, before it is sheared or broken off. Fig. 37 is a perspective view of the tang after removal. Fig. 38 is a perspective view of the line of individual type closed together for delivery. Fig. 39 is a front view of portion of the machine as modified when the second method of justification described is employed. Fig. 40 is a part front elevation of the measuring table and of the two justifying wedges used in the second method of justification. Fig. 41 is a front view of portion of the machine as modified when the third method of justification described is employed in it. Fig. 42 is a front elevation and plan of a divided star wheel. Fig. 43 is a front elevation of the back spacing gear. Fig. 44 is a plan of the back spacing gear. Fig. 45 is a cross section of the locking device for keeping the assembly box closed. Fig. 46 is a cross section through the mold showing one method of forming the tang-break. Fig. 47 is an end view of portions of the corresponding type before and after the removal of the tang. Fig. 48 is a cross section through the mold showing another method of forming the tang break. Fig. 49 is an end view of portions of the corresponding type before and after the removal of the tang. Fig. 50 is a cross section through the mold showing yet another method of forming the tang break. Fig. 51 is an end view of portions of the corresponding type before and after the removal of the tang. Fig. 52 is a section of a distensible space matrix. Fig. 53 is a section through the measuring table. Fig. 54 is a section through the mold table, before retiring and elevating the matrices. Fig. 55 is an end view of addendum escapement gear. Fig. 56 is a section through the mold table after elevation of the matrices. Fig. 57 is a section of receiving box showing a distensible space matrix in position. Fig. 58 is an end view showing top magazine matrix clear of second elevator bar. Fig. 59 is a section of addendum escapement gear. Fig. 60 is a front view of addendum returning gear; (first and fourth methods of justification). Fig. 61 is an end view of addendum returning gear (first and fourth methods of justification). Fig. 62 is an enlarged view of space scale on assembly box. Fig. 63 is a front elevation of hinge or swing plate on justification tables showing space matrices before being raised. Fig. 64 is a front elevation of pivoted jaw of receiving stick in tripped position. Fig. 65 is an end view showing double magazine matrix received on second elevator bar. Fig. 66 is a front elevation of distensible space matrices after being raised. Fig. 67 is a section of first measuring table and hinge or swing plate. Fig. 68 is a vertical section of distensible space matrix (second, third and fourth methods of justification). Fig. 69 is a perspective view of character matrix used in the fourth method of justification. Fig. 70 is a perspective view of a space or quad matrix used in the fourth method of justification. Fig. 71 is a perspective view of a line of type with tang cast in accordance with the fourth method of justification. Fig. 72 is a front view of portion of the machine as modified when the fourth method of justification is employed. Fig. 73 is an enlarged view of portion of driving gear for mold end jaw. Fig. 74 is a vertical section of a distensible space matrix shown closed. Fig. 75 is a front view of addendum returning gear for third method of justification. Fig. 76 is an end view of addendum returning gear for third method of justification. Fig. 77 is a part section of matrix liberating gear and connection to addendum escapement for the fourth method of justification. Fig. 78 is a part front elevation of matrix liberating gear and connection to addendum escapement for the fourth method of justification. Fig. 79 is an enlarged detail of mold jaw adjustment lock.

In Figs. 1, 2, 3, 4 and 5, *a* Fig. 1 is a perspective view of a character matrix in which the strike or intaglio character (1) is shown impressed upon the prominence (2) at the top of the matrix. Immediately adjacent to the intaglio prominence (2) is the projection (3) which is of such length that the distance from the end of the deepest portion of the intaglio measured parallel to the side of the projection is equal to the height of the type required. On either side of the intaglio prominence (2) and of the projection (3) are two lugs (4 and 5) rising from the body of the matrix, *a*, and having their inner sides parallel to each other and to the sides of the intaglio prominence (2) and of the projection (3) and produced to a height sufficient to act as a shield to the edges of the intaglio prominence in any position or angle into which the matrix can be tilted when in use with other matrices as shown in Fig. 5. The lug (4) is provided with a slot or groove (6); the opposite side of the matrix (7) being generally cut away for purposes of delivery from the magazine. The opposite end of the matrix is also provided with lugs or feet (8 and 9), but these feet usually have no slots or grooves cut in them. At a suitable height upon projection (3) may be cut a groove or nick (10), or two or more grooves or nicks, upon the opposite side to which the top of the projection is beveled off at an angle (11) leaving a flat surface (12) on the top of the projection parallel to the lowest portion of the intaglio (1).

For convenience of manufacture, the matrix may be built up to two separate thicknesses of metal, the intaglio prominence (2) being produced in the one and the projection (3) formed upon the other, and the matrix so constructed may be made of two different materials to facilitate the production upon the prominence (2) of the intaglio character itself, and at the same time to provide sufficient strength and wearing capacity in the projection (3). Considering a matrix as built up of two parts, the one part (13) carrying the intaglio, and the other part (14) carrying the projection, then these portions are subsequently fixed together by rivets or other suitable means so as to form one homogenous matrix, adapted to the various guides on which the matrices are received, measure for length of line, justified and used as portion of the mold in casting. The teeth (15) are formed in one of the parts (13) or (14) and are used as in the linotype in connection with the elevation of the type matrices for delivery to the distributing mechanism and afterward for purposes of distribution. To facilitate the arrangement of these matrices in the magazine, they are cut away as shown by the notch (16) so that each matrix clears the projection of the preceding matrix in the magazine, and this clearance may be made sufficiently wide to prevent the contact of the projection (3) with the succeeding matrix when leaving the magazine. Between the lugs or feet (8 and 9) is a shallow slot (17) for retaining the matrix in place when the assembly box is opened.

Fig. 2 is a perspective view of part of the projection (3) showing a modification of the beveled portion (11) in which a step (20) is formed at the lower part of the bevel.

b, Fig. 3. is a perspective view of a distensible space matrix in which the one part (21) carries a short prominence (22) formed to enter a recess (23) on the other part (24); this recess being so formed that the short prominence (22) can be withdrawn from the part (24) to a variable extent. The part (24) carries a projection (25) which serves the same purpose as the projections previously shown on the character matrix, *a*. The two parts (21 and 24) of the space matrix can be separated to a variable extent by the action of the wedge (26) which connects the two pieces (21 and 24) by means of the dove tailed grooves (28 and 29), and the two pieces (21 and 24) are constrained to occupy the proper relative positions to each other by means of the pins (30) fixed to part (21) which slide in the tubular guides (31) fixed to the part (24) as shown in section in Figs. 52 and 74. These guides pass through a slot (27) in the sliding wedge (26) and limit the travel of the wedge when at one point in the cycle of operation; the matrices are lifted by the surfaces (32 and 33). The foot (34) is made longer than the other feet for retaining the adjustable space matrix when the character matrices are lifted to the distributer by the elevator arm.

The space matrix is shown respectively fully distended and completely closed in Figs. 52 and 74. The wedge 26 has one of its plane faces parallel to the prominence-carrying side 21 of the matrix and the other side of the wedge has also dovetails sliding in inclined grooves in the projection-carrying portion of the matrix 24. The inclination of these grooves to the plane face of the projection-carrying portion of the matrix is the same as the inclination of the faces of the wedge to each other, and consequently the outer faces of the projection-carrying portion 24 and of the prominence-carrying portion 21 of the distensible wedge space are constrained to maintain a parallel position with regard to each other. The guide tubes 31 and pins 30 prevent the vertical displacement of the projection-carrying part 24 from the prominence-carrying part 21 when the wedge is elevated.

c, Fig. 4. is a perspective view of a quad matrix which, like the ordinary or thinner space matrix resembles the character matrix in all particulars except that the prominence (40) which would carry the intaglio character is a plain flat surface, and this is nearer the end (12) of the projection (3) than is the case with the character matrix. The distance of this plain face from the end of the projection (3) is such as to give the proper body height to the quad or ordinary space cast.

Fig. 5. is a perspective view of two matrices *a a* tilted relatively to each other in a manner which might occur in use and showing how the lengthened lugs (4 and 5) prevent the edge of the strike (1) on the intaglio prominence (2) coming in contact with the projection (3) of the next matrix as referred to in Fig. 1.

Fig. 6, and Fig. 7 show respectively a front elevation and a side elevation of a type-casting and composing machine constructed in accordance with my invention in such manner as to perform the justification by the method first described. In these drawings, for the sake of clearness, the greater portion of the merely actuating mechanism which forms no part of my present invention, and which may be considered common to the class of machine which casts slugs is omitted. As is usual in machines of this class, the driving power obtained from any suitable source is applied by belt or other convenient means to the main cam shaft of the machine by a pulley *z s* or other appropriate appliance capable of being engaged or disengaged by a clutch.

By depression of any of the finger keys, (101) a character or ordinary space matrix is released from the magazine (102) and by depression of the space key (103) a distensible space matrix is released from the space magazine (104) the liberation may be performed by gear of the kind, usually employed in machines of this class as shown modified in Fig. 10. The liberated matrix as in the linotype, falls down one of the channels (105) and is received on a moving belt (106) by which it is conveyed over a star wheel or feeding mechanism *z'*, Fig. 8 into an assembly box, *g*, (which in Fig. 6 is shown in its rotated position). In the assembly box *g*, each matrix is suspended by its projecting lugs (4 and 5) Fig. 1, and is pushed toward the mold end of the machine by each successive matrix composed into the line. The touching of the space key (103) not only causes the fall of a space matrix from the magazine (104) by moving the rod (171) Fig. 8 in the usual manner in linotype machines but also releases an escapement, *i*, Fig. 8 and Fig. 55, which controls the addendum gears driven in the usual manner from the power shaft *j'* of the assembly box, *g*, and also the coördinated addendum gear, j^2, of the measuring table *k'*, Fig. 14 that mechanically records the amount of the constant upon each distensible space matrix brought down into the line, and moves the end jaw (107) of the assembly box, *g*, from the length set or zero position to the measure increased by such constant or addendum. Upon the line (partially shown) of non-distensible matrices and distensible spaces matrices, *a b c* Fig. 8 assembled in the assembly box, *g* nearly attaining the increased measure, a bell-ringing gear, *h*, Fig. 11 and Fig. 14 comes into action and warns the operator that the line is nearly complete. On completion of the line by the operator, the starting lever (108) is depressed setting in action thereby automatic gear which as pointed out above is similar to gear hitherto employed; the assembly box, *g* as shown in Fig. 12 is now automatically rotated by a member of this gear upward through ninety degrees, so as to occupy the position shown in Fig. 13 and to bring into proper position for casting, with the projections (3) horizontal the matrices which have previously been received from the magazine (102) into the assembly box, *g*, having their projections (3) in a vertical position, Fig. 12. When the assembly box *g*, has reached its rotated position, also shown in Fig. 14 a sweeper *y*, Fig. 6 actuated on an arm or plunger as in known mechanism sweeps the matrices from the assembly box, *g*, along the race ways (109) Fig. 14, the assembly box, *g*, is thereupon returned by its operating gear to its normal position Fig. 12 ready for the composition of the next line and the starting lever (108) Fig. 6 becomes automatically locked in the usual manner. Coördinated with the return of the assembly box, *g*, that portion of the measuring gear, *j'* necessary for recording the increased measure due to the addenda of the distensible space matrices in the new line is returned by its gear to its zero position, the remainder of the gear used for recording the addenda remaining locked until the completion of the cast and withdrawal of the mold end jaws, where after that portion of the addendum recording gear is caused to travel to its extreme limit by means of sector or other gear of known form and is then permitted to return to a position determined by a stop carried on the assembly box, g, addendum gear sector, thereby coordinating the further movement of the recording gear with the movement of the vise jaw of the assembly box which may now be in the course of advancing to record the addenda of matrices added in the composition of the new line. The composition of the new line can therefore be commenced without further loss of time, as in the ordinary linotype. The matrices, a b c are carried by the sweeper arm, y, along the fixed raceways (109) on to a measuring table, k' the vise jaws (110 and 111) (shown also on Fig. 14) of which have been set by the assembly box recording gear, j' j^2, to the increased measure corresponding to the total addenda in the line composed; this measure remains locked till the completion of the cast, when the starting lever (108) is automatically unlocked; the vise jaws (110 and 111) of the measuring table k' which have been set to the increased measure as described, are now advanced by usual means suitable for the movement toward the metal pot to contain the line of matrices a b c as shown by the dotted lines Fig. 53, and the measuring table, k' (shown also on Fig. 53) is elevated by the gear, l', Fig. 6 hereinafter described in detail, and thus raises the wedges (26) of the distensible space matrices, b, to fill the increased measure set between the vise jaws (110 and 111) of the measuring table, k'.

The amount by which the gear, l', on the measuring table has been moved is recorded on the coördinated gear l^2, of the mold table, x', Fig. 16 which is elevated to one half (or other suitable proportion) of the height to which the wedges (26) were elevated on the measuring table k'; the matrices are then released from between the vise jaws (110 and 111) of the measuring table k', by lowering the table, and by the action of the depressor bar (112) which descends to its dotted position Fig. 53, the wedges of the distensible space matrices are restored to normal. After the withdrawal of the vise jaws (110 and 111) from the line of matrices, these are carried forward by a sweeper, y^2, Fig. 15 into the mold, m, Fig. 17 whose end jaws (115 and 116) are then advanced toward the metal pot to embrace the line which now occupies the proper measure; and the end jaw (116) is now closed on the line of matrices.

The mold top and bottom jaws (113 and 114) Fig. 18, hereinafter described in detail and operated by a usual form of gear are now closed on the projections of the matrices and on the mold end jaws (115 and 116) Fig. 16. The melting pot n Fig. 30 is advanced to make contact with the tang blocks (117 and 118) Fig. 19; the pump, plungers (119—124) Fig. 6 and Fig. 30 which have been previously raised by the action of the cross-beam (132) Fig. 30 common to the whole of the plungers, acting on the springs (125—130) are depressed also under the action of the cross-beam on the springs (134—139 Fig. 30) making the cast. In the event of any plunger (119—124) sticking, the springs (134—139) come into play and prevent damage to the particular plunger or to the operating mechanism. The metal pot, n, is now withdrawn from the tang blocks (117—118), the mold top and bottom jaws (113 and 114) and also the mold end jaws (115 and 116) are slackened, the horizontal line of character matrices and space matrices is withdrawn by a retiring movement of the mold table race-ways, u, u', u^2, u^3, Fig. 54 which, by a second and vertical movement, elevates them into position for sweeping into the receiving box, w, and on to the ribbed receiving bar, r, of the elevating arm, o. The distensible space matrices having no teeth, are not elevated, but are each retained by the lengthened lug (34) Fig. 3. They are then swept forward by gear of usual form into a rotatable box, p, which by rotation through ninety degrees, hereinafter more fully described brings them into the proper position for sweeping through the raceways of the box, p, p' and p^2 Fig. 25 back into their magazine (104). The character and ordinary quad or space matrices are re-conveyed to their respective chambers in the magazine by means analogous to those employed in the ordinary linotype. After the matrices have been removed from between the mold end jaws (115 and 116) Fig. 16, and from beneath the character type and space type forming the justified line cast, the top and bottom mold jaw (113 and 114) Fig. 18 are now reclosed on the line of justified type, the lower tang block (118) Fig. 18 is retired, and the upper tang block (117) Fig. 18 depressed thus breaking off the continuous tang or surplusage of metal from the line of type against the edge of the bottom mold jaw (114) Fig. 18. The tang, ~~now~~ liberated, on the further movement of the lower tang block (118) drops clear. The top and bottom mold jaws (113 and 114) Fig. 18 are now slightly opened and the line of type is closed up and pushed out on to a receiving table, q, Fig. 27 by a plunger of usual form having a reciprocating movement; the mold is now restored to its normal position in readiness for the next line, and the locking gear which locks the recording gear, j^2, and the starting lever (108) is released by the return movement of the plunger, which also sets in motion by a usual form of trip the rotating arm, r' which carries gripper gear, r, Fig. 26 which automatically grips the line of justified type t, as hereinafter described; the table q is automatically rotated away, and the type conveyed by the continued rotation of the arm r' into the galley, s, into which it is pressed home; the jaws of the gripper are then automatically released, and the arm, r' and the table q, return to their normal positions in readiness for the next line. The positions occupied by the type table and gripper gear are also shown in Fig. 27 and Fig. 28 by dotted lines.

It must be remembered that the character matrices, a, Fig. 1 and the space and quad matrices, c, Fig. 4 employed in the first three methods of justification have a projection equal in thickness to, or bearing a definite ratio, to the set width of the character, space, or quad to be produced. The distensible space matrix shown in its normal position in section in Fig. 74 shows the normal protrusion of the prominence (22) by the dimension (35); the dimension (36) is equal to or of a definite ratio to (35) as shown by dotted line (54). Deducting the dimensions 35 and 36 from the total thickness of the matrix, a remainder 37 of the projection (25) is left and this forms the addendum. It should further be noted that in the first method of justification just described, the wedges (26) of the distensible space matrices, b, Fig. 3 are elevated on the measuring table to double (or otherwise suitable proportion) the height which they will occupy when justification has been effected at the mold before casting and therefore the prominence (22) and the recess (23) which receives it must be of greater depth than is required in the second, third, or fourth methods of justification hereinafter described in which the wedges of the distensible space matrices, b' are not elevated above the height which they occupy when justification has been effected before casting.

Parts of a machine modified so as to employ the second method of justification are shown in Fig. 39. The preceding description however of a machine employing the first method of justification, as far as the words "the starting lever is automatically locked" will equally serve for the description of the second method. The difference commences when the line of composed matrices has been swept from the rotated assembly box, g, on to a measuring table.

Fig. 39 shows that part of the mechanism which essentially differs from the mechanism employed in the first method of justification; (the front and side elevations given in Fig. 6 and Fig. 7 being views of a machine designed in accordance with the requirements of the first method of justification). The matrices after being received in the assembly box g, having an adjustable jaw (107) Fig. 39 are passed on to a measuring table, k^2, one vise jaw of which (110) is in position between the race-ways (109) Fig. 53, the second vise jaw (151) which is adjustable being brought into position by usual gear between the race-ways (109) when the matrices are in place. Now, however, instead of elevating the wedges in the wedge spaces, b, a single wedge (150) Fig. 40 acting against the abutment (151) of a measuring vise (152) Fig. 39 on the measuring table, k^2 is elevated by any suitable gear. The movable jaw (110) of the vise (152) has been moved by an attachment or addition, j^2, to the same mechanism, j' that operates a jaw (107) of the assembly box, g, for the addendum of each adjustable space matrix. A prolongation of this gear, j^3, operates the one end jaw (116) of the mold, m. The other jaw, (154) Fig. 40 of the mold, m, is distended by means of an elevating wedge (153) to an amount equal to one half (or other suitable proportion) of the amount that the jaw (151) of the measuring vise (152) was distended by the wedge (150) on the elevation of the measuring table, k^2. The jaws (110 and 151) of the measuring vise (152) are now retired and the matrices swept to the mold, m, the end jaws of which (116) and (153) are now advanced toward the metal pot to the casting position, the jaw 116 being moved first. The amount by which the matrices do not fill the new measure set between the mold end jaws (116) and (153) is taken up by the elevation of the wedges of the distensible space matrices which are raised by the mold table, x^2, to complete the justification. In the second method of justification illustrated in Fig. 39 the two wedges 150 and 153 are elevated simultaneously. The inclination to the vertical of the inclined face of the wedge 150 is double that of the wedge 153 as clearly seen in the enlarged Fig. 40. The elevation of both wedges is the same in extent, but the horizontal movement of the measuring wedge jaw 150 is double that of the wedge of the mold jaw 153. In this method of justification the wedges of the distensible space matrices are down during the operation of measuring and are only elevated when the matrices are in front of the mold after the measuring has been effected and the mold jaw set by the wedge 153 to the correct position. The further processes for the completion and delivery of the line of finished and justified type are the same as those already given in the description of the first method of justification.

It is obvious that by relatively altering the inclination of the faces (150) and (151) and (153) and (154) of these jaw distending wedges respectively, they may be arranged so that both may be elevated to the same extent, but that the amount by which the jaw (154) of the mold, *m*, is distended is one half (or other suitable proportion) of the distance by which the movable jaw (151) of the vise (152) of the measuring table, k^2, is distended, as shown in Fig. 39. The table, k^2, is here shown in one piece, and is further shown in detail and enlarged in Fig. 40 with some parts broken away and removed. Parts of a machine so modified as to employ the third method of justification are shown in Fig. 41.

By depression of any of the finger keys (101) Fig. 5 a character or ordinary space matrix is released from the magazine (102) and by each depression of the space key (103) a distensible space matrix is released from the space magazine (104). The liberation may be performed by gear usually employed in machines of this class, as shown modified in Fig. 10. The liberated matrix, as in the linotype, falls down to one of the channels (105) and is received on the receiving belt (106), by which it is conveyed over a divided star wheel, z^2, Fig. 42 into the assembly box, *g*, Fig. 41 into which projects a vise jaw (160) which by the action of the escapement, *i*, and the screw (164) recedes from the feeding mechanism by an amount equal to the addendum of each space matrix delivered into the assembly box, *g*, (which is shown in its rotated position in Fig. 41). This jaw carries an auxiliary lever and gear similar to that already described, (161) and *h*, respectively, Fig. 11 for ringing the warning bell when the measure of the line is nearly reached. If it is desired to correct the line and to use the back-spacing gear, *z y*, Figs. 43 and 44, this can now be done. When the operator considers the line complete, he moves the starting lever (108) Fig. 6 thereby elevating through the medium of usual gear at the matrix delivery end of the assembly box, *g*; Fig. 41 an abutment (162), suitably formed to clear between the halves of the divided star wheel, z^2, or to pass on each side of a narrowed star wheel. The abutment (162) is held in its raised position against the downward pressure of the spring (183) by the latch (184) connected by the link (185) with the interlocking lever (180). A simultaneous movement elevates the stop (172) which is shown also in Fig. 43 engaging with the halves of the coupling (173) (174): this coördinates the movement of the screws of equal pitch (164) and (165) respectively, and the action of the stop locks both the two screws (164) and (165).

The spring propelled sector (175) drives the pinion (176), fixed to the feathered shaft (178) and with it the pinion (177) and the coördinating pinion (179). The pinion (177) gears with a pinion (58) Fig. 41 formed on the nut (166) on the screw (164) and travels with the nut (166) in its lateral movement by means of a forked bracket or its equivalent (64) formed on the assembly box vise jaw (160); the pinion (179) similarly gears with a pinion (59) formed on the nut (167) on the screw (165) and travels with the mold end jaw (169) driving it by means of a forked bracket or its equivalent (67) through a distance one-half (or other suitable proportion) of the distance moved through by the assembly box vise jaw (160), the gears (58) and (177) and (59) and (179) being made of suitable ratios for the required reduction of travel. In this third method of justification, as in the first and second methods above described, each matrix carries a projection of equal thickness to the type to be cast from it, consequently, apart from the wedge spaces, which must be considered separately, the length of the line of matrices is double the length of the line of type to be obtained. If the jaws of the assembly box are set to a given width and the matrices are short of this width by a given difference the total amount by which the spaces of the line to be cast must be increased must be one half of this difference to insure a casting of the proper length of line to fill the actual measure and not the double measure to which the matrices must be set. On the line of matrices being gripped by the action of the sector (175) the left hand mold end jaw (169) is advanced toward the metal pot, the sector (175) is automatically locked by any suitable means (not shown) such as a cam and the interlocking lever (180) acting on the link (181) and the clutch arm (182) at the same time causes the abutment (162) to drop, disengages the half coupling (173) which slides on a feathered portion of the prolongation of the screw (164), from the half coupling (174) and from the stop (172) and enables the screw (164) to be slackened and rotated back to its zero position after the assembly box, *g*, has been automatically rotated and the matrices swept to the mold. The revolutions of parts thereof of the screw 164 when disengaged from the screw 165 (while the composition of a second line has taken place simultaneously with the casting of the preceding line) are recorded by the pinion 187 keyed to the screw 164 which drives the sector 186. When the stop 192 is disengaged from the sector 189 the sector 186 independently records the angle of rotation of the screw 164. This enables the screw 165 to be set to the correct corresponding angle of rotation by engaging the stop 192 after the sector 189 has fully rotated backward, and on the sector 189 being allowed to rotate forward it comes in contact with the stop 192 which has been returned to the left, thereby coördinating the two screws and thus permitting them to be connected by the coupling 173, 174 in the relative position they would have occupied if the screw 165 had been connected throughout the operation to the screw 164. The screw (164) is restored to its zero position by the sector (186) driving the pinion (187) which is keyed to the screw shaft (164) and limited in its travel by the fixed stop (191). The movable stop (192) feathered to sleeve (193) on the shaft (194) to which sleeve is keyed the sector (186) is withdrawn from the sector (189) by the lever gear (195), thereby permitting the sector (186) to record, if required, a larger number of addenda in the new line being composed than were composed in the line being cast. As the stop 192, which is feathered to a hollow shaft 193, is withdrawn by the lever 195 from the sector 189 it is possible for the sector 186 to be rotated through a greater angle than the maximum previously attained in the preceding setting when the screw 165 was set to embrace the line of matrices. The nut (166) remains locked by the pinion (177) on the shaft (178) of which the gear (176) remains engaged with the locked sector (175). The vise jaw (160) of the assembly box g, will therefore occupy a position closer to the abutment (162) than its zero or normal position, by the amount which it was closed on the line just composed.

The operator can make the backward movement of the starting lever 108 Fig. 6 in two stages as desired, the first stage releasing the measuring gear and causing the measuring and elevating of the assembly box to take place, while the second stage returns the assembly box g to its normal position after rotation and the composition of the next line can now be at once proceeded with as in the linotype machine.

The line of matrices which has been swept into the mold against the mold end jaw (169) is now embraced by an advancing movement of the right hand mold end jaw (170) toward the metal pot, n. The wedges of the distensible space matrices are now elevated by the mold table x^3 and this effects the justification of the line. The operations of closing the mold, advancing the metal pot, making the cast retiring the metal pot and slacking the top and bottom mold jaws are the same as in the previously described methods. The slacking of the mold end jaw (169) is performed by the lowering of the stop (172) releasing the half coupling (174) and permitting the automatic operation of the sector (189) which is caused to travel to its extreme backward extent, thereby driving the pinion (190) which is keyed to the screw shaft (165) to its full extent and opening the mold end jaw (169). The mold table x^3 is now lowered, the mold end jaws (169) and (170) retired the matrices withdrawn from the mold and from the cast, elevated on the first elevator, u Figs. 54 and 56 ready for removal by the second elevator arm o, Fig. 6 and thence to the distributing gear. The mold top and bottom jaws are again closed on the type as in the first and second methods, the tang sheared or broken off and the line of justified type transferred to the type table, the type stick, and thence to the galley as in the previously described methods. The sector 189 runs on the shaft 194 and does not move laterally relatively to it or to the sleeve or hollow shaft 193 which carries the sector 186. The stop 192 which slides on the hollow shaft 193 is used to limit the arc of rotation of the sector 189. The sector 189 may be caused to move to the end of its travel by one of the main cams of the machine in any well-known manner, and may be caused to return to the stop by spring or other well-known means.

When the sector (189) has been moved to its extreme position, the movable stop (192) is allowed by movement of the lever (195) to slide on the feather way on the sleeve (193) and to reëngage with the sector (189) which travels till it comes in contact with the stop (192) and the amount of rotation from its zero position of the screw (165) is the same as the amount of rotation from its zero position of the screw (164). The sector (186) keyed to the same sleeve as the movable stop (192) records the rotation from its zero position of the screw (164) corresponding to the number of addenda in the line being composed. The movements of both sectors now record the total amounts of the addenda on the distensible space matrices in the new line partially or completely composed. After the sector (189) has come in contact with the movable stop (192) the half coupling (173) is engaged with the half coupling (174), the correct relative position of the screws (164) and (165) having been insured by the movable stop (192) on the sleeve (193) acting on the sector (189) and by the sector (186). The sector (175) is now unlocked and rotated until it meets the stop (196) causing the rotation of the shaft (178) and by means of the pinions (177) gearing into the pinion (58) and (179) gearing into the pinion (59) it re-sets the nuts (166) and (167) respectively to their zero positions in readiness for the operation of justifying the line now being composed. The measure set in the jaws up to this time is short of the true measure by the amount of movement made in justifying the preceding line but the nuts (166) and (167) are restored to their zero position immediately after the cast of the previous line is made so that no retardation of the composition of the succeeding line need occur.

In Fig. 72 are represented the necessary portions of a machine constructed in accordance with my invention in such manner as to perform the justification by my fourth method. In this drawing, as elsewhere, for the sake of clearness, the greater portion of the merely actuating mechanism which forms no part of my present invention and which may be considered common to this class of machine, is omitted. By depression of any of the finger keys (101) Fig. 6 a character or ordinary space matrix is released from the magazine (102) and by depression of the space key (103) a distensible space matrix is released from the space magazine (104). The liberation may be performed by gear of the kind usually employed in machines of this class, as shown modified in Fig. 10, but in this method of justification the escapement, i' Fig. 72 is coordinated with the matrix liberating gear for all matrices including the distensible space matrices, in such manner that the liberation of any character matrix or distensible space matrix is accompanied by the liberation of the addendum escapement, i'; and in place of the screws for adjusting the assembly box jaw and the mold end jaw to record the addenda of the matrices added, I may employ a ratchet escapement of some well known pattern such as is employed for a similar purpose in typewriters, in which the carriage advances for each key depression though in the present case the assembly box and mold end jaw addendum recording gear advances for each matrix released. The liberated matrix, as in the linotype, falls down one of the channels (105) and is received on a moving belt (106) by which it is conveyed over a star wheel or feeding mechanism z' Fig. 8 into an assembly box g, which is substantially the same as those described in the first and second methods of justification. In the assembly box each matrix is suspended by its projecting lugs, as already described, and is caused to travel toward the mold end of the machine as each successive matrix is composed into the line. The release of the escapement i' Fig. 72 controls the gear, j^4, j^5 that mechanically records the amount of the constant or addendum upon each matrix brought down into the line, and moves the end jaw (107) of the assembly box, g, from the length set or zero position to the measure increased by such constants or addenda. Upon the line of ordinary or distensible space matrices, a' b' c', assembled in the assembly box, g, nearly attaining the increased measure, a bell-ringing gear, h comes into action and warns the operator that the line is nearly completed. On completion of the line by the operator, the starting lever (108) Fig. 6 is depressed, setting thereby the automatic portions of the machine in action. The assembly box g, is now automatically rotated through ninety degrees, so as to occupy the position in which the matrices have their projections horizontal and in the proper position for casting. When the assembly box, g' has reached its rotated position, the mold addendum gear j^5 is locked and disconnected from the assembly box addendum gear j^4. The mold end jaw (95) is advanced toward the metal pot to position the matrices swept from the assembly box, g, by the sweeper y so as to abut against the jaw 95, the other mold end jaw (96) is now similarly advanced to position, and the wedge spaces elevated to fill the measure, as in the linotype machine. The coördinated gear, j^4 of the vise jaw of the assembly box which has been disconnected, is now returned to its zero position, whereupon the assembly box is restored to its normal position, and composition of the new line can be commenced.

The following sequence of operations is the same as in the first and second methods of justification: The mold top and bottom jaws closed; the top and bottom tang pieces brought into place; the cast made; the mold opened; matrices removed; mold closed again; the tang sheared or broken off; the line of justified type swept to the type table, type stick and galley; the matrices elevated and passed to the receiving box; elevated to distributer and distributed through magazines. When the mold end jaws (95) and (96) Fig. 72 have been withdrawn from the mold, the movable end jaw (95) is caused by the operation of the slip belt driven reversing gear, z t, to move to the extremity of its travel and then to return to a position determined by a stop 356 carried on the assembly box addendum gear sector 189, thereby coördinating the further movement of the mold end jaw with the assembly box jaw.

The slip belt driven reversing gear, z t, for the mold end jaw (95) consists of a screw (97) driving into the prolongation of the support (98) of the mold end jaw (95). This prolongation carries a trip lever (99) which engages with the vertical arm (100) connected to the link (143) which in turn is connected to and operates the lever (144) engaging with the clutch coupling (145) and causing it to become disengaged from the pulley (146) and to become engaged with the pulley (147), thus driving the screw (97) by its attached spur gear (148) by means of the pinion (149) and causing its return till the mold jaw support (98) is arrested in accordance with the position of the stop 356 on the assembly box addendum gear sector.

It must be remembered that in the fourth method of justification described above, unlike the three preceding methods of justification, the character matrices, a' Fig. 69

and the space or quad matrices, c' Fig. 70 carry a constant (and not a proportional) thickness of projection (55) and (56) respectively, and that this constant thickness is equal to the total thickness (57) Fig. 68 of the projection of the space matrices, b'.

The matrices shown in Figs. 69 and 70 have the addendum or thickness of the projection-bearing part constant. In Fig. 69 the character bearing portion is thinner than the addendum, and in Fig. 70 the space or quad-forming portion carrying the prominence is thicker than the projection carrying the addendum. In respects other than the relative thickness of the projection-bearing part and the character-bearing part these matrices are exactly similar to those used in the first three methods of justification and illustrated in Figs. 1 to 4.

Fig. 8 and Fig. 9 show in detail the assembly box wherein the matrices are first received. The assembly box, g, Fig. 9 is capable of being rotated by the assembly box shaft (211) to which it is attached. It is provided with the fixed guides (212) and (213) on which the matrices rest, and also with the sliding guide (214) which can be elevated by means of the sliding guide lever (215) which turns on the pivot (216), and of which the end (217) passes through a slot in the sliding guide (214). Pivoted to the assembly box frame (218) by the pivot (219) is the front guide frame (220) carrying the front guide (221). This is shown in its dropped or open position in Fig. 9 and in its closed position in Fig. 12. It is retained in its closed position by the ball lock, $z\ x$, shown in detail in Fig. 45. The ball lock $z\ x$ is carried in the ball lock boss (222) in the assembly box front guide frame (220). The ball (224) is pushed outward by the action of the ball lock ring (223) and engaged with a depression in the assembly box frame (218) when holding the guide frame (220) in its place. On the bearing bracket (209) Fig. 9 is formed a small projecting foot (210) which serves to steady the matrices on their fall from the belt (106) Fig. 8 into the assembly box, g, until they have been received by the action of the star wheel, z' or z^2 on to the guides (212) and (221) Fig. 12 where they hang by their projecting lugs or feet as shown in Fig. 12 so long as the projection (3) is in its vertical position, but upon the surfaces (18) and (19) bearing upon the guides (214) and (213) respectively when the assembly box has been rotated to bring the projection (3) into the horizontal position required for casting.

Fig. 10 shows the matrix liberating gear which is operated by the finger key (101) through an intermediate gear as in the linotype; and an escapement (225) which permits the matrices, a, to feed forward one at a time down the magazine channel (102) under the action of gravity; the escapement stops (226) and (227) retain the matrices by engaging with the foot (5) Figs. (65 and 58). Where a double magazine is used, this is effected with a duplicate escapement (228) acting by means of the stops (229) and (230) on the upper lugs (4) Fig. 58 of the matrix. In this case the matrices, a^2, a^3 are arranged with the teeth (15) nearer the opposite side than in the single magazine matrix shown in Fig. 1 and with the notch (6) continued across so as to leave the lugs (4) and (8) projecting above the remainder of the surface just as the lugs (5) and (9) project beyond the surface (7). The matrices for the top and bottom magazines, a^3, a^2 are shown in Figs. 58 and 65 respectively. The matrices a^3 intended for distribution to the second magazine carry an additional notch (331) Fig. 58. In passing to the distributing bars, the one set of matrices, a^2 are carried on the bar (332) and engage with the first distributing bar, $z\ v$, the other matrices, a^3 for the upper magazine shown in Fig. 10 traveling on the same surface of the bar (332) Fig. 58 present their teeth (15) at a level below that of the distributing bar, $z\ v$ with which they do not engage, and drop by gravity into an elevator box or are conveyed by other suitable gear to the second distributing bar as in the linotype machine.

The bell-ringing gear, h, as shown in Fig. 11 is common to the first three methods of justification described, and is so arranged that the warning bell is rung when the line is nearly completed on the first matrix reaching a definite position in respect to the movable jaw of the assembly box irrespective of the position which that jaw may occupy at the time.

The addendum recording gear, j' Fig. 11 or (164) Fig. 41 or, j^4, Fig. 72, moves the assembly box vise jaw (107) Fig. 11 forward by a constant amount for each distensible space matrix added in the line. Pivoted to the jaw (107) is the lever (161) Fig. 12 bearing the projection (231) Fig. 11 against which the first matrix bears when the line is filled nearly to the jaw (107). The arm (161) Fig. 12 is keyed to a spindle (232) to which is also keyed the bell crank lever (233). The upper end of the bell crank (233) carries a stop which strikes against a portion of the arm (107) and limits the travel of the bell crank; the lower end of the bell crank (233) carries a projecting pin (234) which can travel in the slotted bar (235) Fig. 11 as the jaw (107) moves in common with the action of the addendum recording gear. The slotted bar (235) is pivoted at the one extremity to the link (236) Fig. 11 and at the other end to the lengthened link (237) which carries a counter weight (238) to partially counterbalance the slotted bar (235). The prolongation of the slotted bar (235) carries a pawl (239) pivoted thereto, which normally rests on the stop (240); the links (236) and (237) are pivoted on a fixed portion of the machine as also is the bell ringing hammer (241) which strikes the bell (242) when released under the action of gravity. When the lever (161) is moved to the left by the pressure of the matrix against the projection (231), the lower arm of the bell crank (233) lifts the slotted bar (235), the pin (234) sliding in the slot in the bar (235) and permitting this to follow the rocking motion of the links (236) and (237). In the forward and upward movement of the slotted bar (235) the pawl (239) encounters the projection (243) on the bell ringing hammer (241) moving the weighted end of the hammer away from the bell (242) and in its further movement tripping the projection (243) and allowing the hammer to strike the bell (242). On the line being removed from the assembly box, the bell crank (233) returns by the freeing of the projection (231), and the slotted arm (235) returns to its normal position by the rocking movement of the links (236) and (237), the pawl (239) in its travel is elevated by the projection (243) on the bell-ringing hammer (241) and tripped, returning to its normal position against the stop (240) by the action of gravity or a spring. In the fourth method of justification the same gear may be employed as shown in Fig. 72, though in this case the jaw (107) advances for each matrix added to the line.

Figs. 12 and 13 show in detail the movements of the assembly box: When the line of matrices has been assembled (and in the third method of justification already described, measured) in the assembly box, it is partly rotated through ninety degrees from the position shown in Fig. 12 as indicated by the dotted lines in Fig. 13 to bring the matrices into position for casting with the projections (3) horizontal. In the down or normal position of the assembly box, the matrices are carried by the lugs (5) and (4) on the guides of raceways (212) and (221) respectively and hang suspended therefrom. In the up position the matrices are carried on the internal faces (18) and (19) Fig. 1, and hang suspended from the raceways (214) and (213) respectively. In the up position they are guided laterally by the raceway (221) which engages with the notch (6) Fig. 1 and in this position they are ready for the action of the sweeper, y, Fig. 14, by which they are swept forward on to a measuring table; (or in the third method of justification, already described, into the mold. This also is the case in the fourth method of justification.

In Fig. 14 which is given for the sake of clearness, the relative positions are plainly set out, of the addendum recording gear, j'; bell ringing gear, h; assembly box, g, in its rotated position with portion of a line of matrices, a b c, in place; space matrix liberating rod (171) and space matrix magazine (104), and the measuring table, k'. These parts have been particularly described elsewhere.

The elevating gear for the measuring and mold table is shown in Fig. 15 in the general description of the first method of justification, the elevating gears l', and the coordinated elevating gear, l^2, for elevating the wedges of the distensible space matrices are mentioned. These are shown enlarged in this figure. A bracket (244) is fixed to the machine and carries a shaft (246) fixed at one end to a spur pinion (247), with at the other end a bevel pinion (248) fixed to it; the spur pinion (247) can be rotated by the action of the sector (249); such rotation drives by the pinion (248) the bevel pinion (250) formed in one piece with or fixed to the nut (251) which is capable of rotating in the bracket (244). The nut (251) is formed with a shoulder or collar (252) on its upper end to bear on the bracket (244); the rotation of the pinion (250) thus causes the screw (253) fixed to the crossbeam (254) to be elevated. The crossbeam carries at its two ends pillars (255) and (256) attached to the measuring table, k' which participates in the vertical movement of the crossbeam (254). Coördinated with the sector (249) is the sector (257) which gears with the spur pinion (258) fixed upon the hollow end of the shaft (259) which is supported by the prolongation of the shaft (246) and by the bracket (254). Keyed to the shaft (259) at its farther end is the bevel pinion (260). The bevel pinion (260) gears with the bevel pinion (261) formed in one piece with or fixed to a nut which carries the shoulder or collar (262). The rotation of the bevel pinion (261) causes the elevation of the screw (263) (which is of one-half the pitch (or other suitable proportion) of the screw (253)). In this the first method of justification the matrices, as above described, carry a projection-bearing part of a width equal to the character to be cast and it follows that the amount by which the line does not fill the double measure will be double the amount required to be added to the aggregate of the spaces to be cast in order that these may fill the line. Since the increase of width of the matrices is proportional to the height to which the wedges are elevated it is necessary before closing up the line on the matrices preparatory to casting that the wedges should be elevated to only one half the height to which they are elevated in the measuring vise. This may be conveniently effected by lifting both tables by means of screws, as above described, making the same number of revolutions, but so proportioned that the screw for the mold table has a pitch one half of that of the screw for the measuring table, as above described. The screw (263) is fixed to the crossbeam (264) which carries the pillars (265) and (266) attached to the measuring table x' of the mold. In performing the justification of the line, the sector (249) is rotated by means of a slipping belt, spring pressure, or other suitable means, so as to rotate the pinion (247) and thereby elevate the table k', until the wedges of the distensible space matrices have filled the line.

In its movement for elevating the table, the sector (249) carries with it the sector (257), and on the sector (249) coming to rest, the sector (257) is locked, and remains locked until the cast is completed. The sector (249) is disengaged and returns to its zero position, carrying back with it the crossbeam (254) and with it the table k'. By separate automatic mechanism of usual form a depressor bar (112) is now lowered so as to restore the wedges of the distensible space matrices to their lowest, or normal, position. After withdrawal of the jaws (110) and (111) of the measuring vise (140) the matrices can be swept to the raceways, u', u^2, u^3. As the table, x', is now at a higher level than the table, k', the wedges of the distensible space matrices are raised by the partial rotation of the swing plate (141) Fig. 63, pivoted by the pin (68) to the mold table, x'. The elevation of the swing plate rod (69) brings the upper surface of the swing plate (141) to a horizontal position and raises the wedges of the distensible space matrices to the height of the table, x', Fig. 66, on which they rest elevated to the position they must occupy for giving correct justification to the end jaws of the mold when closed to embrace the line. After the cast is made, the sector (257) Fig. 15, is unlocked and returns toward its zero position, rotating the pinion (258) and thereby rotating the nut (261) and lowering the table x', to its normal position; the swing plate rod (69) Fig. 63, is then lowered and the swing plate (141) falls with it; the sector gear comes to rest in its normal position ready for the next line to be justified. When the sector (249) is returned to zero, the addendum recording gear, j^2, which has been locked by (142) is moved to its extreme limit and then released allowing the recording gear, j^2, and with it the jaw (110) to return under the action of a spring, weight, or other suitable means to its zero position or to such position in advance of the zero as may be occupied by the addendum recording gear j' of the assembly box.

Figs. 15 and 79 show adjustments for varying the length of line cast with the first method of justification in which the assembly box vise jaw can be closed by altering the engagement of the gears so that the screw, j', is partially rotated and the jaw (107) occupies the appropriate position for the length desired to be cast. In this method of justification the jaw (110) will occupy the coördinated position and insure the line of the desired length being justified: it is preferable to provide an adjustment for altering the zero position of the mold vise jaw (116) so as to provide means for setting the mold end jaws to a position closer together when a shorter line is to be justified. The amount which the jaw must travel to embrace the line of matrices with the wedges of the distensible space matrices elevated to the correct height to give proper justification is thus reduced to a small amount. The jaw (116) is closed by means of a sector or gear driven by a slipping belt, spring-pressure or other suitable means and engaging with a spur pinion (86) carried on a prolongation of the screw (70) which revolves in a nut carried in a prolongation of the support (74) of the mold end jaw (116). Fixed to the prolongation of the screw (70) is the hand wheel (87) which can be engaged with the pinion (86) by means of the spring locking gear (88) Fig. 79. When the pin of the spring locking gear is withdrawn by pulling the handle (89) of hand wheel (87) outward, the hand wheel (87) can be rotated independently of the sector and spur gear (86) and the mold jaw support 74 can be set to the desired zero position in respect to the fixed mold jaw. Thereafter the hand wheel and sector are again locked together.

In Fig. 16 the line of matrices justified by the first method is shown with the mold end jaws (115) and (116) in place, embracing the line of matrices and closing them up to the width predetermined by the height to which the wedges of the adjustable space matrices have been elevated.

The mold in which the type are cast is shown in Figs. 17 and 18, and Figs. 19, 20 and 21. The body faces of the type are formed by the top and bottom mold jaws (113) and (114) respectively, which may contain passages for the circulation of water for the cooling of the mold. The jaws (113) and (114) can be moved independently away from their closed positions to permit of the matrices being put into place or withdrawn from the mold after the cast has been made. The foot of the type is formed by the tang pieces (117) and (118) respectively, which also may contain passages for the circulation of water for cooling, and which are also capable of independent movement. The end of the tang is formed by the mouth of the metal pot, which bears against the tang blocks (117) and (118). The ends of the mold are formed by the mold end jaws (115) and (116) respectively, and the ends of the tang by projecting portions upon the tang pieces (117) and (118). From this description it will be seen that the length of the tang may considerably exceed the length of the cast line of type and matrices provided that the mold end jaws (115) and (116) are made of sufficient length to close that portion of the tang space which would otherwise communicate with the interior portion of the mold.

The action of the parts of the mold is as follows:—The line of matrices, *a b c*, being received in place, the bottom mold jaw (114) is brought up to bear upon the projections (3) of the matrices by the rod (148) acting upon the bell crank (147) and the links (146). The matrices are held pressed toward the metal pot by the faces (17) on the side opposite to the projection (3) Fig. 1. The mold end jaws (115) and (116) are in the first method of justification now set to embrace the length of line to which the distensible wedge spaces have expanded the line of matrices, and are pressed together so as to take the measure of the length from the line of matrices itself. In the second, third and fourth methods of justification the mold end jaws (115) and (116) are set to a measure which corresponds to the length of line to be cast, increased by the number of addenda or addendum bearing matrices in such line and decreased in the second and third methods by an amount one half (or other suitable proportion) respectively of the amount by which the line is deficient in its first measurement. The elevation of the wedges of the distensible space matrices fills the line of matrices to this measure. The measure being filled, the top jaw of the mold (113) is brought down upon the projections (3) of the matrices, *a*, to close the top of the mold by means of the rod (145) acting on the bell crank (144) and depressing the mold jaw (113) by the links (143). The bottom tang block (118) is now brought up into the casting position by the rod (269) acting on the bell crank (268) and the links (267). The top tang block (117) is brought into place by the rod (272) acting on the bell crank (271) through the links (270). The mold now being closed, the metal pot, *n*, is brought into place against the tang blocks (117) and (118) and the cast made. The metal pot having been retired, the top mold jaw (113) is elevated, the mold end jaws (115) and (116) are slacked and brought away from the metal pot, the line of matrices withdrawn by means of the raceways, *u*, in the elevating block Fig. 54. When the matrices are clear of the mold the top mold jaw (113) is again closed on the cast and the bottom tang block (118) is moved downward to its lowest position by the action of the lever (269), the bell crank (268) and the links (267); the top tang block (117) is now moved up clear of the tang by the rod (272) acting on the bell crank (271) and the links (270). The motion of the top tang block is reversed and the block (117) brought down to shear off the tang, Fig. 37 which can now fall clear. The top mold jaw (113) may be formed with a projecting bead (273) for forming a nick in the type similar to that cast in ordinary loose type produced by the usual methods. The top jaw (113) of the mold must in this case be lifted a sufficient amount to enable the bead to clear the groove in the type before these are withdrawn. This is shown in Fig. 19 in which the mold jaw is in its elevated position.

Fig. 20 shows the jaws in their position after the matrices have been removed and the mold again closed.

Fig. 21 shows the position of the tang blocks after the break has been effected, the lower tang block (118) being at its lowest position and the top tang block (117) being at the lowest position it assumes after shearing or breaking off the tang from the line of justified type.

Figs. 22 and 23 show the second elevator arm and ribbed receiving bar. After the line has been cast and the matrices have been elevated on the first elevator, *u*, and swept into the receiving box, *w*, the character matrices, *a*, and space or quad matrices, *c* are received on the ribbed distributing bar, *v* pivotally attached to the second elevator arm, *o* as in the linotype machine. The second elevator arm, *o*, operated in the usual manner from the main cam shaft of the machine as in the linotype, elevates from the receiving box as shown in Fig. 22 the line of character and space or quad matrices which are held in position by the spring latch (274) against the stop bar (275) when the lever, *o* attains the end of its travel as shown in Fig. 23. They are thereby kept in position for sweeping off to the distributing gear as in the linotype.

The method of distribution of the space matrices is shown in Figs. 24 and 25. After the character matrices *a*, and space or quad matrices, *c*, have been removed from the receiving box, *w*, the distensible space matrices, *b*, remain in the box as they are retained by the lengthened lug (34) Fig. 57 engaging with a groove (77) in the raceways, w' Fig. 57 and guided by the notch (53) which rests upon the rib (78) of the raceway, w^2. The distensible space matrices are then swept from the receiving box raceways, w' and w^2 into the revolving space box, *p*, in which they are received on the raceways, p' and p^2 and rotated through ninety degrees by the rod (79) pivotally attached to the arm (82) of the box, *p*, the wedges, previously vertical, being now caused to assume a horizontal position toward the back of the machine, and the projections (25) of the distensible space matrices stand vertically upward. After the rotation of the box, p, the matrices, b are swept into the magazine (104). The box p may be limited in its travel by a pin (92) engaging in the curved slot (93) in the supporting frame (94) of the rotating space box p.

Figs. 26, 27, 28, 29, and 64 show the receiving table, receiving stick and galley. After the mold end jaws have been withdrawn from the mold, the tang sheared off and the mold top and bottom jaws (113) and (114) Fig. 21 closed again, the type t, are swept through the mold by a sweeper to a receiving table, q, Fig. 27 on which they rest. The type table, q, is pivoted on a shaft (282). When the type t are in place and the sweeper has receded, the gripper arm, r' keyed to the shaft (285) Figs. 26 and 27 rotates toward the type table, q from its normal position, shown dotted in Fig. 27. To suit various lengths of line of type, the jaw (286) is made in two pieces, clamped together by the screw and nut (284) embracing the gripper plate (294) and clamping the jaws (286) together and to the receiving stick r. Before the adjustable jaw (286) of the gripper reaches the type table, the stop (283) of the type table acting on the trip lever (287) releases the pivoted jaw (288) which under the action of the spring (289) causes the pivoted arm to rotate about its pivot (290) and to grip the justified line of type t. The type table, q, Fig. 28 is now rotated from its dotted position to its lowered position, leaving the line of justified type held between the gripper jaws (286) and (288). The type table, q having been lowered, the gripper arm, r' is rotated from its dotted position Fig. 28 to the further rotated position shown in which the line of justified type, t, is opposed to the galley, s, Fig. 28 and the arm r' is locked in position. The galley s is now advanced toward the gripper of the type stick, r, and after the type have entered between the projections on the sides of the galley (291) and (292), the gripper jaws (286) and (288) are pressed back by the surfaces of the projections (291) and (292) of the sides of the galley, s. The jaws (286) and (288) in their backward movement carry with them the gripper plate (294) which slides on the pins (295) and (296) fixed to the gripper arm, r'.

The gripper plate (294) is normally held away from the gripper arm r', by the action of the coil springs (297) and (298) against the gripper presser plate (299) also secured to the pins (295) and (296). The presser plate 299 is secured to the pins 295 and 296, Fig. 26. The pins 295, 296 are fixed to the gripper arm r'. The gripper plate 294 is normally held away from the gripper arm r' by the action of the springs 297, 298. When pressure is applied to the arms 286, 288 it pushes the gripper plate 294 toward the gripper arm r' and compresses the springs 297, 298. When the pressure is relieved the plates 294, 299 close together again under the action of the springs 297, 298. The continuation of the movement of the galley causes the type to be forced by the presser bar (299) into the galley, and the already composed lines of type in the galley to be pushed farther back the position ultimately attained being that of readiness for the receipt of the new line of justified type. When the line of type has been received in the galley and has left the gripper arms (286) and (288), the continued pressure of the galley causing the receiving stick arms (286) and (288) to recede, carries the gripper plate (294) away from the presser plate (299) by sliding on the pins (295) and (296) and by doing so, the pivoted jaw of the receiving stick (288) swings to the position shown in Fig. 64. The movement of the galley in causing the separation of the plate (294) from the plate (299) causes the pin (300) fixed to the plate (299) acting on the inclined face (301) of the pivoted gripper jaw (288) to partially rotate it on the pivot (290) and permits the trip lever (287) to be reëngaged by the action of the spring (302) and the pin (303) sliding in a hole in the gripper arm, r'. The jaw (288) is now locked in its normal position and the galley is now retired, permitting the plates (294) and (299) of the receiving stick to close together again under the action of the springs (297) and (298). The gripper arm is rotated back to its normal position shown dotted in Fig. 27 and the receiving table q is also returned to its normal position.

Referring to Figs. 20, 21 and 22, the metal pot, n, as shown in section of Fig. 20 is in some respects of the ordinary pattern in so far as the arrangements for heating and jacketing are concerned, but in so far as the length of tang to be produced on the type is generally continuous and greater than in most other methods of type casting, I employ two or more plungers arranged side by side as shown in the plan (119—124) Fig. 31. As the plungers require to have some independent movement relatively to each other according to the work required of them and in case of the sticking of any individual plunger I prefer to actuate them by means of a crossbeam (132) acting by means of the springs (125—130) Fig. 30 on the upstroke and through the springs (134—139) on the down stroke. The valves (131) may be of the ball or other usual pattern, actuated independently by levers (133) in the usual manner. The pumps (119—124) are preferably each made independent with separate pockets (304—309) each communicating by separate delivery channels (310—315) with a longitudinal nozzle channel (316) which is covered by but does not extend to the end of the nozzle plate. The nozzle plate (188) is formed with a number of holes (317) which may be tapered which communicate with the longitudinal nozzle channel at their smallest or inner ends.

Fig. 33 is a portion of a magazine shown in section with a matrix, *c* shown hanging in the usual manner from the distributer bar, *z v*, from which it is released when arriving at the proper tooth combination, as in the linotype machine by the action of the screws (318) and (334). The matrix being liberated, falls upon its surface (7) on the tilting bar (319) on which it is caused to rotate by the action of gravity through ninety degrees into the position shown by the matrix, *a*, with the projection (3) vertical; it then slides down the curved channel (320) of the magazine mouth into a compartment (102) of the magazine.

Fig. 34 shows a matrix, *a*, on the distributing bar before it is released, and by the dotted line in the position in which it is received on the tilting bar (319).

Fig. 35 shows the action of the tilting bar (319) causing partial rotation of a matrix *a* after its liberation from the distributer bar *z v*. A line of type as cast in the machine with the matrices and mold removed and the tang, *z u* left in position, is shown in Fig. 36. The tang *z u* after being sheared off is shown in Fig. 37 and the line of justified type *t* closed together after the tang, *z u* has been broken off is shown in Fig. 38.

Referring further to Figs. 43 and 44, the back spacing gear, *z y* Fig. 41 mentioned in the description of the third method of justification, can also in a simpler form be employed in the first and second methods of justification. Taking the third method, when a distensible wedge space is removed from the line by the compositor, the number of addenda recorded by the screw (164) Fig. 41 will be in excess of the number remaining in the line. The scale (197) also shown in Fig. 62 and the pointer (198) indicate the number of addenda recorded by the screw (164) and enable this number to be compared with the number of distensible space matrices remaining composed in the line. By means of the handle, (199) Fig. 41 the bevel pinion (200) fixed thereto drives the bevel pinion (201) fixed to the screw (165). Partial rotation of the handle (199) Figs. 43 and 44 by the operator, causes the screw (165) to rotate and to drive backward through the half coupling (174) fixed thereto the half coupling (173) feathered to the screw shaft (164). The escapement, *i*, Fig. 55 is thereby driven backward in the opposite direction to the arrow, and in the arrangement shown, the amount of an addendum is deducted for each quarter revolution of the shaft (164) and the ratchet (203). The anchor arm (204) being restored to its locking position by a spring, weight or other suitable means, locks the escapement in its corrected position. The ratchet 203 and anchor arm 204 are illustrated clearly in Fig. 55. Their position is indicated in Fig. 41 by the letter *i*. The reading of the scale (197) informs the operator of the state of the line. In the first and second methods of justification, which only employ one screw *j′* the back spacing gear may be arranged to operate directly upon this screw without the intervention of the couplings (174) and (173), Figs. 41 and 43 and 44.

The ball lock *z x*, Fig. 45 is provided for locking the front of the assembly box, *g*, Fig. 12 in position when correction of the line being composed has been made. The front of the box (220) can be pulled forward about the pivot (219) to obtain access to the line of matrices, the ball (224) springing within the recess in the plate (218) when the front of the box is restored to its normal position.

Figs. 46, 48 and 50 show arrangements of the mold blocks for producing different arrangements of tang break respectively. In Fig. 46 the lower tang block (118) is made considerably thicker than tang block (117) and is formed with a bead (321) which produces a groove or nick (322) in the front of the type, *t*, near the foot as shown in Fig. 47. The groove is placed in such position that the fracture (323) of the tang, *z u*, when this is broken off will be effected through a portion of the section weakened by the nick or groove (322).

In Fig. 48 is shown an alternative method of producing the tang break in which the lower tang block (118) is made thicker than the upper tang block (117) and in its normal position stands above the top surface of the lower mold jaw (114) and produces a sharp reëntrant corner (324) where the lower face of the tang, *z u*, joins the body of the type, *t*. The fracture (323) Fig. 49 is thus confined to the portion of the metal between the reëntrant corner (324) and the corner (325) formed by the upper tang block (117). The third form of tang break is shown in Fig. 50 in which the top and bottom mold jaws (113) and (114) are made of equal thicknesses, and the tang break jaws (117) and (118) are also made of equal thicknesses. In this case the downward movement of the tang block (117) is generally made short so that it does not touch the lower mold jaw (114) in traveling downward to break or shear off the tang,

$z\ u$ or jet. The type cast by this method are shown in Fig. 51, and the action of producing the fracture is mainly shearing due to the downward pressure of the tang block (117) acting on the tang, $z\ u$, of the type, t, and thus causing the fracture.

In describing the space matrix shown in Fig. 3 the tubular guide (31) and the pin (30) are mentioned. These are more clearly shown in the cross-section of the figures, which also show the arrangement of the guides of the wedge.

Fig. 52 shows the distensible space fully distended and Fig. 74 shows the distensible space matrix in its normal or undistended position.

The cross section of the measuring table used in the first method of justification is shown in Fig. 53 in which the first jaw (111) of the measuring vise is withdrawn from the position which it occupies when embracing the line of matrices, shown by the dotted lines, and is in the position which it occupies when the matrices are being received in the raceways (109) of the measuring table.

When the matrices have been received and the jaw (111) moved to its dotted position, the screw (253) is elevated by a nut (251) Fig. 15, and the crossbeam (254) fixed to the screw (253) Fig. 53 is elevated with it, raising the pillars (255) and (256) and the longitudinal bar, k' attached thereto, which forms the measuring table and elevates the wedges (26) of the distensible space matrices, b.

After the measurement of the line has been effected and the coördinating sector (257) Fig. 15 locked, the table, k' is lowered by means of the nut (251) and screw (253); the depressor bar (112) Fig. 53, then comes into action and by downward movement, pushes the wedges of the distensible space matrices, b, down to their normal position. The recording gear, j^2 moves the measuring vise jaw (110) which is similar to the jaw (111) and slides on the bars (327) and (328), whereas the jaw (111), which can slide in its block (326) remains fixed laterally to the bars (327) and (328) by means of its slide (330), which is capable of traveling transversely to the slide bars (327) and (328).

Figs. 54 and 56 show the mold race u and elevating devices 346, 351 secured to one of the mold end jaws (115) and passing through a slot in the other end jaw is the bar (329) which presses the projection (3) of the matrices home into the mold, when the mold end jaws are in place. The matrices are justified from the back surface 17, Fig. 1, and the bar 329 presses against this surface causing the surfaces 14 adjacent to the prominence 2 and the projection 12 to bear against the top and bottom mold jaws 113 and 114, thereby insuring the correct position of the matrix in relation to the mold jaws. The mold end jaw (115) is carried on the mold end jaw frame (342) and is capable of sliding transversely on the slide (343); the mold end jaw (116) Fig. 15 is carried on the mold end jaw frame or support (74) and is capable of sliding transversely on the slide (344). The first elevator frame, u Figs. 54 and 56 carries the raceways or guides, u', u^2, u^3 which in their normal position form a continuation of the raceways (109) of the measuring table (in the first and second methods of justification) or of the raceways (212), (214), (221) and (213) Fig. 13 of the assembly box in its partially rotated position (in the third and fourth methods of justification). Before the matrices are swept from the measuring table raceways (or the assembly box raceways), the mold end jaw (116) Fig. 15, is advanced on its slide (344) and the matrices are swept into the mold. The mold end jaw (115) is then advanced on its slide (343) and the mold closed. After the cast has been made and the mold end jaws (115) and (116) retired, the first elevator raceways, u', u^2, u^3, Figs. 54 and 56, which embrace the matrices are retired by the elevator frame, u, to which they are fixed; this moves with the bracket (346) which slides on the slide (347) being moved from a suitable source of power by the rod (349) pivotally attached to the lug (348) on the bracket (346). When the matrices have been retired from the cast the elevator frame, u, is elevated by the slide (345) on the bracket (346) being moved from a suitable source of power by the rod (351) pivotally attached to the lug (350) carried on the elevator frame, u. In the retired and elevated position the raceways, u', u^2, u^3 of the elevator, u form a continuation of guiding surface with the raceways, w^2 and w', of the receiving box to which the matrices are swept.

The addendum escapement, i Fig. 55, enables each addendum added in any one of the four methods of justification to be recorded by the partial rotation of the screw j' or (164) or, j^4, in the direction of the arrow under the action of power applied by the slipping belt (163) to a pulley (168) Fig. 41, and (168) Fig. 39. Coördinated with the space matrix escapement rod (171) Fig. 8 is the rod (207) Fig. 55, which is pivotally attached to the anchor arm (204) turning on the pivot (205), except in the fourth method of justification shown in Figs. 77 and 78. The movement of the one end of the anchor arm frees the ratchet (203) permitting the escapement to partially rotate, and the action of the anchor return ratchet (206) restores the anchor arm to position for arresting the movement when the succeeding tooth of the ratchet (203) has come into position.

A section of receiving box is shown in Fig. 57; when the matrices are swept from the first elevator, *u*, they are received in a receiving box, *w*, Fig. 6, having guides, *w'*, and w^2, the front guide, *w'* being formed with a groove which receives the lengthened lug (34) of the space matrix, *b*, and retains it when the ribbed receiving bar, *v*, of the second elevator arm, *o*, elevates the character and space or quad matrices, *a*, and *c*.

Figs. 58 and 65 show a matrix for use in a double magazine machine; the matrix is of a somewhat different form; the upper portion being formed with the notch (6) carried across the width of the matrix, leaving the lugs (4) and (8) projecting above the surface, so that the escapement stops (229) and (230) Fig. 10, can act upon the lugs (4). The toothed portion of the matrix is carried nearer the face (7) than in the single magazine matrix and the supplementary notch (331) is provided in those matrices which are to be distributed to the upper magazine, so that when the matrices are received on a supporting rail (332) the matrices, a^2, Fig. 65, without the notch are received on the first distributer bar, *z v*, and the matrices with the notch a^3, Fig. 58 are not received on this bar, but pass to an elevating mechanism and to a second distributing bar as in the double magazine linotype machine.

Fig. 59 shows the escapement freeing gear. When the escapement, *i*, is required to be rotated back to the zero position of the screws, *j'* or (164) or, j^4, the friction clutch (333) of the driving pulley (168) is disengaged from the cone (334) of the escapement gear, thereby enabling the screw, *j'* or (164) or, j^4 to be rotated backward freely without the necessity of overcoming the friction of the slipping belt (163) of the pulley (168). The return of the assembly box adjustable jaw (107) Fig. 8 is effected by the sector (335) Figs. 60 and 61, which is caused to rotate under the action of suitable power, thus revolving the pinion (340) fixed to the screw, *j'* through the intervention of the train of gearing (336) (337) (338) and (339) until the sector reaches its zero position, when the screw *j'* will also reach its zero position. This position can be varied according to the length of the line required by sliding the pinion (336) laterally on the feathered shaft (341) fixed to the spur wheel (337) out of mesh with the sector (335) thus revolving the screw, *j'* and bringing the jaw (107) to the required position. The gear can then be replaced and the range of movement of the sector is not affected. During the return movement of the screw *j'* the friction clutch, *z w* Fig. 14, driven by the pulley (168) is disconnected from the escapement gear, *i*, to facilitate the backward revolution of the screw.

The addendum scale (197) Fig. 62 is carried on the assembly box, *g*, and is so arranged that the position of its zero division can be varied to suit the length of line to be cast; the progressive movement of the vise jaw (160) of the assembly box, *g*, for each addendum received in the line is shown on the scale (197) by the pointer (198) carried by the vise jaw (160).

The swing plate for elevating the wedges of the distensible space matrices is shown in Figs. 63, 66 and 67. The swing plate (141) shown in its normal non-elevated position. Fig. 63 is elevated to the position shown in Fig. 60 by the rod (69), which is driven by a spring or other suitable source of power; this elevates the swing plate (141) till a stop (352), carried thereby, comes in contact with the table, *k'* when the line of matrices has been measured on the measuring table, *k'* and after the measuring table jaws (110) and (111) Fig. 6 have been retired. The elevation of the swing plate (141) elevates the wedges (26) of the wedge spaces, *b*, so that the lower ends are at the same level as the mold table, *x'* and enables the line of matrices to be swept to the mold table.

The matrices and type employed in the fourth method of justification are shown in Figs. 68, 69, 70 and 71. The character matrices, *a'* Fig. 69 and the quad matrices, *c'* Fig. 70 each carry a projection (55) and (56) respectively of a thickness equal to the thickness (57) of the projection of the space matrix, *b*, Fig. 68. The space matrix, *b'* used in the fourth method of justification, is of the same construction as in the second and third methods of justification, but in the fourth method of justification the addendum is equal to the whole thickness of the projection, whereas in the second and third methods the addendum is only equal to the part thereof shown in the dimension (37) given in the section of a matrix, *b*, Fig. 74. The type, *t*, with tang, *z u*, cast by the fourth method of justification is shown in Fig. 71.

The sector gear used for coördinating the position of the mold end jaw (169) Fig. 41 with the assembly box jaw (160) is shown in detail in Figs. 75 and 76. In restoring the mold end jaw to its zero or normal position the sector (189) is rotated by a spring or other suitable source of power and drives the spur pinion (353) which carries with it the spur wheel (354) rotating on the pin (355) carried on the fixed bracket (357). The spur wheel (354) drives the spur wheel (190) fixed to the prolongation of the screw (165). The sector (189) rotates until the stop (356) carried on it, comes in contact with the stop (192) feathered to the tubular shaft (193). The tubular shaft (193) occupies normally its zero position, but may occupy an advanced position corresponding to the number of addenda received on the new line being composed.

In the fourth method of justification it is necessary that the escapement in this case designated by i' should be liberated with each liberation of any matrix. Mechanism by which these two operations are coördinated is shown in Figs. 77 and 78. The depression of the finger keys (101) as in the linotype, lifts the lower verge rod (358) and operates one of the tumblers (359), liberating one of the eccentric carriages (360) permitting one of the eccentrics (361) to fall on one of the rubber rollers (362) by which the lifting of the upper verge rod (363) Fig. 10 is effected, thereby operating the matrix escapement (225) and liberating a character matrix, quad matrix, ordinary space matrix, or distensible space matrix as desired. The elevation of any one of the eccentric carriages (360) Fig. 77 lifts the rectangular frame 364 carrying the rollers (365) running on the guides (366) and (367) fixed to the frame of the machine. The link (368) pivotally attached to the lug (369) on the frame (364) causes the latter to operate the lever (370) connected to the end of the anchor arm (204) of the escapement i'.

It will be obvious that the type cast by the methods and apparatus above described, being exactly similar to type as usually set up by hand, may be used to form portions or a letter or design which extends over more than one line; consequently I may use matrices having a portion or a letter or design engraved thereon so that when used in successive lines they produce a larger character or design than could be produced by a single matrix in one line. It has been proposed to use matrices of slug casting machines so as to cast part of a large character, but the ridges usually cast on the sides of these slugs prevent the type from being perfectly continuous from line to line so that a character occupying more than one line would have small breaks occurring between each line unless the mold were changed to give a flat-sided slug whenever such was required. The casting of a two-line initial letter upon one slug which overhangs the other below it has been introduced to get over the difficulty, which does not arise when separate type are used according to my invention, as the face and matrices carrying part of a character or design are carried through to the body face of the matrix at the necessary parts. The face of the portion of the character produced will charge the body, and form a continuous printing surface when composed with no space or interruption between the parts.

I do not herein claim *per se* matrices constructed as hereinbefore described, as specific claims for such subject-matter are contained in my co-pending application No. 598132, although the use of such matrices is included in the terms of the following claims.

I claim—

1. A type-casting and composing machine adapted to cast a line of separate properly justified type at a single pouring; comprising in combination, means for assembling matrices having projecting tongues integral therewith, said tongues forming partitions between successive type cast in a line; means for assembling distensible space matrices having projecting tongues integral therewith, said tongues forming partitions between successive type cast in a line; means for justifying said matrices including an assembly gage vise and means for actuating said vise at each operation of said means for assembling distensible space matrices, means for presenting said matrices when justified to the mold; and means for casting type coöperating with said mold and matrices, as set forth.

2. In a type casting machine, in combination, matrices having projecting tongues integral therewith, forming partitions between successive type cast in a line, matrix magazines, a receiving device comprising a set of revoluble rails, means for passing said matrices from said magazines on to said rails, a measuring device including a pair of jaws, means for moving one of said jaws away from the other, as set forth.

3. In a type casting machine, in combination, matrices having projecting tongues integral therewith, forming partitions between successive type cast in a line, matrix magazines, a receiving device comprising a set of revoluble rails, means for passing said matrices from said magazines on to said rails, a measuring device including a pair of jaws, means for moving one of said jaws away from the other, a pair of mold end jaws, means operated from said first mentioned measuring device jaw to adjust the distance between said mold jaws, and means for passing said matrices to a position between said mold jaws, as set forth.

4. In a type-casting machine in combination matrices having projecting tongues integral therewith forming partitions between successive type cast in a line, matrix magazines, distensible space matrices having projecting tongues integral therewith, a measuring device, a movable vise jaw coördinating with said measuring device and means for moving said vise jaw on the assembly of each distensible space matrix as and for the purposes described.

5. In a type casting and composing machine in combination, matrices including

distensible space matrices, wedges carried by said space matrices, said matrices having projections integral therewith forming partitions between successive type cast in a line, a space matrix magazine, means for releasing said space matrices from said magazine, a measuring device including a pair of jaws, and means coördinated to said matrix releasing means increasing the measure between said jaws by a distance corresponding to the width of the projecting tongue for each space matrix delivered into said measuring device, as set forth.

6. In a type casting and composing machine, in combination, matrices including distensible space matrices, wedges carried on said space matrices, said matrices having projecting tongues integral therewith forming partitions between successive type cast in a line, a receiving device comprising a set of revoluble rails, means for passing said matrices on to said rails, a measuring device comprising a pair of jaws, one of said jaws being vertically movable, the other of said jaws being horizontally movable to close upon matrices assembled in said receiving device, a pair of mold end jaws, reducing gear connecting said horizontally movable measuring device jaw to one of said mold end jaws, and means for elevating said wedges of said distensible space matrices, as set forth.

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

JOHN CAMERON GRANT.

Witnesses:

ALBERT E. PARKER,

P. A. OUTHWAITE.