

Oct. 15, 1929.

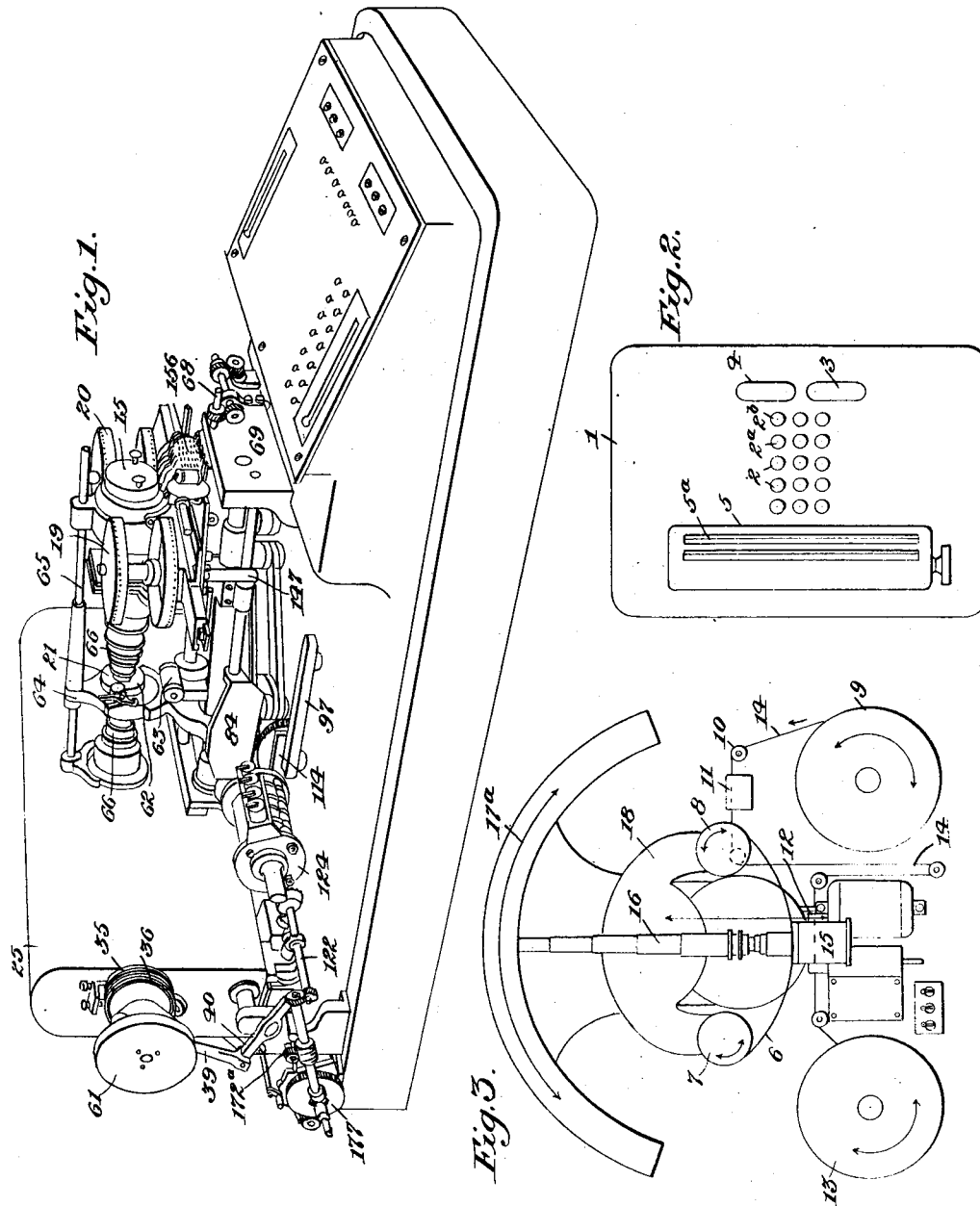
E. K. HUNTER

1,732,049

PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 1



Inventor:
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Oct. 15, 1929.

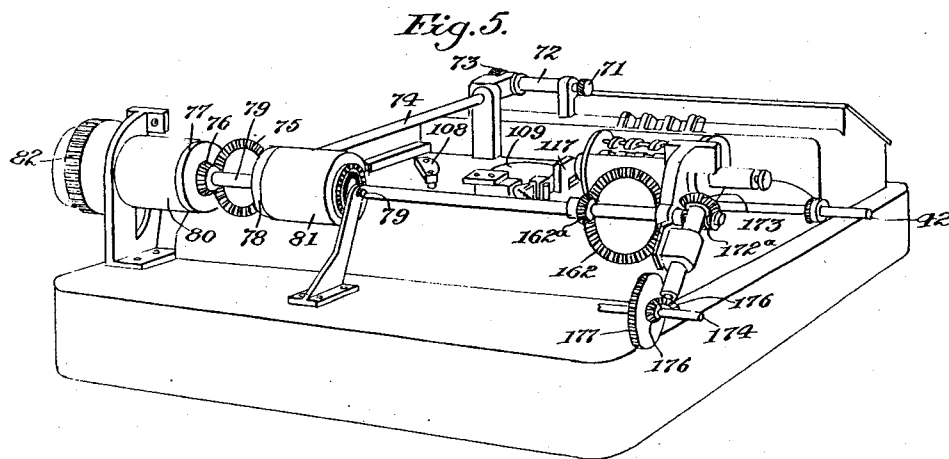
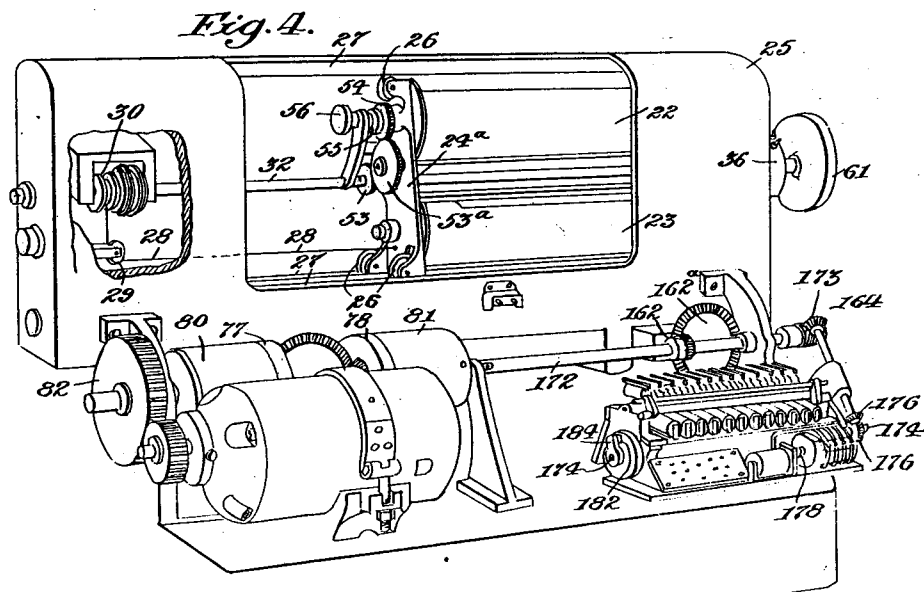
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 2



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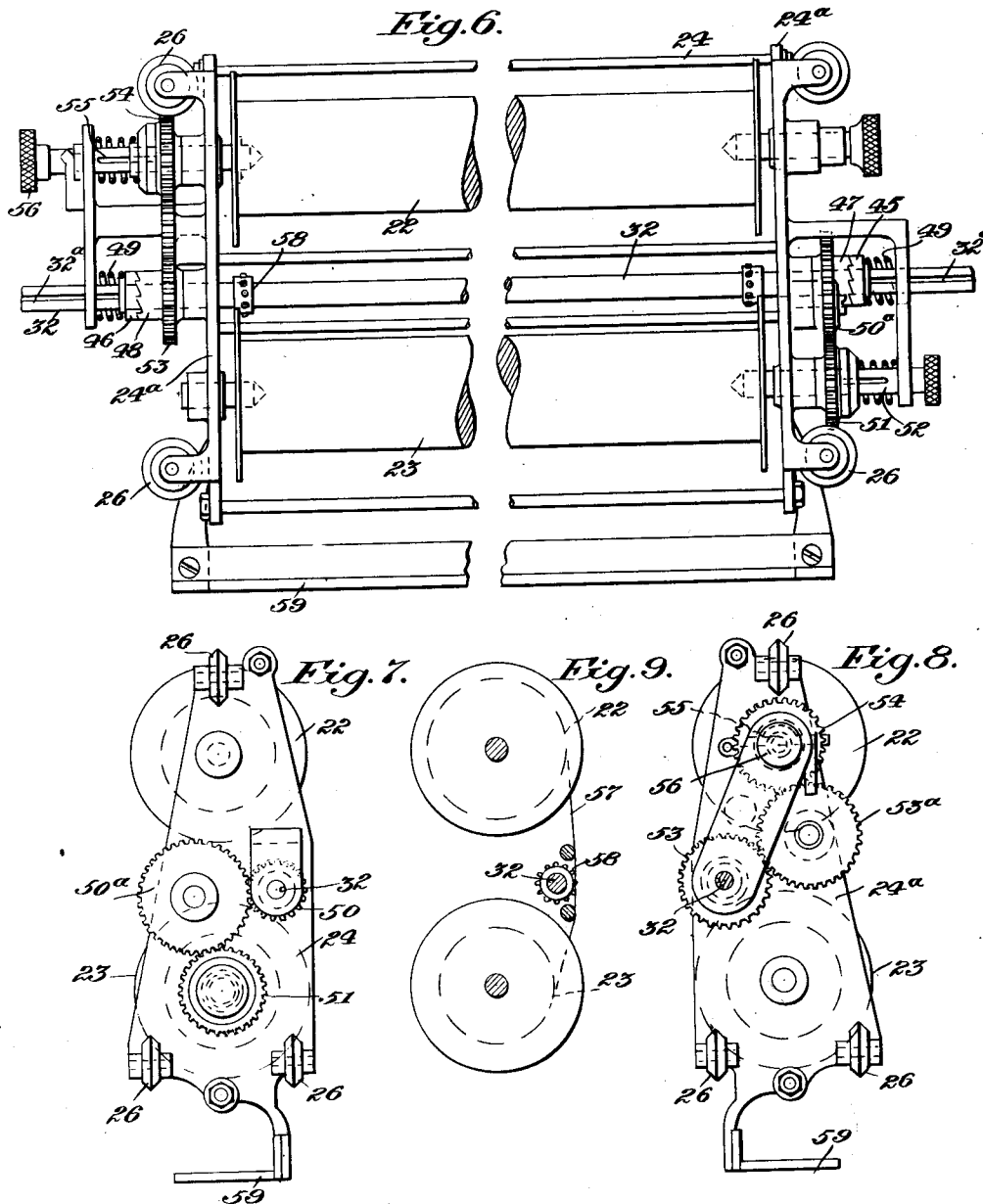
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 3



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1,732,049

PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 4

Fig. 11.

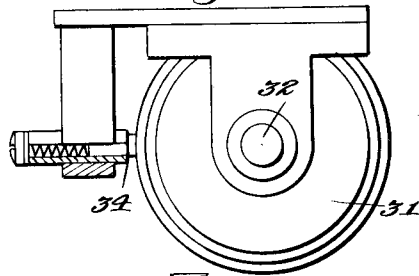


Fig. 10.

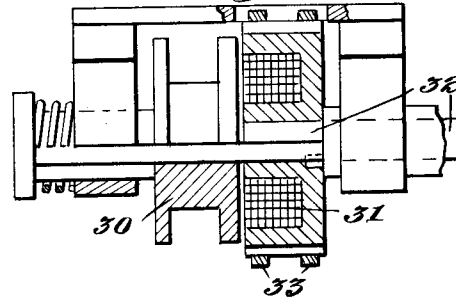


Fig. 13.

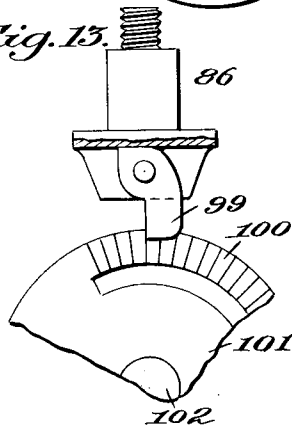


Fig. 12.

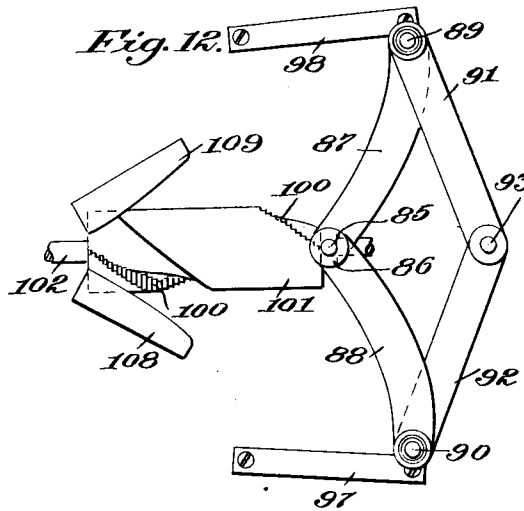
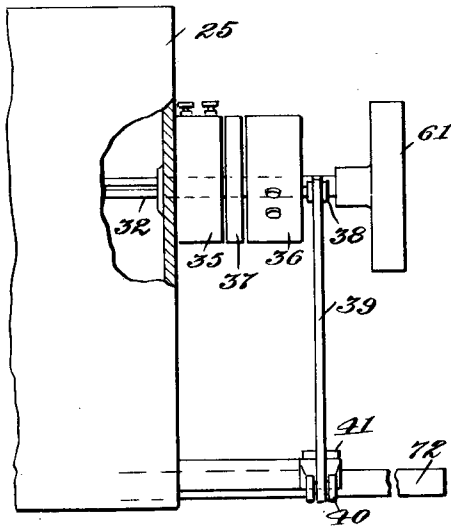


Fig. 15.^a



Oct. 15, 1929.

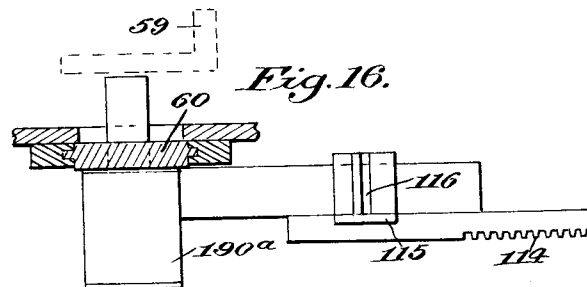
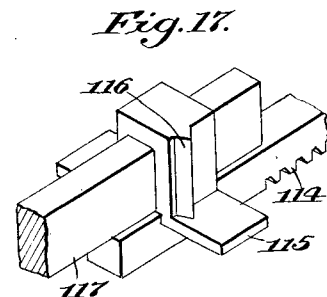
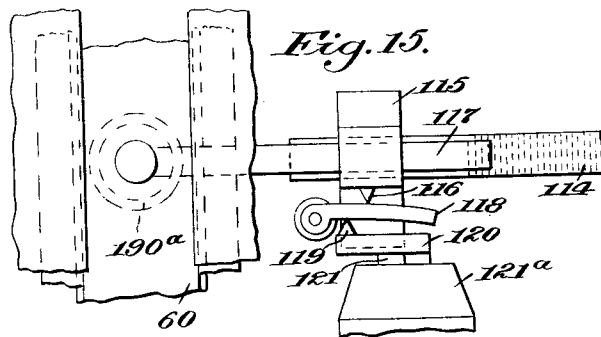
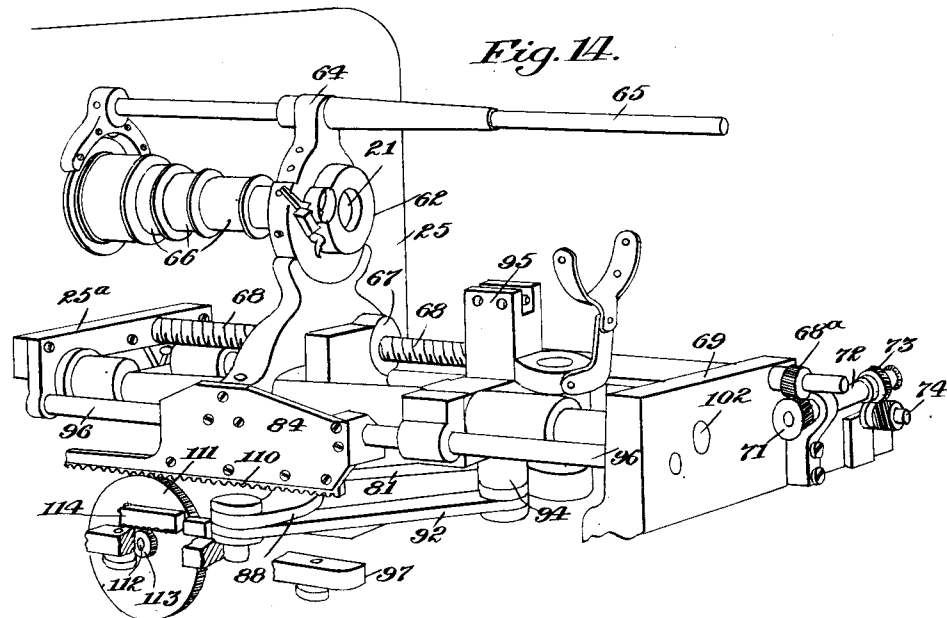
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20. 1922

14 Sheets-Sheet 5



Inventor:
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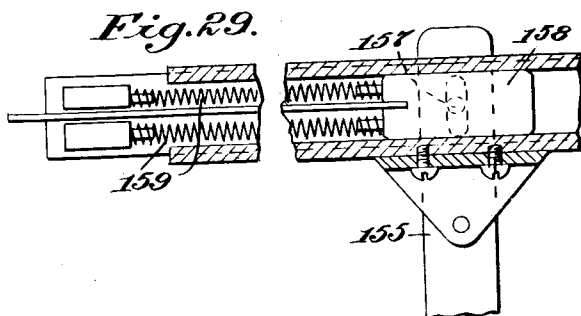
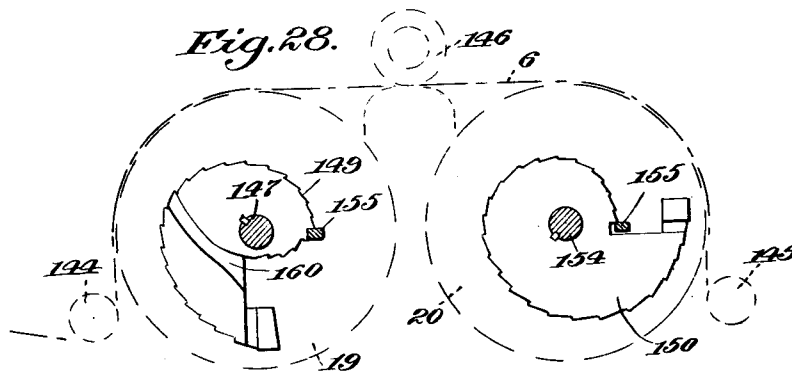
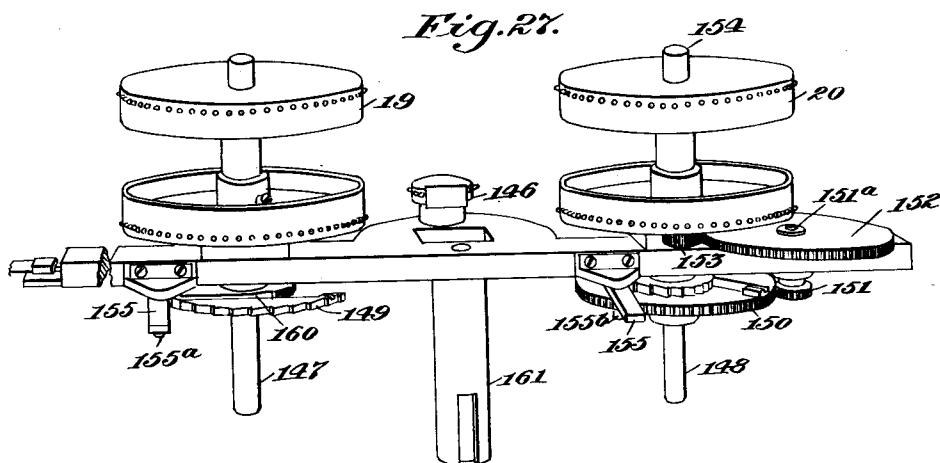
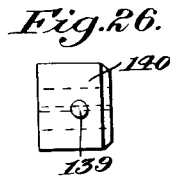
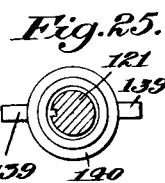
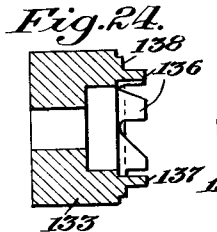
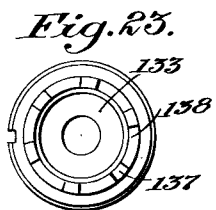
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 7



Inventor:
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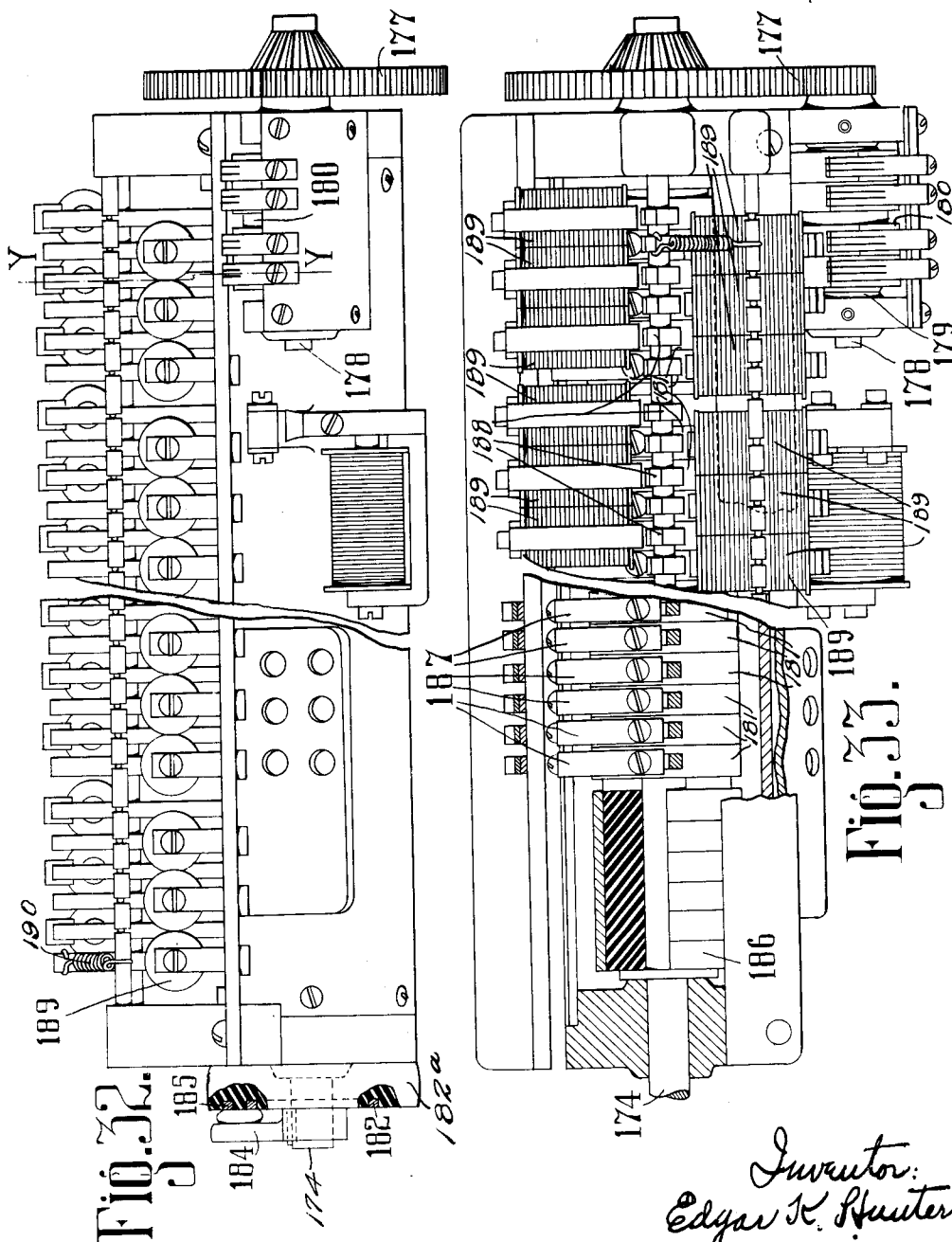
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 9



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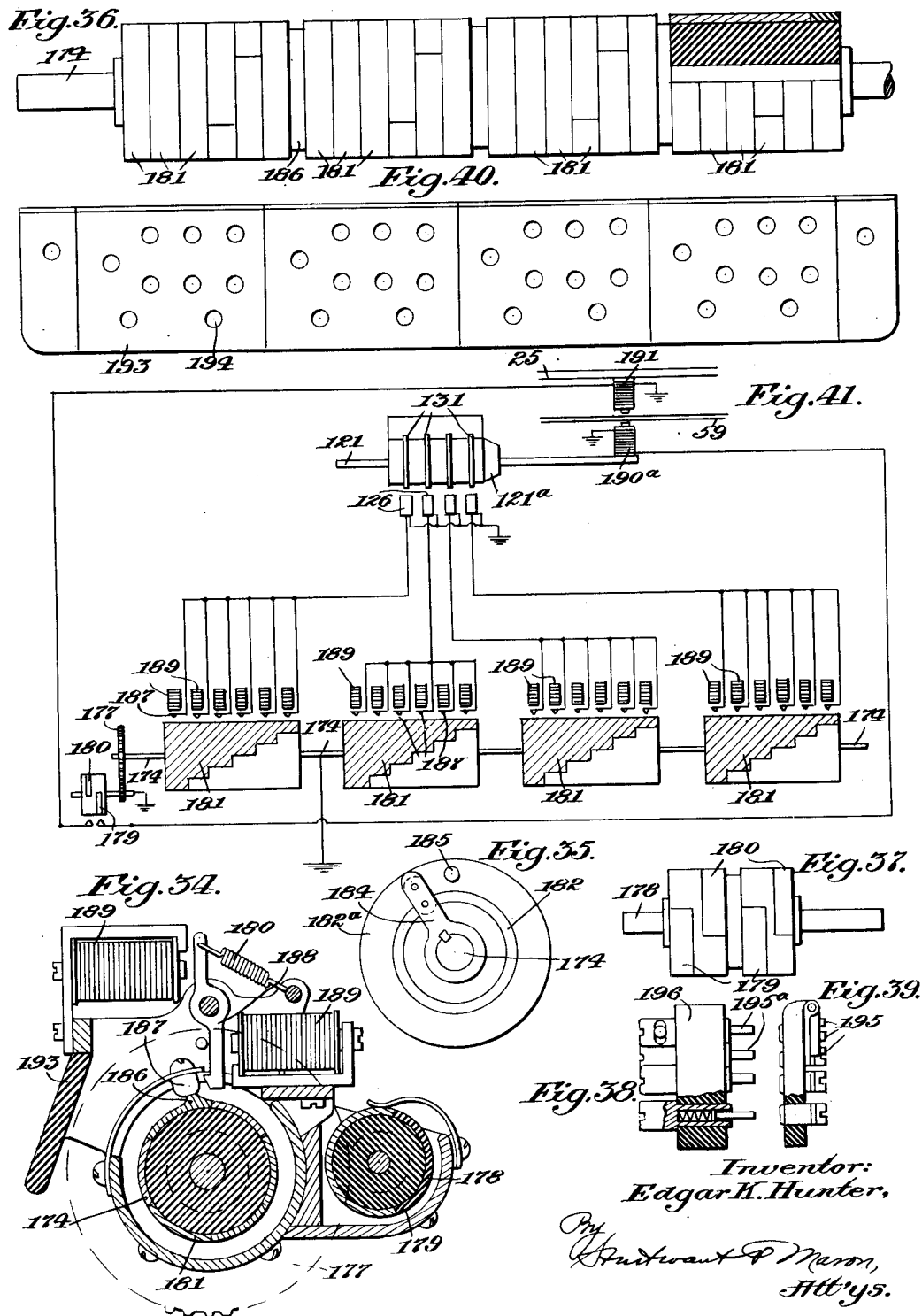
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 10



Oct. 15, 1929.

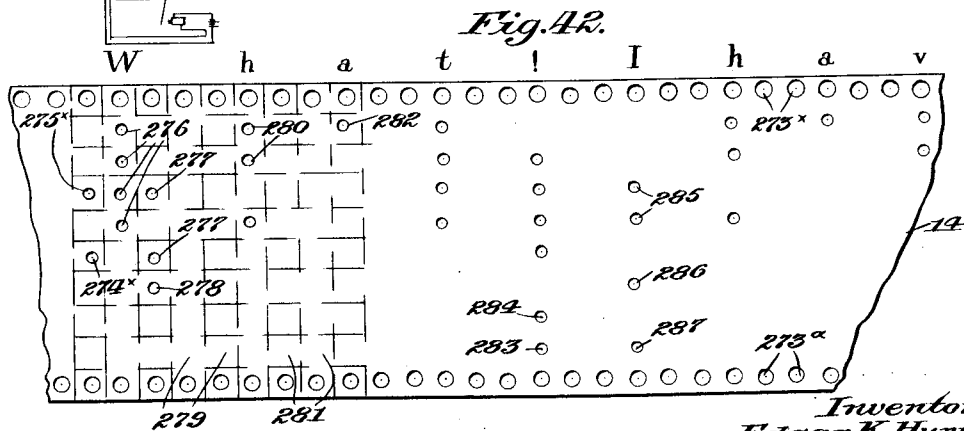
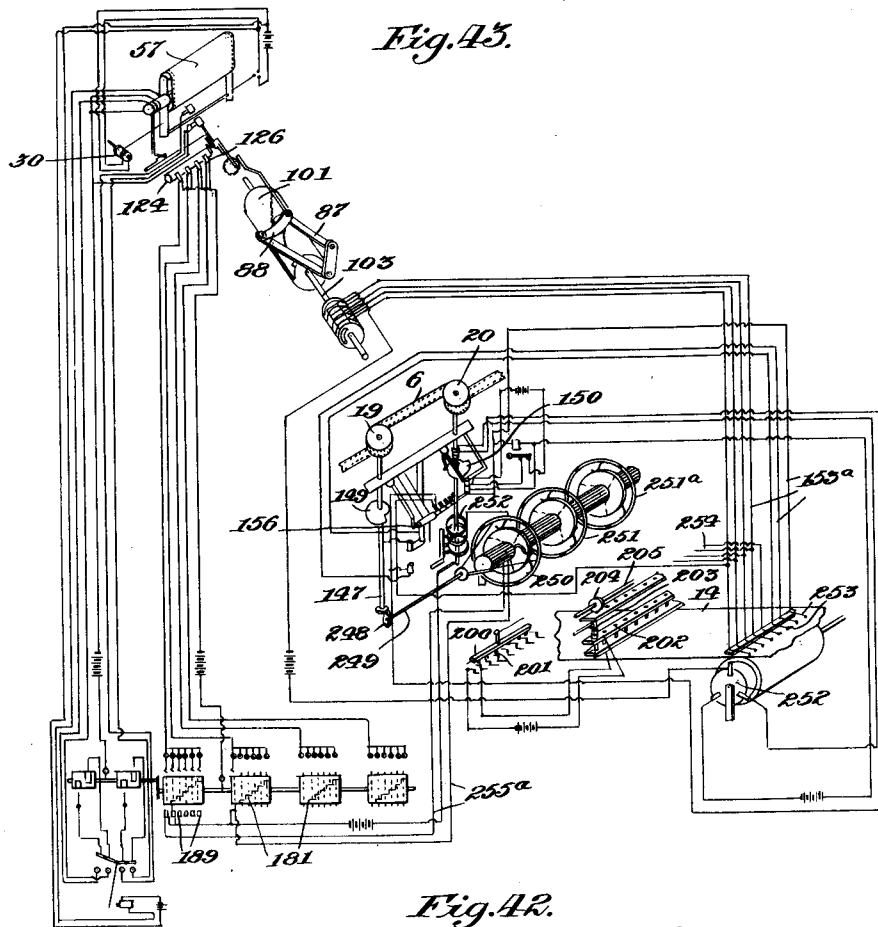
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 11



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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20. 1922

14 Sheets-Sheet 12

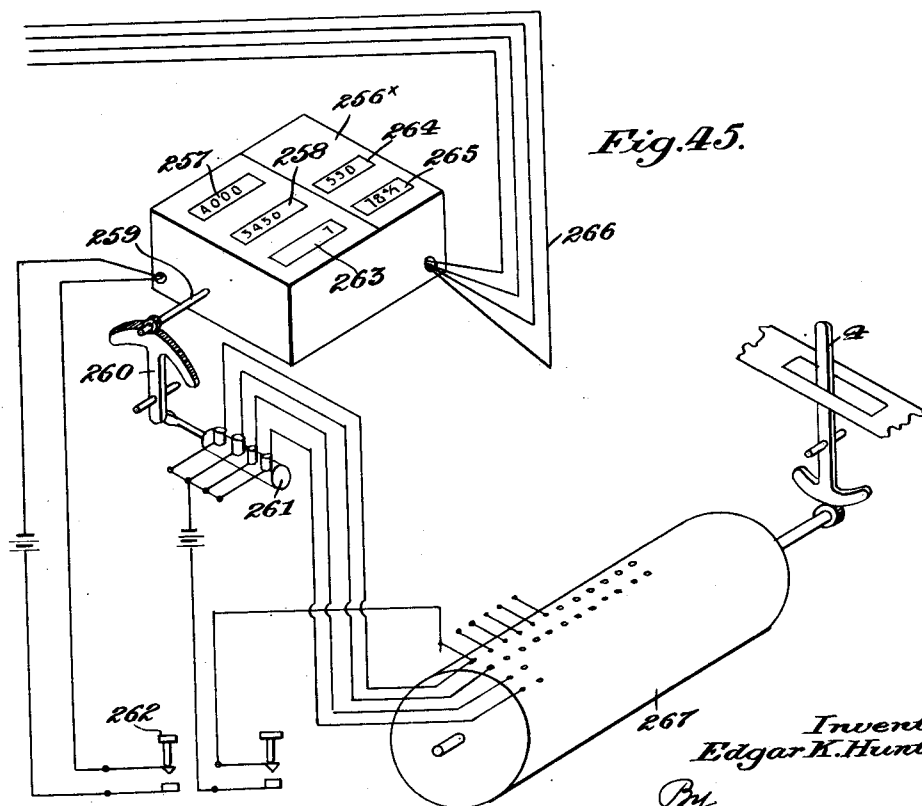
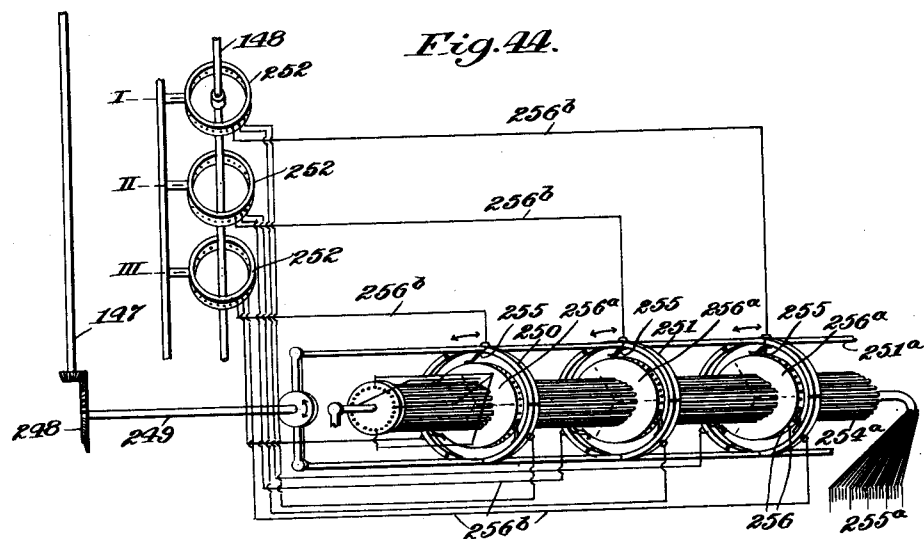


Fig. 45.

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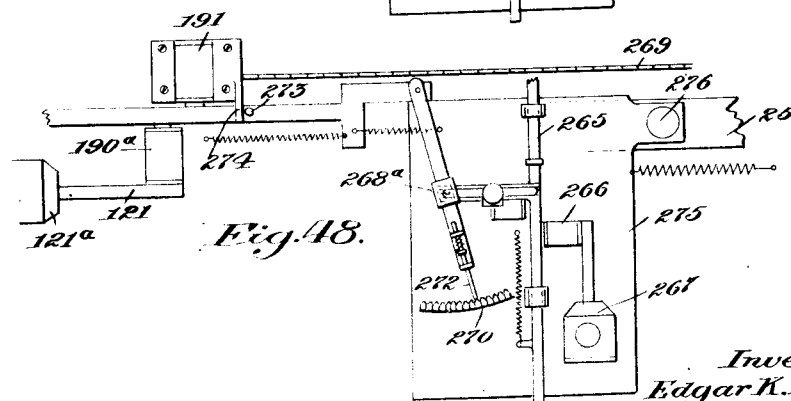
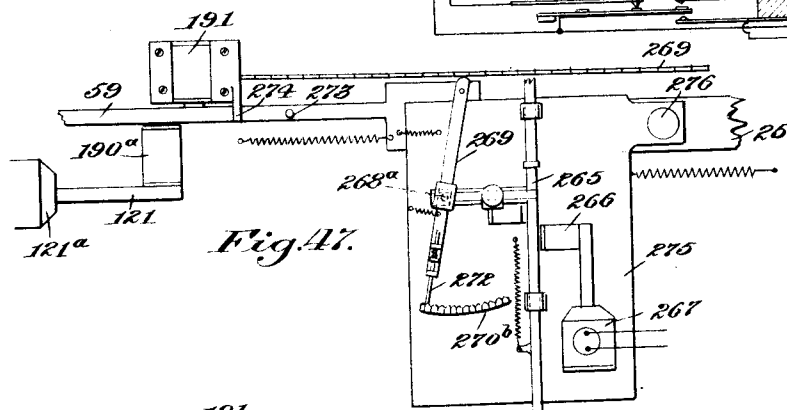
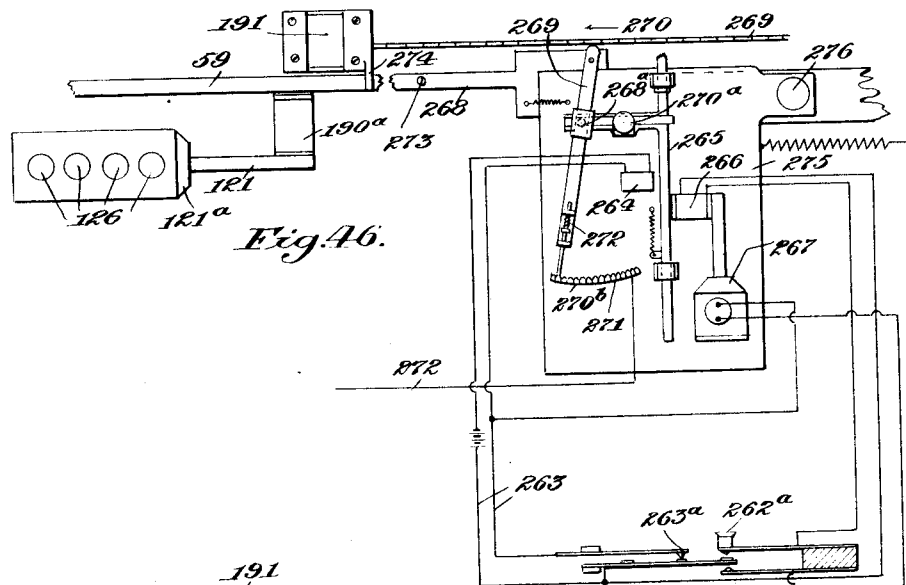
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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 13



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PHOTOGRAPHIC PRINTING PROCESS AND APPARATUS THEREFOR

Filed Sept. 20, 1922

14 Sheets-Sheet 14

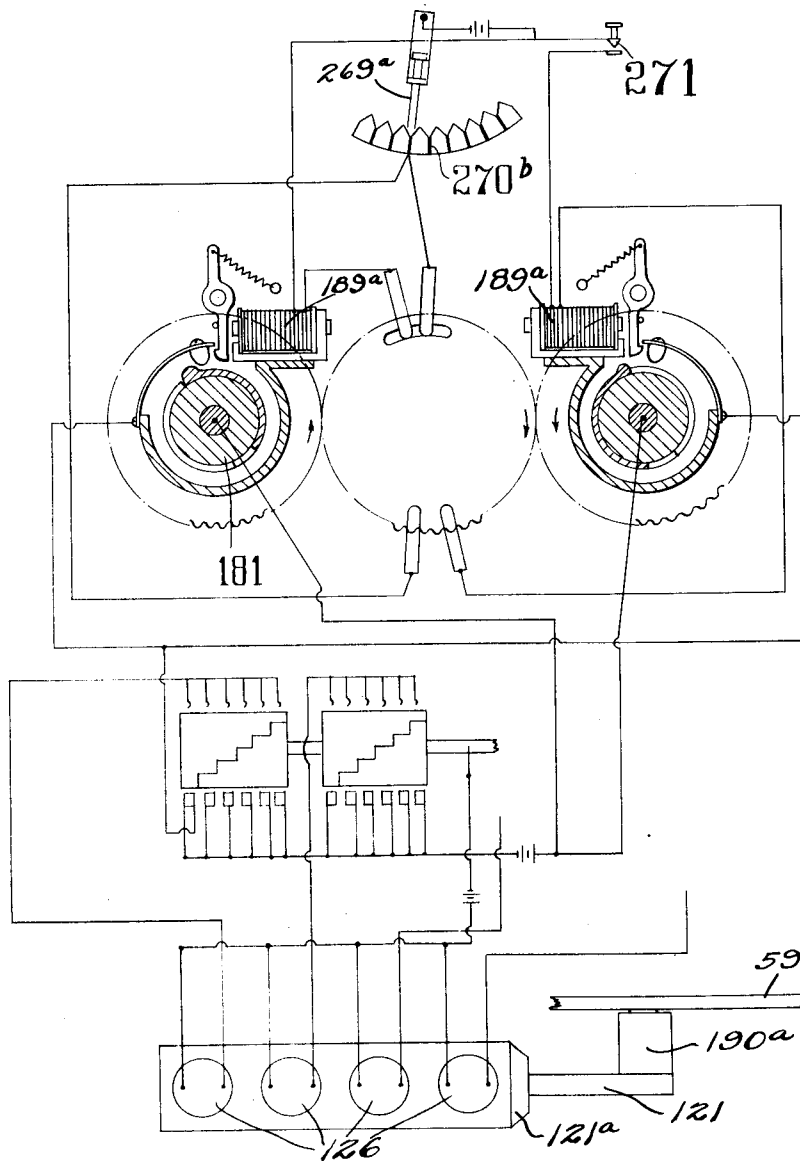


Fig. 49.

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UNITED STATES PATENT OFFICE

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PHOTOGRAPHIC-PRINTING PROCESS AND APPARATUS THEREFOR

Application filed September 20, 1922, Serial No. 589,365, and in Great Britain September 21, 1921.

The present invention relates to an improved printing process and apparatus therefor more particularly of the type in which symbols or other devices to be printed are
5 primarily established upon a reception element such as a metal sheet, cylinder or the like slab or lithographic stone by means of a photographic process operated by a light beam into the path of which a replica of the
10 symbol is passed by a key or the like setting mechanism.

The present invention more particularly concerns control means for operating such processes.

15 According to the present invention the various steps of such a process including a spacing of the type, which as will be evident will be differential owing to varying widths of letter and forms thereof and including
20 justifications, that is to say the variable spacing of words or other symbols forming a line of printed matter are controlled from a master strip of paper, card, metal, or other material, capable of being punched with
25 holes or otherwise having its surface effectively altered so that it may co-operate with mechanical parts for the setting up and subsequent indexing of mechanism.

The elements of a machine operating according to such a series of a number of separate groups of variables, that is to say by way of example in the establishment for instance the printing of a letter such as "Z" the elements controlling this printing must
35 be susceptible to at least two groups of variables and further movable according to a series in each group of variables, one variable thus forming two groups, whilst each group according to the Arabic alphabet will comprise a series of at least 26 letters.

Should it be desired for the machines to be capable of symbol printing as is required in the modern typography it must be further capable of instantaneously setting up a further
45 set of groups as is required by the large number of variable cases of type such as italic, roman, Arabic, script and the like. The selection of the particular element in the series of the particular group desired, and
50 further, the manipulation of such groups as

is desired by individual spacing and later on word justification in other controls are effected as above stated from a control strip. It is preferred to subdivide the effective area of such control strip into a plurality of unit
55 area, the cutting away of any particular unit area consequently setting up means whereby any individual operation of the series or groups controlling the ultimate setting up of a symbol can be effected at any later time. 60

In the preferred form of construction of the machine, keys are provided either corresponding identically with the symbols ultimately to be set up for printing or according to some function thereof. The operation of these keys will then cause the operation of individual punches or the like elements deforming or otherwise altering the operative surface of a strip fed forward by space, that is to say the width of a unit area
70 at each operation of the key, whether this be a spacing key or the key for a definite symbol, or again the key of the selection of a group or of a series of any other one of the variable controlling the setting up of the
75 symbol. Any suitable escapement means can be provided to feed the punch strip forward.

It is preferred that the symbols may be set up visually by the operation of the punching
80 keys corresponding to them so that the operator will have before him a ready means of appreciating how far he has progressed in the establishment of a line of symbols. It is preferred also that some visual or optical
85 indicating means will be provided so that he will also readily see as to what space will be left at the end of the line, so that he will be able to make the decision as to whether he will transfer a fresh word on to a fresh
90 line or will include it in the line in which he is at that time operating.

The usual signalling means such as a bell or the like can be provided to indicate to him as to when he is entering upon the permissible stop length. 95

Having therefore operated a key for the establishment of a punched hole or the like in the operative control strip, the operation of a further key will determine the group 100

such as the type of letter or keys, and again he may operate further keys as to the size of character.

The continuation of the set position of style, of character, size of character and the actual character automatically defines its spacing which is effected automatically when the group in the series have been selected or set up by the establishment of the keys corresponding thereto. At the end of any line of set up type, that is to say when the control strip has been punched with indicia corresponding to the symbols in other groups or series, justification of the words forming the line of type will be necessary. For each unit of spacing it is preferred to set apart a unit area of the punched strip so that when the end of a line is reached, the spacings between individual words forming that line can be automatically justified.

It is preferred however to arrange for a separate group of unit areas on the control strip at the end of each line so that master corrections can be made here to correct any error in the original setting up of a symbol or spacing.

Where the translation of the control strip is effected electrically, it is preferred that such correction means will be arranged in series with the main setting mechanism so that the setting up of an element by one of the punchings on the control strip will only be effective that is not corrected by a punching on the particular master area of the said control strip.

The translation of the control from the control strip to the element setting up of the stencil symbols, spacing and the like, can be effected either mechanically by means of jacquard fins co-operating with the punchings in the strip or by means of electrical contacts where the strip of insulating material allows for the passage of electrical brushes or the like contact elements through the punch holes or like punchings therein. These punchings whether affecting the operations either mechanically or electrically, preferably do so by step-by-step mechanism displacing the elements which they control, preferably through micrometric means. One type of micrometric means is set forth in my co-pending application United States Serial No. 602,475, filed Nov. 21, 1922.

By way of example the existence of a punching in a particular unit area on the control strip may move forward the stencil band in the light path either longitudinally or again laterally. The punching of the control strip may be performed either electromagnetically or mechanically by the operation of the keys.

The escapement for the carriage or the like carrying the matrix or the element receiving the light impressions such as a photographic or lithographic plate or film will be operated

by micrometric control preferably operating step by step from a single punch perforation on the control strip.

In a convenient form of construction the source of light for obtaining a photographic image is arranged centrally to the stencil carrying the spindle rotatable around it into suitable position whilst the projection lenses are also rotatable around the source of light as also is the photographic film paper, metal sheet, cylinder or other element receiving the light beam for the formation of an image thereon.

If desired every operation or combination of the machine necessary for the selection of any particular symbol or its spacing or the spacing of groups of symbols or other justification has been set up as a line may have a numeral assigned to it so that by establishing this numeral in the machine that operation will then be subsequently automatically performed. This numeral can be established by sets of keys one set for instance operating the setting up of numerals from 1 to 5, a second set multiples of 5 to 25, and a third set from 25 to 125 and so on, or again these numerals can be set up by keys the values of which are arranged in geometrical progression or other suitable series so that the setting up of any numeral by the keys of the machine will operate the ultimate setting up of the symbol of the desired form, spacing, size or other characteristic on the matrix or reception element.

This may be obtained by causing the operation of any key to select the particular area for the punching on the control strip so that the operation of a very few keys can operate a large variety of punching on the control strip and can consequently operate a very large variety of operations.

The present invention is more particularly described with reference to the accompanying drawings in which:—

Fig. 1 is a perspective view of the entire machine.

Figure 2 is a diagrammatic view showing a form of construction of operative table of a punching machine.

Figure 3 is a diagrammatic view of a photographic composing machine.

Figure 4 is a perspective rear view of a modified form of construction.

Figure 5 is a rear perspective view of the machine with the carriage and other parts removed.

Figure 6 is a front elevation of the carriage.

Figure 7 is a right hand end view.

Figure 8 is a corresponding left hand end view.

Figure 9 is a detail of the drive for the receiving film.

Figure 10 is an end view of part of the winding back mechanism for the carriage.

Figure 11 is a part sectional elevation corresponding to Fig. 9.

Figure 12 is a diagrammatic plan view of the toggle displacement for the lens.

Fig. 13 is a detail view of a part of Fig. 11.

Fig. 13^a is a view of a part of the casing with the rock mechanism for the casing shaft 32.

Figure 14 is a perspective view on an enlarged scale of the automatic focusing mechanism, whereby the size of projected character is determined.

Figure 15 is a detail view of means for altering the ratio of displacement of the carriage according to varying size of character.

Figure 16 is a corresponding side view.

Figure 17 is a perspective view of a part.

Figure 18 is a plan view of a setting mechanism.

Figure 19 is a sectional end view.

Figure 20 is a plan view showing the carriage diagrammatically.

Figure 21 is a detail.

Figure 22 is a bottom plan view showing magnets on the carriage.

Figure 23 is an end view of a setting cam.

Figure 24 is a sectional view of one of the setting cams.

Figure 25 is a sectional end view of the pin element co-operating with the setting cams.

Figure 26 is an outside view of the pin element on the shaft.

Figure 27 is a view in perspective of the film.

Figure 28 is a plan view of the drums.

Figure 29 is a detail control drum.

Figure 30 shows the drive for the drums.

Figure 31 is a corresponding plan view.

Figure 32 is an outside elevation of the main control drum.

Figure 33 is a corresponding plan view partly in section.

Figure 34 is a sectional elevation on the line Y—Y of Fig. 32.

Figure 35 is a detail.

Figure 36 is an outside view of the commutator drum.

Figure 37 is a view showing the control for the carriage magnets.

Figure 38 is an end view of a plug panel 36.

Figure 39 is an end view of the contact socket panel co-operating therewith.

Figure 40 is a plan view of the plug panel.

Figure 41 is a wiring diagram of the controller of Fig. 36—39.

Figure 42 shows an example of the punch strip.

Figure 43 is a wiring diagram of the complete apparatus.

Figure 44 is a view on an enlarged scale of the commutator switch contact.

Figure 45 shows diagrammatically a justification means.

Figure 46 shows a modified form of line justification means.

Figure 47 is similar to Figure 46 with the parts in another position.

Figure 48 is similar to Figures 46 and 47 but the parts in the justification position.

Figure 49 shows the connection of the justification means with the spacing means.

Fig. 50 is a perspective view of a stencil strip.

The principle and operation of the machine would be briefly described with relation to the form of construction shown in Figs. 1 and 2, in which 1 is an operating table having a plurality of keys 2, and slides 3, 4. An indicating mechanism is shown at 5.

The adjustment of an element in the slide 3 taken by way of example, caused the automatic selection of the style of type, that is to say either roman, Arabic script or the like. This type is in the form of a negative matrix or stencil on a film band 6, wound on and off the drums 7, 8.

As the photographic reproduction from the negative matrix or photographic stencil 6 can proceed automatically at a very much higher rate of speed than the operation of keys on a key-board corresponding to letters can be effected manually it will be desirable not to control the displacement of the negative matrix or stencil film 6 directly from the said keys 2, but rather through an intermediate control mechanism, which by this invention comprises an element such as a perforated strip 14 carried by rollers 9, 13 which may subsequently operate the necessary displacement of the strip 6 and like parts through electric selective mechanism, jacquard mechanism or other like means. The displacement therefore, of the element within the slide 3 will cause the punching of a slot or other indication on a strip within the casing 1, whilst the operation of a slide element 4 governing the size for instance, of the character within the group of the particular style selected will cause also a second indication to be punched on the said strip in pre-determined relation and grouping to the first punching. Similarly the depression of a key 2 corresponding to a particular letter or unit within the group or style will also operate a separate and individual punching in the strip.

The operation of the keys 2, not only causes a particular punch in the record strip, but also the setting up in visible character to the operator of the typed matter in the window 5^a, of the indicator 5, so that he will be aware as he approaches the end of a line of typed matter, and the amount of justification necessary in the spacing of the individual units or letters of the words and the words themselves. The operations of another key such as 2^a will operate the punch

of a further indication on the record strip to automatically later effect the necessary justification of the symbols, that is to say, the space through which the carriage must ultimately be fed between the successive exposures of characters.

Should any error have been made in the setting up of indications or punchings in the record strip 14 this can be corrected by the operation of further keys such as 2^b, which in a certain pre-determined area of the record strip also causes the operation of certain corrective punchings.

The record strip 14 then obtained from one or a number of operative tables 1 is passed from a drum 9 on which it is wound over a guide roller 10 and through a master control box 11, then through a control box 12, to be wound up upon another drum 13. The control boxes 11 and 12 are so arranged relatively to one another that the normal operative portion of the record strip 14 lies within the box 12 when its corrective portion lies within the box 11. The electro-magnetic mechanism operated by these control boxes are arranged in series with one another so that the mechanism of box 12 only comes into operation if not cancelled or corrected by box 11.

The record strip 14 therefore, by passage through boxes 11 and 12, causes firstly, the unwinding of the strip 6 until a certain area is reached, then displaces the strip within the area selected until a definite unit is reached and comes into the light path of a projection system 15, whereupon the focussing mechanism 16 is automatically operated by the record strip, due to the particular punching following the operation of the slide 4.

With a view to avoiding the effect of inertia in the form of construction shown, the projection apparatus 15, with focussing mechanism 16 remains stationary, whilst the surface 17^a upon which the character from the strip 6 is to be received is arranged within a light-tight casing 17, capable of rotation about a pivot whilst also the casing 18 carrying a drum 7, 8 is also rotated about the same pivot, so that therefore, in this case the drums 7, 8 will be wound or unwound respectively until a certain area is reached corresponding to a certain style, whereupon the casing 17^a is oscillated about its pivot to bring from within this area a certain character on the strip 6 in the projection system 15.

The operative details of the machine according to the present invention will however, be more particularly described with reference to the modified construction shown in figures 3 et seq.

In this form of construction the negative matrix or film stencil 6 is mounted on a pair of drums 19, 20 (Figs. 27, 30) displaced together with the projection lens mechanism 21

relatively to the receptive sheet or receiving film wound on and off drums 22, 23 on a carriage 24, within a light-tight casing 25 (Fig. 3).

The stencil strip 6 in Fig. 50 is illustrated as having a series of characters arranged thereon, and it will be noted that portions of a gothic and an italic gothic alphabet are illustrated in sequence on this portion of the strip.

Receiving film carriage and drive therefor

The carriage comprises a pair of end frames 24^a carrying guide rollers 26 running on rails 27 within the casing 25 (Figure 3). The carriage is connected by a cord 28 running over a pulley 29 on the inside of the casing 25 to a drum 30 (Figure 10) freely revoluble on its spindle. Adjacent to drum 30 is an electro-magnetic clutch 31 keyed to the driving spindle 32 so that whenever the clutch 31 is energized through the contact rings 33 and brush connections 34 (Fig. 11), the drum 30 will be connected to the shaft 32 to wind the cord 28 upon it so as to displace the carriage 24 along the rails 27.

The main driving shaft 32 (Figures 6, 7, 8 and 12) is mounted in bearings in the casing 25 and on the outside of the casing passes freely through a pair of electro-magnetic clutch elements 35, 36. The electro-magnetic clutch 35 (Fig. 12) is solid with the casing 25 so that when it is energized, the shaft 32 will be locked rigidly in any position of adjustment. This shaft 32 has a flange 37 rigid on it between the electro-magnetic clutch 35 and the similar clutch element 36 loose on the shaft 32. The element 36 has a crank pin 38 through which it is connected by means of a connecting rod 39 with one end of a pivoted lever 40, the opposite end of which bears on a wedge or cam 41 mounted on a shaft 272, which is constantly reciprocating.

A pair of feathers (not shown) engage with the groove 32^a in the shaft 32 and are keyed within bushes 45, 46, one having right hand ratchet teeth, whilst the other has left hand ratchet teeth, and which are respectively held up to a pair of correspondingly toothed sleeves 47, 48 by springs 49.

The sleeve 47 has a pinion 50 driving an idler 50^a meshing with the pinion 51 sliding on a key-way on a spindle 52 having a pin drive on the socketed end of the drum 23. Similarly the sleeve 48 has a pinion 53 driving an idler 53^a meshing with a pinion 54 keyed on but slidable along a spindle 55, similarly provided with a pin drive to the drum 22.

The spindles 52, 55 can be withdrawn against the springs shown by means of the hand-knobs 56 to release the rolls 22, 23 when desired.

It will consequently be seen that owing to the ratchet couplings 45—47, 46—48, one

drum 23 will be rotated when the shaft 32 rotates in one direction whilst the other drum 22 will be rotated when the shaft 32 rotates in the opposite direction, but the driving drum for any particular direction of rotation can over-run the other when necessary.

The receptive sheet or receiving film 57 (Figure 8) has notched sides to engage with a pair of driving cog-wheels 58 sliding on but driven from the shaft 32.

Finally the carriage has a flange rail 59. This flange 59 is adapted to be periodically electro-magnetically clutched to a bar 60 periodically oscillated between set but variable limits, as will be hereinafter described in regard to Figs. 15 to 22, and 41.

A hand-wheel 61 is mounted on the end of the shaft 32 for hand operation when desired.

In the printing of successive characters on the sheet 57 by the photo exposure and development from stencil symbols or matrices on the sheet 6, it will be obvious that as each character has its own peculiar width so must the carriage 24 be displaced step by step by varying amounts relatively to the light path through the lens element 21.

At the commencement of a line therefore the margin of the column lies in the axis of the light path, and then after the character has been printed by being brought into the light path, the carriage 24 will be automatically fed forward not the whole width of the character space, but one half of this, and then at the establishment of the next character it will be automatically fed forward by the remaining half space amount and then, or simultaneously, as desired by an amount equal to half the letter spacing of the next letter to be established. This is effected in that (as hereinafter to be described) the bar 59 is displaced step by step by proper amounts according to the letters automatically set up in the light path.

Drive for optical projection system

The optical projection system comprises a source of light 15, (Figure 1) a shutter 62 adapted to be operated by an electro-magnet 63 when the current is passed to this electro-magnet from a main control switch drum to be hereinafter described. A projection lens 21 and the shutter 62 are mounted on a carrier 64 slidable on guides 65 rigidly mounted on the casing 25, telescopic sleeves 66 connecting the light-tight casing 25 with lens carrier 64 and projection element 15. The carrier 64 has a threaded bush 67 on it engaging with a threaded spindle 68 carried in bearings of bracket 25^a on the casing 25 and in a flange 69 on the bed-plate of the machine. The shaft 68 has a wheel 68^a on it driven from a worm 71 on a counter-shaft 72 having a wheel 73 driven from a shaft 74 lying parallel with the shaft 68 (Figures 3, 4, 14). The shaft 74 carries at its inner end

a crown bevel wheel 75 (Figs. 3 and 4) meshing with a pair of bevel gears 76 on a pair of discs 77, 78, both loose on a cross shaft 79, but either of which can be coupled at will to the said shaft 79 by a pair of electromagnetic clutches 80, 81. The shaft 79 has a wheel 82 at its outer end driven by a motor 83 or otherwise from a source of power (Fig. 3).

The current is passed automatically either to the clutch 80 or 81 or cut off from either automatically from a main control drum, as will hereinafter be more particularly described.

Differential adjustment of optical elements for the purpose of varying size or projection of image

It will be obvious that to obtain varying sizes of image projected from a stencil or matrix film 6 on the drums 19, 20 upon a sensitized sheet 57 within the casing 25, not only will the lens carrier 64 have to be displaced but also either the sensitive sheet 57 or the stencil film 6 on the drums 19, 20.

In the arrangement shown by way of example in the drawings, the mechanism supporting the stencil film 6 has been arranged to be the second movable element and is connected to the carrier 64 by means of cam controlled toggle levers.

The carrier 64 has on its lower end a bracket 84 and also a central bracket 85 (Figures 11 and 14). The bracket 85 carries a pin 86 (Fig. 11) forming one of the pivots of a pair of levers 87, 88, the outer ends of which are in turn connected by pivots 89, 90 to a pair of levers 91, 92, the mutual pivot 93 of which is connected to a bush 94 on a slide 95 moving along guide bars 96, mounted in the bracket 25^a of the flange 69 and in the casing 25 respectively. The levers 87, 88—91, 92 form a pair of toggles so that the pin 93 and bush 94 are displaced according to the location of the pin 86 and of the pivots 89, 90, which latter engage respectively inclined planes or cam surfaces 97, 98 respectively.

In order more definitely to locate the position of the carrier 64 it is preferred that the spindle 68 be driven continuously through a clutch element provided with an overload release gear or through an element such as a friction clutch capable of slipping at a predetermined load; the accurate location of the carrier 64 being obtained by the engagement of a pivoted pawl 99 (Fig. 12) on the pin 86 of the bracket 85 which engages with one or other of a number of steps or teeth 100 on a toothed cam surface of a cam drum 101 (Fig. 11) carried on a shaft 102 mounted in suitable bearings on the machine. Whenever the shaft 102 is moved clockwise the pawl 99 is swung about its pivot to operate a reversing switch reversing the drive of

the shaft 74 by cutting out one of the magnetic clutch coils 80, 81 and energizing the other one. The shaft 102 is provided with means for turning it angularly within rigid but variable limits. Such means for instance, may comprise an armature 103 (Figure 42) mounted on a shaft 102 and having radial fins 104, co-operating with the poles of double magnets 105, 106, 107. Current is applied to either magnets 105, 106, or magnets 106, 107 according to the direction of rotation desired, the flow of current being controlled by a commutator ring on the shaft 102 preventing the armature 103 from rotating more than one step at each current impulse.

The magnets 108, 107 are each arranged slightly out of phase with the magnet 106 as shown to make certain the direction of rotation of the armature 103, should this at any time come into position, shown in the drawing, in which a pair of fins 104 lie symmetrically with the pawls of the electro-magnet 106.

Any other means providing definite but variable location of the shaft 102 may be used.

In certain cases depending on the characteristics of the lens element used in the optical projection system, the pin 93 will not require to be moved constantly forward with the continued forward motion of the pin 86, but after a certain position is reached will be required to be moved backwards at a variable rate during the further forward progress of the pin 86. This is obtained by providing cam surfaces 108, 109 (Fig. 11) adapted to come into contact with and operate the inward motion of the levers 87, 88, and thus displace the pin 93 backwards.

Springs or weights (not shown) are provided to hold the parts up to their working positions.

Control of carriage displacement for varying size of character

The bracket 84 on the carrier 64 has a rack 110 (Figs. 3 and 14) on it engaging with the pinion 111 on a spindle 112 which has a pinion 113 engaging a rack 114 (Figures 15-17). The rack 114 has a guide groove cut in it to receive a cross slide 115 carrying a knife edge 116. The slide 115 is slotted to form a guide for a bar 117, the said bar being connected to the slide 60 which in turn carries the magnet 190^a.

The knife edge 116 co-operates with one side of a curved cam lever 118 pivoted to the machine base, the other curved cam surface of which lever co-operates with a knife edge 119 on a head 120 on the spindle 121 which spindle 121 is capable of reciprocation between precisely accurate but differing set limits. It will consequently be seen that by a relative displacement of the knife edges 116, 119 any amount of displacement of the spindle 121 can be accurately multiplied or

divided by any ratio and increase in size determined by the ratio of optical magnification obtained by the setting of the carrier 64 and light projection element 15, as hereinbefore described.

Setting mechanism

One means for accurately displacing the slide 60 between precisely set limits is shown in Figures 18 to 25. For the sake of clearness the mechanism giving the variable ratio of displacement shown in Figures 15 to 17 are omitted from these drawings.

A spindle 122 receives a constant oscillation from the main drive and rocks through shaft 172 the spindle 123 connecting a pair of end flange pieces 124 provided with a bridge 125 supporting a plurality of electro-magnets 126. These end flanges also carry a cross spindle 127 supporting a plurality (four in the present instance) of pawls 128 having extension levers 129 controlled by springs 130 to normally lie with their teeth out of contact with the respective ratchet rings 131 four in number, each having a key 132 (Fig. 21) sliding in a groove in bushes 133, (Figs. 23 and 24) which bushes are recessed to receive sleeves 135, and have cam teeth 136 on one face, the front and rear edges 137, 138 of which respectively are ground with extreme accuracy, as these provide the set limits for displacement of the spindle 121 in the particular construction shown, each having surfaces 137, 138 set at extremely accurate displacements to one another, these displacements differing for each of the bushes 133. These surfaces at the cams 136 co-operate with pins 139 on bushes 140, which slide along a key-way on the spindle 121.

Should any one of the four magnets be energized by way of example, the arm 129 and the pawl 128 will be lifted to bring the pawl into range of the teeth surface of the ring 131, so that on reciprocation of the flanges 124 from the shaft 122 the spindle 121 will be displaced against the spring 141 by a precisely accurate amount determined by the distance between the precisely ground surfaces 137, 138 of the sleeve 135 corresponding with this particular ring.

It will be understood that if any one of the electromagnets 126 is energized, the respective lever and pawl 128, 129 is moved so that upon the reciprocation of the shaft 122, the ring 131 will be rotated through a fraction of a revolution, whereby the pin 139 of the respective bushing 140 is caused to move from the low surface 137 to the high surface 138, with an endwise displacement of the respective bush 140 corresponding to the distance between these surfaces 137, 138. This causes a displacement of all of the corresponding members 133, 135, 140 toward the right in the figures, with a final movement

of the end cap 131^a which is secured to the spindle 121 and produces a similar movement of the spindle 121 and therewith a movement of the transfer system including the electromagnet 190^a, with the final result that the flange 59 on the carriage 24, 24^a is moved and therewith the sensitive surface 57. If more than one of the electromagnets 126 is actuated, there is a corresponding movement of more than one of the rings 131, whereby the corresponding pins 129 cause a movement in proportion to the distances between the respective surfaces 137, 138 so that an increased movement over that of an energization of a small electromagnet 126 results, with a correspondingly greater movement of the spindle 121.

Means to be hereinafter described are provided so that the magnet will only be energized during any one reciprocation of the shaft 127.

By selecting the distances between the surfaces 137, 138 of the consecutive sleeves 135, in the well-known definite mathematical progression where 1, 2, 4, 8, 16, it will be seen that any single oscillation of the shaft 121 can be turned through a variable distance, either of unity or of anything between this and the sum of all the displacement heights of the various sleeves 135.

Control for negative matrix or film stencil

The negative matrix or film stencil 6 is carried upon supply spools 142, 143 and passed over guide pulleys 144, 145, (Figures 30 and 31) and partly over the peripheries of the toothed drums 19, 20 engaging in the perforations in the edge of the film stencil strip. This perforated edge also engages with a locating wheel 146 (Figs. 27 and 30) to accurately space it into position.

On the spindles 147, 148 respectively are small cams 149, 149^a. The shaft 147 is integral with the shaft of the drum 19 but the shaft 148 has a pinion 150 on it gearing with the pinion 151 on a countershaft 151^a carrying a gear wheel 152 meshing with a pinion 153 on the shaft 154 of the drum 20. The reason for this is that the drum 20 will be turned through the gears 150, 151, 152, 153, to bring the film stencil into a new group area for the setting of a different "style", whilst this film stencil receives its motion within this group area with the setting of an individual "character" by operation of the drum 19.

The shafts 147, 148 respectively may each be rotated between precisely accurate angular limits either by a synchronous electrical mechanism as shown in Figure 15 or by mechanical step by step displacement, shown with reference to Figures 18 to 20 inclusive, such mechanism being controlled from a master control drum as will be more particularly hereinafter described.

Where however, the shafts 147, 148 are rotated by means such as the synchronous mechanism shown in Figures 15, it will be desirable to more accurately locate their position. This is effected by the displacing of pivoted levers 155 from the setting mechanism 156 (Fig. 1) which may be similar to the setting mechanism described with reference to Figures 18 and 20, connection between the spindle of the setting mechanism 196 and the ends of the lever 155 being omitted from Figure 27, for the sake of clearness. These levers 155 have (Fig. 29) a pin and slot connection 157 with a block 158 sliding in a guide against the action of a pair of springs 159, whilst the end of these levers have pins 155^a, 155^b to lie in the plane of the cams 149, 150 respectively.

As the cam 149 may have to rotate through a large number of revolutions idly, a slot 160 (Fig. 28) is provided so that the locating pin 155^a can pass through this slot at each revolution. It will be seen that the locating bar 155 can be automatically moved to a radial distance from the centre of the shaft 147 or 148 as the case may be and then the ratchet cam surface 149 or 150 as the case may be turned around from the zero position until the desired teeth surface engages with this bar 155.

Under certain conditions it may be desirable to provide one or more rows of characters on the film strip such, for instance, as three rows of character "capitals" "smalls", and "incidentals." In this case means may be provided to raise the spool drums 19 and 20 by accurately predetermined amounts by sliding a stem 161 on which these are mounted, vertically in suitable guides.

Drive is applied from the main shaft 172 (Figs. 3, 30 and 31) by gears 162^a to a spindle 162 meshing with a bevel gear 163 on a countershaft having a long pinion 164 to mesh with a pinion 165 loose on the spindle 166 of the film spool 142 in any of its three vertical positions of adjustment. Drive is communicated through gear wheels 168, 168 free on the spindles 147, 148 to sleeve 169 loose on the spindle of the spool 143. When therefore it is desired to rotate spool 143 in the directions indicated by the arrow in Fig. 30, the electromagnetic clutch 170 is energized to lock the sleeve of gear 169 to the shaft of the spool 143, the drive to the spindle of spool 142 then slipping by reason of the overload friction clutch connection 171 between pinion 165, and the shaft of spool 142.

Automatic control gear

The shaft of the driving spindle 79 (Fig. 4) is extended as shown at 172 and its outer end carries a worm 172^a meshing with the worm-wheel 173 driving a spindle 174 of a controller through bevel gearing 176. This

shaft 174 has a plurality of commutator rings 181 (Fig. 36) upon it arranged in groups. It will be understood that each part of the machine to be operated will be provided with a similar controller. The arrangement will be particularly described by way of example, with reference to a controller of the setting mechanism of Figures 18 to 20 and for the lateral displacement of the carriage.

The spindle 174 has a gear wheel 177 (Figs. 3, 4, 37, 41) upon it meshing with a wheel 178^a on a spindle 178 carrying a switch drum (Fig. 37) provided with pairs of overlapping segments 179, 180. The ratio of gearing between spindle 174 and the spindle 178 would be 6 to 1, in view of the fact that 6 ratchet teeth are provided on each ring 131 (Figure 21).

In series with all the contact segments 181 is arranged a contact ring 182 in an insulating block 182^a (Figs. 32 and 35) cooperating with a rotating switch arm 184 keyed on the shaft 174 (Figure 35) whereby circuit is completed once per revolution for a short period of time through contact stud 185.

At the end of each commutator strip 181 is arranged a cam 186 (Fig. 34) which once per revolution lifts away the respective spring contact 187 from the respective commutator segment 181, each of which group of contacts 187 is in circuit with one of the electro-magnets 126 of the setting mechanism (Figures 18 and 20).

Pivoted pawls 188 are provided and adapted to be lifted against the action of springs 190 whenever the magnets 189 are energized, out of range of the end of the spring arms carrying the contacts 187. It will be seen from Figure 41 that each of the commutator segments of any particular group of segments 181 is of different length to its neighbour so that the periods of time during which a magnet 126 is energized can be fixed as desired. Should it be desired, by way of example, to cause the spindle 121 to be displaced through three unit degrees then a key 2 will be depressed on the front of the machine operating either directly or through a punched strip or other intermediate mechanism energizing that pair of electro-magnets 189 which lie above the contact strip 181 which gives the duration of time of three, so that the contact 187 will be dropped into engagement with segment ring 181 and will remain in engagement therewith for one complete revolution of the spindle 174. It will be seen that during this time the main switch drum 180 has been rotated six times so that the spindle 121 has by means of the electro-magnets 190^a been clutched on six separate occasions to the flange 59 of the carriage, on three

occasions having been displaced through unit displacement.

The second electro-magnet 191 is provided mounted on the fixed casing 25 (shown diagrammatically in Figures 18 and 20) which electro-magnet is operated to lock the flange 59 from all possibility of movement during such times when it is not locked to the electro-magnet 190^a.

It will be seen that the segments 179 and 180 on the drum on shaft 178 over-lap by a certain amount so that the flange 59 will always be locked either to one or other of the electro-magnets 190^a, 191, as otherwise it would be returned to its zero position, due to the operation of the winding gear on the winch drum 30 (Fig. 10).

The face of each controller is provided with a contact panel 193 (Figs. 34, 40) having a plurality of contact studs 194 into the backs of which can be soldered or otherwise connected, for instance, by screws 195 (Fig. 39) the electrical connections, whilst the front of these studs 194 co-operate with spring plunger 195^a on a removable contact panel 196 (Fig. 38). Should any of the mechanism therefore, require inspection or adjustment it will not be necessary to break any electrical connections, as these remain permanently connected to the panel 193.

Formation of the punched strip

A key 2 (Figure 44) will have underneath the top plate of the keyboard a rod 200 having a variable number of contacts 201 below it, closing one or more circuits of a number of electro-magnets 202, which cause the expansion of an element 203 in a similar manner to the setting mechanism 124, 126, so that on the revolution of a cam 204 on the rod 205 a variable number of punchings will be inserted into the punched strip 14.

Operation of the stencil film from the punched strip

The spindle 147 of the spool drum 19, the rotation of which between a limited area selects the desired character is connected through a three to one bevel gearing 248 (Figs. 44, 45) with a spindle 249 carrying a number of squirrel cage commutator drums 250, 251, 251^a. . . each of which is divided into three separate portions corresponding with three separate segmental portions on a contact drum 252 on the spindle 148 of the spool drum 20, forming a closed circuit between a number of brushes 253 and the perforations in the punched strip 14. According therefore, to the number or disposition of punched holes in the strip 14 as it passes below the brushes 253, so will a number of these be energized to make contact through one or more connections 254 with the setting element 156 (Fig. 1) controlling the stop 155 for the snail cam 149 (Figs. 27, 28). The spindle 147 of the snail

cam will thus be rotated as above described to rotate the spindle 249 and bring the commutator drums 250, 251, 251^a to a predetermined position completing the circuits through one of a number of rings 252 on the shaft 148 so that a contact is selected among the squirrel cage commutators 250, 251, 251^a... which will correspond with the character corresponding to the particular punched hole, that is to say that for each stencil on the film bands 6 there is one contact to be found on the arrangement 250, 251, 251^a... This will therefore, complete a circuit from the respective brush 253 through respective conductor 253^a to a setting mechanism 124, 126 for displacing the carriage by that particular spacing of that particular character.

The necessity for the above will be obvious as each character in each style will have a different letter spacing. The bars 254^a of the squirrel cage, in this particular instance 24 in number, being ranged in four sets of six corresponding with four drums of the controller on six duration contact segments on each controller, the wires 255^a leading away to the coils 189.

The rings 250, 251, 251^a... which carry 3 brush contacts 255 contacting one at a time with contact studs 256 on insulating disks 256^a to be rocked into one of 30 positions corresponding to one of 30 different styles available and corresponding with the 30 contacts on the rings 252 and connected thereto by the conductors 256^b.

Line justification

In setting up letters to form words in a column it will be obvious that depending on the width of the individual letters and depending on the number of words there will be left a space at the end which will have to be divided between the words in the automatic printing of these on the sensitized sheet. One form of construction for effecting this is shown in Figure 46 in which an indicator is provided 256^x showing in one window 257, the value corresponding to the maximum width of column, then as each character is pressed, a number wheel 258 at another window will be turned from a shaft 259 having a gear co-operating with the toothed segment 260, this shaft 259 being moved from the setting mechanism 261, which may be the same identical setting 124, 126 as operates the carriage displacement so that the spindle 259 is turned by the main equivalent of any particular letter spacing. As each word is completed the operator will close a contact 262 to set up in a window 263 the number of words in the line to advise 256, as in the form of a calculating machine, which shows on a number wheel 264 the remainder between the number of spaces already occupied by letters in the line and operating automatically the division in the value in the window 263 and in the value in

the window 264, obtaining the result as shown in the window 265, thereby completing electric contacts so that whenever the punched strip operates this displacement of the carriage without operating the shutter 62, then electric contacts will be completed through the wires 266 for the setting mechanism 124, 126.

The lever 4 setting the width of the character may also displace the commutator drum 267 (Fig. 45) controlling the setting mechanism 261 according to the size of the character selected. It will be obvious that the lever 4, is the same lever that operates the displacement of the lens carrier 64 to a predetermined position.

Automatic line justification

If desired the justification may be purely automatic, shown with reference to Figures 46 to 49. The displacement of the carriage flange 59 from the spindle 121 of the setting mechanism 126 through magnet 190^a will cause the displacement of the extension 268 upon it, which displacement can be read off on a scale 269 on the fixed casing 25 of the machine, the carriage flange 59 being supposed to be moving in the direction of the arrow 270 (the reverse of what will actually take place in practice, but this has been adopted for the sake of clearness in drawing).

As each word is completed the operator presses the key 262^a breaking a circuit at contacts 263^a through wires 263 to an electro-magnet 264 locking a bar 265, but energizing an electro-magnet 266 connecting bar 265 to a setting mechanism 267 similar to the setting mechanism 124, 126 and the bar 265 will therefore, be displaced by a unit degree at the completion of each word thereby shunting downwards a fulcrum 268^a of a contact lever 269^a. An electro-magnet 270^a may be provided to lock the fulcrum 268^a rigid to the lever 269^a when desired.

The lower end of the contact arm 269^a engages with a number of contacts 270^b on a contact segment; one conductor only from each is shown for the sake of clearness. This conductor 272 passes to one or more coils of the setting mechanism similar to that of 124, 126 operating the punching of additional holes in the punched strip 247. The end of the contact arm 269^a is formed with a spring extension 272^a to compensate for variations in warp, according as the fulcrum 268^a is moved.

At the beginning of a sentence therefore, the parts will be in the position, for instance, as shown in Figure 46. When the sentence is complete the parts will have reached the position shown in Figure 47 showing the distance between a stop 273 and a fixed stop 274 on the fixed casing 25, which is the distance available for line justification.

tion, that is to say, the distance which has to be divided between the words to be set up in the sentence. Immediately therefore, justification is desired the slide 275 carrying the contact lever 269^a, its fulcrum 268^a, the bar 265 and setting mechanism therefor, will be locked by electro-magnet 276 to the casing 25 whereupon the flange 59 of the carriage will be displaced to its fullest extent, causing the displacement of the arm 269^a about its fulcrum, and thus sweeping the lower end 272^a over the number of contacts 270^b dependent on the two variables, viz, the distance between the stop 273 and the stop 274 and on the number of words in the sentence, the parts then coming into the position shown in Figure 48. The circuits will then be complete from the contact segment 270^b through commutator segment 20 drums 181, the circuit being completed on pressure of a justifying key 271 (Fig. 49.)

The punched strip

The operation of the machine from the punched strip will now be briefly described. Such a punched strip is shown in Figure 43 in which the strip 14 is provided with feed perforations 273^{*} at its two edges. Supposing the sentence to be typed is the following:—"What! I never said so"—then supposing that a size corresponding to size 20 available in the machine is desired and the style corresponding to style 15 available to the machine is desired, then punchings 274^{*}, 275^{*}, will be arranged in the strip 9 as the value in the particular instance taken on the punched strip from the top will be respectively 1, 2, 4, 8, 16 . . . the two punchings 274^{*}, 275^{*} thus corresponding with a size 20, whilst the punchings 276 in the next line will give a value corresponding to size 15, then if the character "W" is of a value equal to 20 there will be punchings 277 as indicated. A punching 278 in the next row will indicate that the "W" is a capital. Two spaces 279 are then left as no change in style or size has been made before the next letter small "h" has to be punched. This letter small "h" corresponding to say character 11 punchings 280 will be arranged as shown. Two spaces 281 will then follow as the style has not been altered, nor the size, and then will come a punching 282 corresponding to a value of one giving the letter small "a". At the end of the word "what" an extra punching 283 will be provided in the last line to operate the machine for word spacing and also an extra punching 284 to show that the spindle 161 supporting the drums 19, 20 must be raised into the third highest position for the special or fancy character of the exclamation mark. It will be seen then that when it is desired to punch the letter corresponding to capital "I" not only are the punchings 285 provided corre-

sponding to the particular letter, but also a punching 286 to move the spindle 161 upwards into the second position for capitals and a punching 287 to operate further word spacing.

The depression of a character key 2 feeds the punched strip forward one space and then operates the punching off, then a character key is pressed which also sends forward the brush drum to its third position. The depression however, of a "style" key brings the brush drum into the second position, whilst the depression of the key or lever corresponding to "size" moves the commutator brush drum into the first position. When the spacing key is pressed at the end of each word the punched paper or the like strip is not moved forward.

The setting mechanism of the above constructions 124, 126 and others are arranged in the arrangement shown for working in a six cycle period, that is to say in ratios of one, five, thirty, eighty, the displacement of such separate ratio being capable of six time periods.

A single cycle period however, may be adopted thereby avoiding the necessity for the control drum in which case the setting mechanism would be arranged in the ratio of one, two, four, eight, sixteen.

I declare that what I claim is:—

1. A photographic composing machine comprising a camera, means to support a light sensitive surface, displacing means for moving said light sensitive surface relatively to said camera, a carrier for light opaque character stencils and control means integral with said carrier for operating said displacing means.

2. A photographic composing machine comprising a camera, means to support a light sensitive surface, displacing means for said light sensitive surface, a flexible strip having light opaque character stencils thereon, and means having punched mutilations co-ordinated with said light opaque stencils for controlling said displacing means.

3. A photographic composing machine comprising a camera, means to support a light sensitive surface, displacing means for moving said light sensitive surface relatively to said camera, a flexible strip having light opaque stencils comprising a plurality of groups of characters, each group being of a distinctive style and means to adjust the relative positions of light sensitive surface and film stencil relatively to the camera to vary the size of projection of image to be photographed, whereby any size of image may be obtained with the use of a single individual character of a given distinctive style.

4. A photographic composing machine comprising keys for predetermining the sequence of composed letters, visible means for indicating the sequence of letters composed

operated by said keys, a flexible strip having light opaque character stencils thereon, means to support a light sensitive surface, a camera, displacing means for moving said light sensitive surface relatively to said camera, and means for displacing said character stencil relatively to said camera, and means controlled by said keys to actuate said moving and displacing means.

5. A photographic composing machine comprising keys for predetermining the sequence of composed letters, visible means for indicating the sequence of letters composed operated by said keys, a flexible strip having light opaque character stencils, and displacement determining means integral therewith, means to support a light sensitive surface, a camera, displacing means for moving said light sensitive surface relatively to said camera, and means for displacing said character stencil relatively to said camera, and means controlled by said keys for controlling the operation of said displacing means for said light sensitive surface relatively to said camera and operated by said means integral with said light opaque stencil strip.

6. A photographic composing machine comprising means to support a light sensitive surface, a camera, means to displace said light sensitive surface step by step relatively to said camera, a carrier for light opaque character stencils, a punched record strip having punchings operating the displacement of said carrier, a translation box having controls operated from said punched strip and a correction box operated by punchings in said strip to form a master control for said translation box.

7. A photographic composing machine comprising means to support a light sensitive surface, a projection camera, a carrier for light opaque stencils including means to present one stencil at a time for projection onto the sensitive surface and means to displace said light sensitive surface by half the width of the optical projection on the light sensitive surface of the respective character.

8. A photographic composing machine comprising means to support a light sensitive surface, a projection camera, a carrier for light opaque stencils and means to displace the light sensitive surface step by step by amounts equal to half the width of the character last photographed plus half the width of the character next to be photographed.

9. A carriage for rolls of varying diameter having a pair of rolls, a pinion driving each roll, an overload clutch between the pinion and each roll, a driving shaft, first one-way clutch elements on said driving shaft, and second one-way driven clutch elements cooperative with said first clutch elements and driving connections between said second clutch elements and respective pinions.

10. A photographic composing machine

comprising a light tight casing means in said casing to support a light sensitive surface means to displace said light sensitive surface step by step within said casing, a camera, a flexible film strip, having characters thereon, means to displace the optical elements of said camera to obtain varying sizes of projection of the image of said characters on the said film strip, a punched record control strip, and means operated by said strip to control said displacing means to effect the displacement of said film strip relatively to said camera.

11. A photographic composing machine comprising means to support a light sensitive surface, a photographic camera, a flexible strip having light opaque stencils thereon, means to displace said light sensitive surface step by step by amounts corresponding to the varying width of character projected, means to vary the optical relationship of the film strip, camera and sensitive surface to vary the size of image projected and means to adjust the ratio of movement of the control means for displacing the sensitive surface according to the ratio of size of the stencil and its projected image.

12. A photographic composing machine comprising means to support a light sensitive surface, an optical projection camera, a flexible strip having light opaque stencils, thereon, means to displace said strip longitudinally of its length relatively to said camera and means to displace said strip laterally of its length relatively to said camera.

13. A photographic composing machine comprising means to support a light sensitive surface, an optical projection camera, a flexible strip having light opaque stencils thereon, having groups of characters of different styles along its length and having each group divided into transverse lines comprising characters of different case, coarse adjustment means displacing said strip longitudinally of its length for selection of style, fine adjustment means for displacing said film longitudinally of its length for the selection of a particular transverse row of characters in the style group and means for displacing said strip laterally of its length for the selection of a particular case character in the row.

14. A photographic composing machine comprising means to support a light sensitive surface, an optical projection camera, a flexible strip having light opaque stencils thereon, having groups of characters of different styles along its length, coarse adjustment means displacing said strip longitudinally of its length for selection of style, fine adjustment means for displacing said film longitudinally of its length for the selection of a particular character in the style group and additional means to accurately locate said strip relatively to the camera.

15. A photographic composing machine

comprising means to support a light sensitive surface, a projection camera, a light opaque stencil, means to predetermine the sequence of characters brought into the optical path of said camera, a sequence determining
5 element, means to displace such element by added amounts as the sequence of each character is determined, mechanical means deducting the total of such amounts from a constant width of line to produce a justifying remainder, a word counting element and
10 means to displace such element step by step as each word is composed, and mechanical means controlled by said counting element to divide the justifying remainder by the number of words, a justifying device and means to operate such device according to the quotient of such division.

16. The method of photographic composition with a stencil strip having characters of differing widths thereon, which comprises bringing a receptive light sensitive surface and one of said characters into predetermined positions, momentarily projecting the
20 image of said character onto said surface, and thereafter displacing said surface by an amount determined by the particular character projected and by the distance between said character and said surface.

17. The method of photographic composition with a camera having a lens and a stencil strip having characters of differing widths thereon, which comprises bringing a receptive light sensitive surface and one of said
25 characters into predetermined positions in said camera, momentarily projecting the image of said character onto said surface, and thereafter displacing said surface by an amount determined by the particular characters projected and by the distance from said
30 lens to said surface.

In witness whereof, I have hereunto signed my name.

EDGAR KENNETH HUNTER.

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