

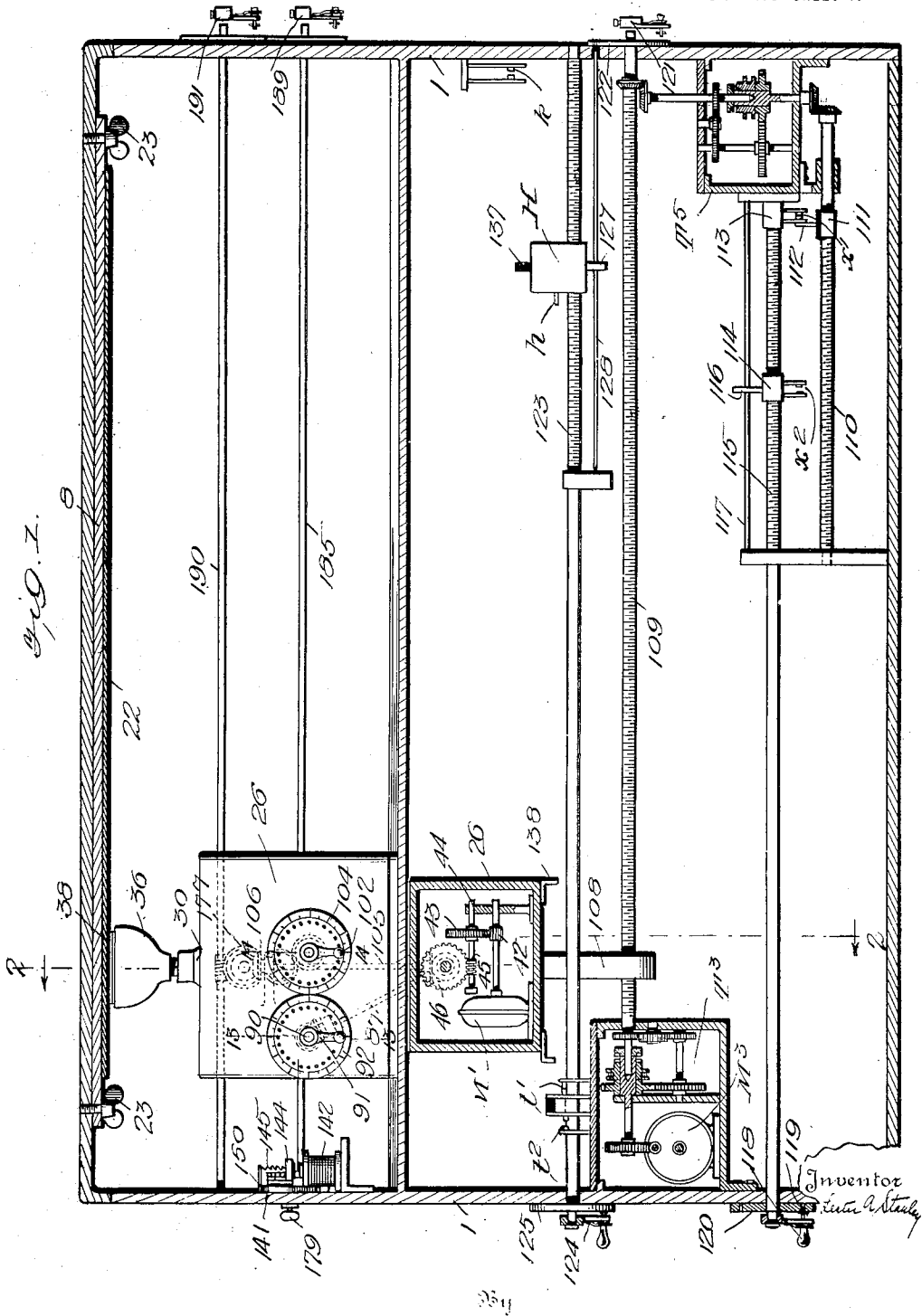
L. A. STANLEY.
PRINTING DEVICE.

APPLICATION FILED FEB. 10, 1917.

1,336,989.

Patented Apr. 13, 1920.

6 SHEETS—SHEET 1.



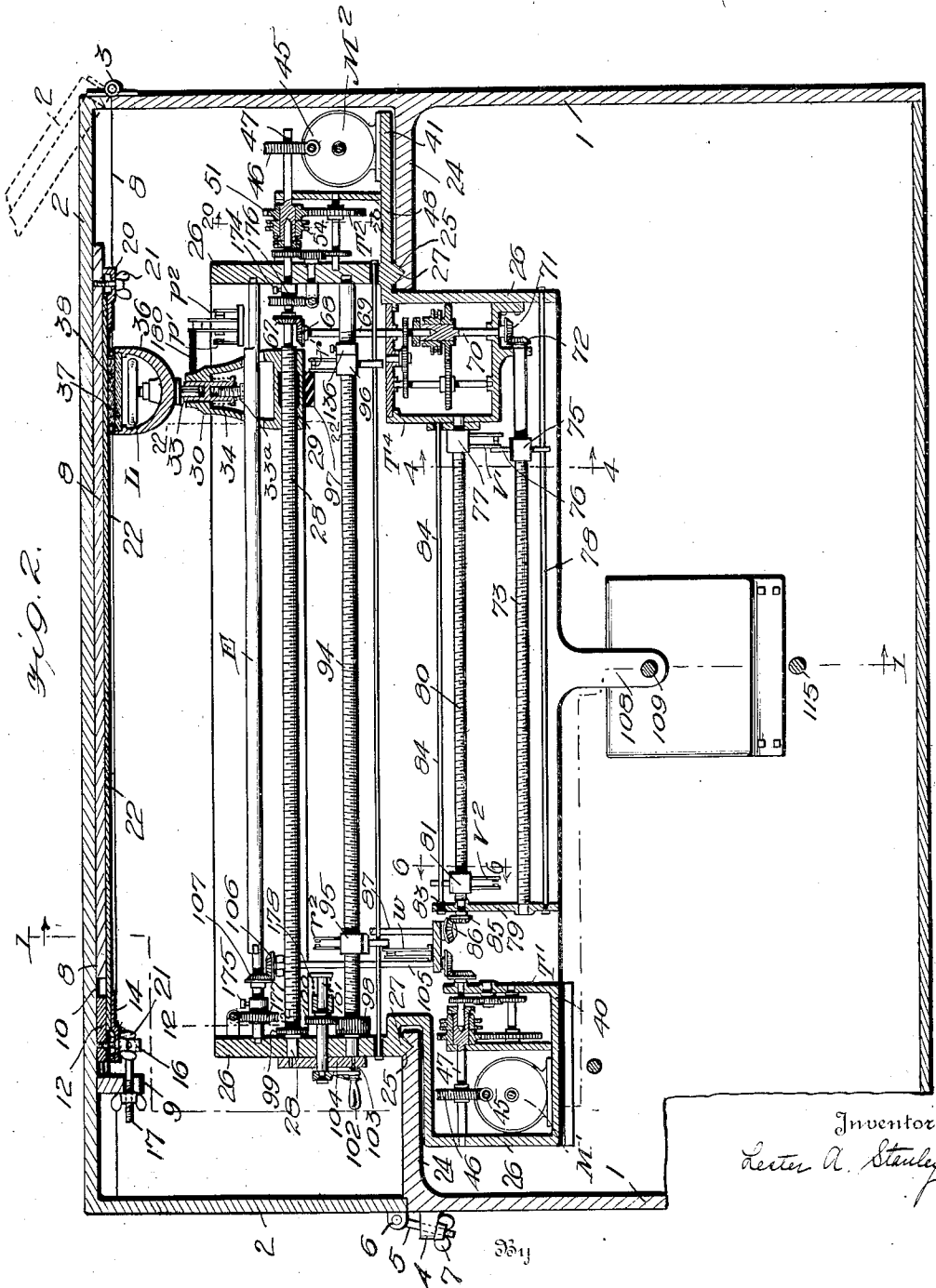
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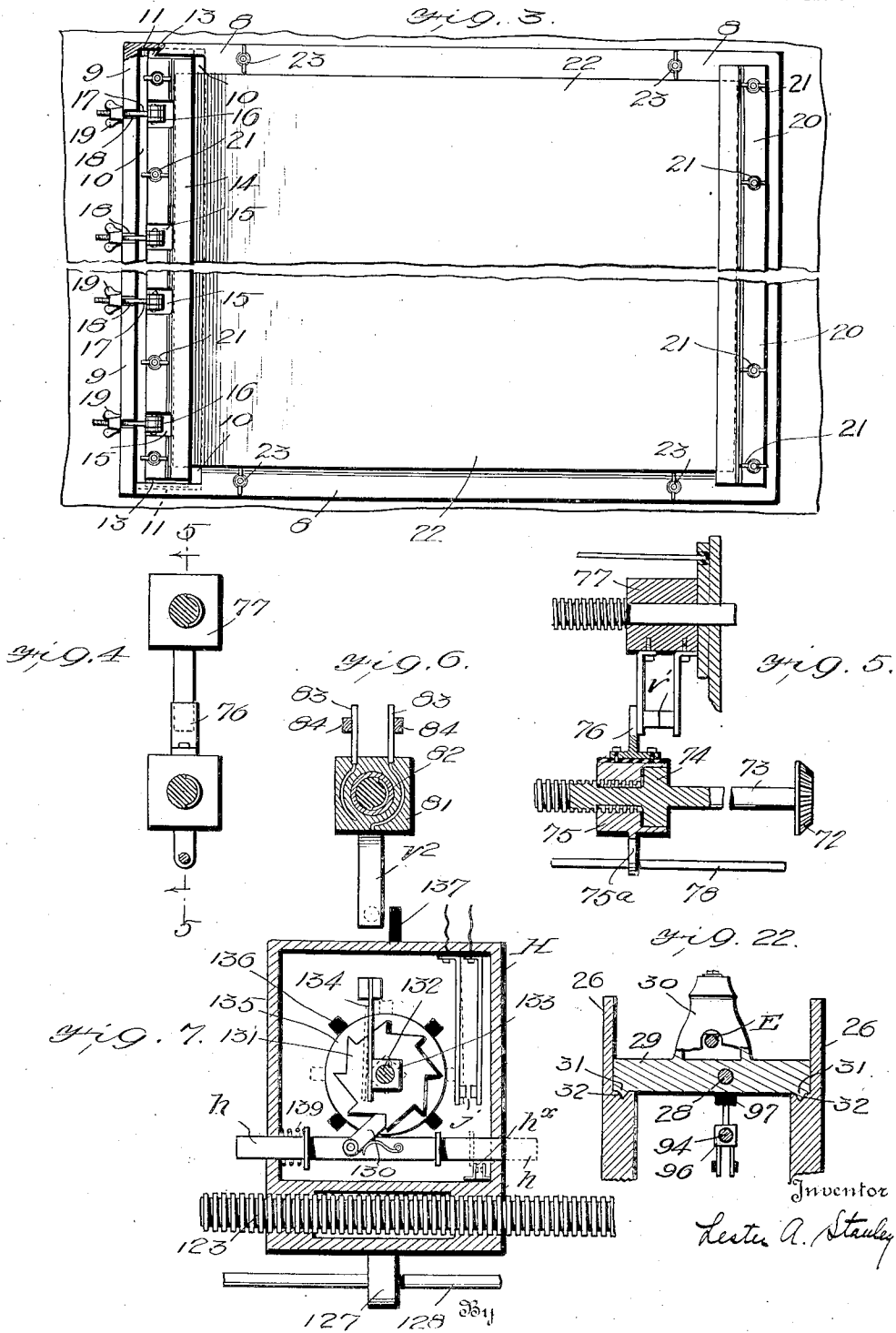


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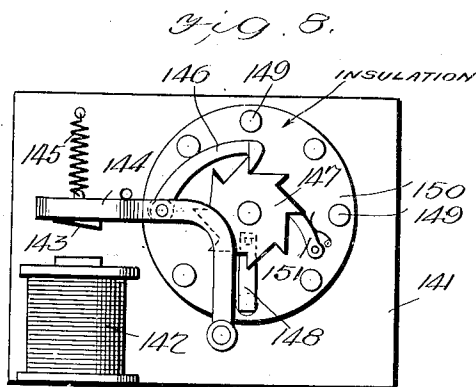
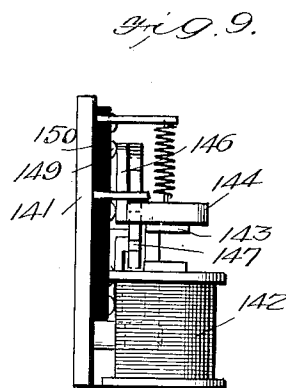
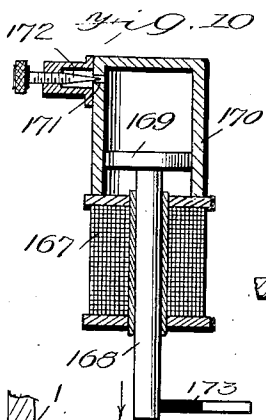
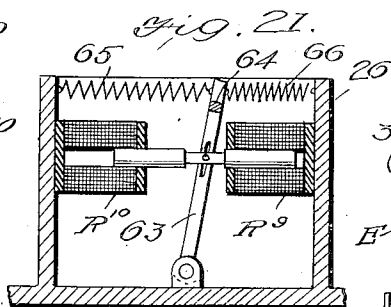
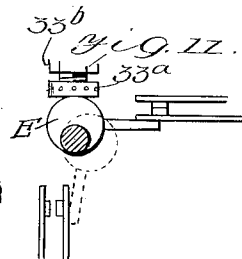
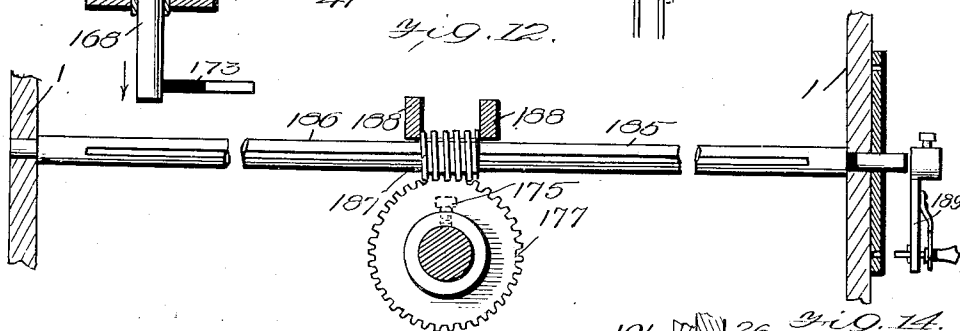
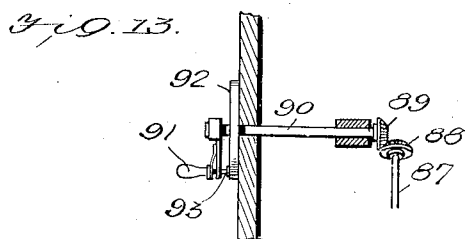
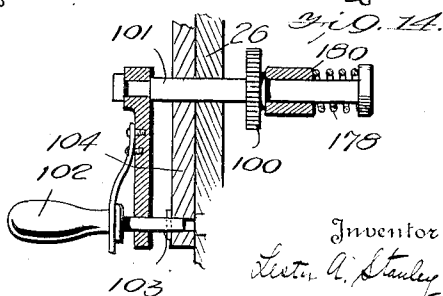
6 SHEETS—SHEET 3.



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6 SHEETS—SHEET 4.



Inventor
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6 SHEETS—SHEET 5.

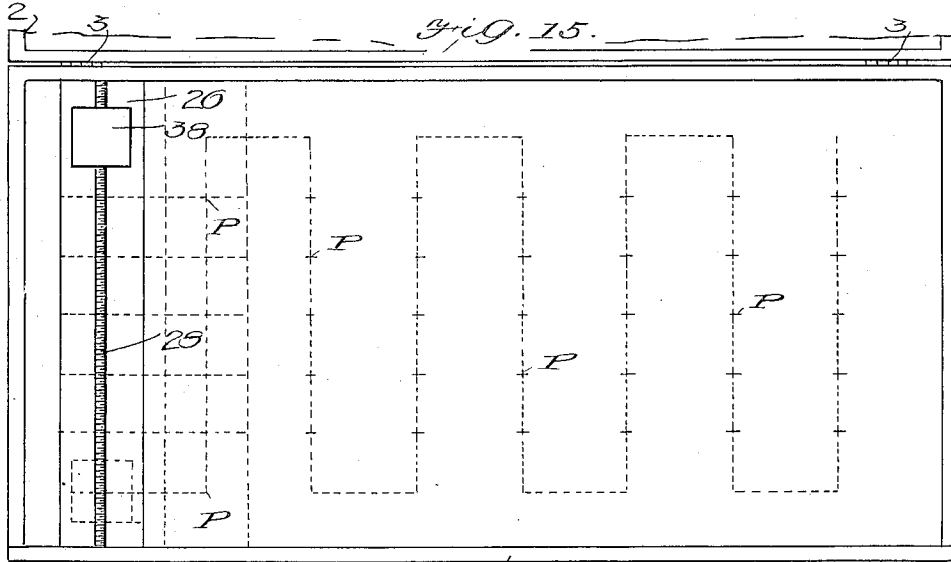


Fig. 16.

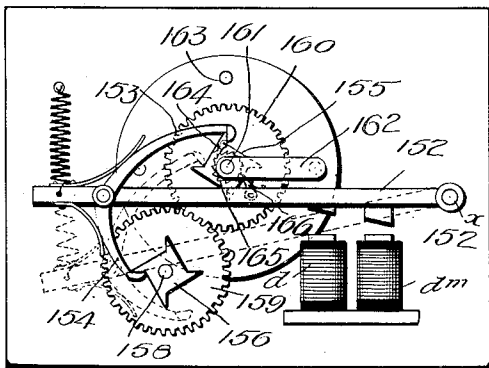


Fig. 17.

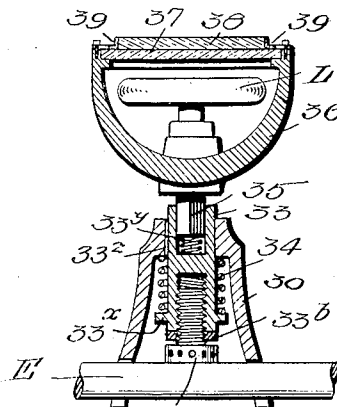


Fig. 18.

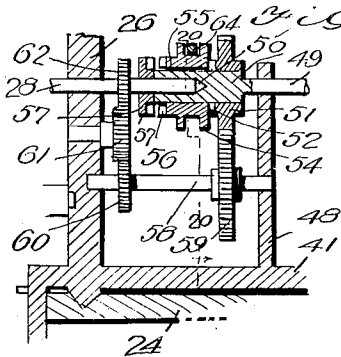
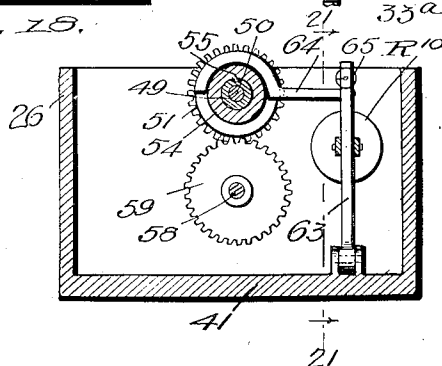


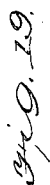
Fig. 20.

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6 SHEETS—SHEET 6.



Lester A. Stanley

UNITED STATES PATENT OFFICE.

LESTER A. STANLEY, OF WASHINGTON, DISTRICT OF COLUMBIA.

PRINTING DEVICE.

1,336,989.

Specification of Letters Patent.

Patented Apr. 13, 1920.

Application filed February 10, 1917. Serial No. 147,837.

To all whom it may concern:

Be it known that I, LESTER A. STANLEY, a citizen of the United States, and a resident of the city of Washington, in the District of Columbia, have invented a certain new and useful Improvement in Printing Devices, of which the following is a specification.

My invention relates to photographic printing devices, and it consists in the combinations, constructions and arrangements herein described and claimed.

An object of my invention is to provide a device by means of which a number of prints may be automatically made from a single negative after the machine is started, said prints being arranged in rows and columns on a single plate.

A further object is to provide a device which will space the prints symmetrically on the sensitized plate.

A further object is to provide an automatic printing device which may be also operated manually if desired.

A further object is to provide means for automatically returning the printing mechanism to its initial position when certain indicating devices have been manually reset at the end of the printing operation.

Other objects and advantages will appear in the following specification, and the novel features of the invention will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings which form a part of the application, and in which:

Figure 1 is a longitudinal section through the device, along the line 1—1 of Fig. 2.

Fig. 2 is a transverse section on the line 2—2 of Fig. 1.

Fig. 3 is a plan view of the holder for the sensitized plate.

Fig. 4 is an enlarged section on the line 4—4 of Fig. 2.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged section on the line 6—6 of Fig. 2.

Fig. 7 is a section through a switch or circuit closing device.

Fig. 8 is a face view of a step-by-step switch.

Fig. 9 is an end view of the switch shown in Fig. 8.

Fig. 10 is a sectional view of a time-retarded solenoid.

Fig. 11 is a detail view showing the contacts controlled by the eccentric shaft.

Fig. 12 is an enlarged section on the line 12—12 of Fig. 2.

Fig. 13 is a detail sectional view on the line 13—13 of Fig. 1.

Fig. 14 is a detail sectional view on the line 14—14 of Fig. 1.

Fig. 15 is a diagrammatical view showing the successive printing positions.

Fig. 16 is a face view of a double-acting switch.

Fig. 17 is a sectional view of the carriage.

Fig. 18 is a sectional view of one of the transmission gearings.

Fig. 19 is a diagrammatical view of the electrical circuits.

Fig. 20 is a section on the line 20—20 of Fig. 18.

Fig. 21 is a section on the line 21—21 of Fig. 20, and

Fig. 22 is a section through the base of the carriage and the movable frame at right angles to Fig. 2.

In carrying out my invention I provide a box or casing 1, having a cover portion 2, which is hinged at 3, and whose front portion extends downwardly. (see Fig. 2) where it rests on the casing 1. The latter is provided with a lug 4 which is slotted to receive a screw bolt 5, pivotally secured to the cover portion at 6. A thumb nut 7 is provided by means of which the cover portion 2 may be fastened securely. In practice as many of these fastening devices as are necessary may be used.

The holder for the sensitized plate is shown in Figs. 1, 2 and 3. It consists of a backing plate 8, preferably of metal, having a laterally extending flange 9 at one end. A rectangular opening 10 is provided in the plate 8 adjacent to the flange 9. Grooves 11 are provided in the plate at the ends of the opening 10, these grooves being at right angles to the flange 9. A slidable metal strip 12 has tongues 13 which enter the grooves 11 so that the strip 12 may slide in the opening 10. A clamping plate 14 is provided having openings 15 through which ears 16, carried by the strip 12, project. Hinged to the ears 16 are screw bolts 17 which are adapted

to enter slots 18 in the flange 9, thumb nuts 19 being provided to tighten up on the screw bolts. At the opposite end of the holder is a clamping plate 20. Thumb screws 21 clamp the sensitized plate 22 securely at both ends. When the sensitized plate is made of metal it may be stretched flat by tightening up on the nuts 19. The backing plate 8 is secured to the cover 2 by means of the screws 23.

Referring now particularly to Fig. 2, it will be seen that the casing 1 has portions 24 extending inwardly from opposite sides. These portions have V shaped grooves 25 near their inner edges which run longitudinally with respect to the edges. A traveling frame 26 has V shaped runners 27 which slide in the grooves so as to permit the frame to travel back and forth. As will be seen from Fig. 2, this frame 26 extends above and below the supports 24.

Journaled in the ends of the slidable frame 26, are the reduced end portions of a screw shaft 28 which passes through the base 29 of a slidable carriage 30. As will be seen from Fig. 22 the base has V shaped runners 31, arranged to slide in V shaped grooves 32 in the walls of the frame 26 in a direction at right angles to the movement of the frame itself. The movement of the carriage is effected by revolving the screw shaft 28, and by reversing the rotation of the shaft the carriage will be moved in the reverse direction. A shaft E is also journaled in the ends of the frame 26. The main portion of the shaft E is enlarged and is preferably cylindrical, but is eccentric with respect to its journaled end portions. It passes freely through the carriage 30 itself but is always in engagement with the adjustable end 33^a of a plunger 33, (see Fig. 17) which is borne by the carriage and which is raised or lowered as the eccentric shaft E is turned by the means hereinafter described. The adjustable end or head 33^a may be turned so as to vary the effective length of the plunger, a lock nut 33^b being provided to retain the head in its adjusted position. A spiral spring 34 bears on a collar 33^x carried by the plunger so as to keep the head 33^a in engagement with the shaft E.

The plunger 33 has a bore of square or other angular cross section extending downwardly, and at the bottom of this bore is a spring 33^y. A second plunger 35 is slidably disposed in the bore and rests on the spring 33^y. A feather 33^z keeps the plunger 33 from turning. The upper end of the plunger 35 bears a light tight chamber 36, in which is disposed an electric light L. The top of the chamber 36 is covered by a plate of glass 37, and the negative 38 surmounts this glass plate, being held in place by adjustable clamps 39. The plunger 35 fits the bore in the plunger 33 snugly and

the plunger 33 is provided with a feather 33^z to prevent rotative movement of the negative. It will be seen that when the eccentric shaft E is turned so as to raise the plunger 33 the negative will be pressed against the sensitized plate 22. The spring 33^y holds the negative firmly in contact with the sensitized plate but will prevent the pressure from breaking the negative. When the shaft E is turned, the negative will be withdrawn from the plate 22 so as to permit the carriage 30 to be shifted to another printing position. One end of the spring 33^y may be secured to the end of the plunger 35 and the other end to the plunger 33 so that the negative will be positively drawn away from the plate 22 by the spring 34. The pressure may be varied by means of the screw head 33^a.

I may state here that in the specific form of the invention disclosed herein I make use of three separate power devices for driving the screw shaft 28, the eccentric shaft E and another screw shaft 109 (which moves the slidable frame 26) respectively. Each power device consists of a motor, a speed-reducing gearing and a transmission mechanism. Since the power devices are precisely alike, a description of one will suffice for all. The motor for driving the shaft E is shown in Figs. 1 and 2 at M¹ on a platform 40 carried by the slidable frame 26. The motor shaft has a pinion 42 meshing with a gear 43 on a shaft 44 bearing a worm 45 which in turn meshes with a worm gear 46 on the drive shaft 47 of the transmission gearing T¹.

The specific form of the transmission forms no part of the present invention, since any suitable form having a drive shaft with means for imparting direct or reverse motion to a driven shaft through the shifting of a clutch lever may be used. The means by which the clutch lever is actuated however is a feature of the invention. The transmission is best illustrated in Fig. 18 and includes the drive shaft 47 mentioned which is journaled in the plate 48, and which has at its inner end an integral cylindrical head 49 having a bore 50 extending inwardly from the end, into which the end of the driven shaft is disposed. A gear 51 is loosely mounted on the head 49, one side of the gear having clutch members 52 adapted to engage clutch members 53 on a slidable collar 54 which is feathered at 55 to slide longitudinally with respect to the head 49 but to rotate with it. The collar 54 has clutch members 56 adapted to engage the clutch members of a collar 57 which is fixed on the driven shaft 28. An auxiliary shaft 58 has a gear 59 which meshes with the loose gear 51. It also bears a gear 60 which meshes with an idler 61, this idler in turn meshing with a gear 130

62 fixed on the driven shaft. It is obvious that either the drive or the driven shaft may serve the purpose of the other shaft. The means for shifting the clutch collar 54 is shown in Figs. 20 and 21. It consists of a pair of solenoids R^9 and R^{10} respectively, whose cores are joined together, both being connected to a rock arm 63 by a pin and slot connection. The arm 63 bears an arm 64 which fits in a groove in the clutch collar 54. When the solenoid R^{10} is energized the arm 63 will be moved into the position shown in Figs. 1 and 18, thus bringing the clutch 54 into engagement with the gear 51 and imparting to the driven shaft 28 a movement in a reverse direction from that of the drive shaft 47, through the medium of the gearing on the auxiliary shaft 58. When the solenoid R^9 is energized the shaft 28 will be driven in the same direction as the drive shaft 47 by means of the fixed collar 57. The gears are so arranged that the forward and reverse speeds are the same. When neither of the solenoids is energized the arm 63 will be held by the springs 65 and 66 in a central position. This will hold the clutch 54 in a neutral position so that no movement will be imparted to the driven shaft.

The transmission gearing described above is duplicated for several portions of the apparatus and these I have indicated generally by the reference characters T^1 , T^2 , T^3 , T^4 and T^5 .

The shaft 28, as has been stated before, is for the purpose of moving the carriage which bears the negative from one printing position to the next. The prolonged reduced portion of this shaft constitutes the driven shaft of the transmission gearing T^2 which is operated by the motor M^2 . The latter is carried on a platform 41 supported by the slidable frame 26. When the end of the row or column of prints thus made is reached, the frame 26 is moved so as to bring the carriage to the next row or column and the movement of the carriage is reversed. The carriage therefore, takes the path shown in Fig. 15, the printing positions being indicated at P. The means for stopping the carriage in its movement from one printing position to the next, in the same row or column, is as follows. A gear 67 on the screw shaft 28 is in mesh with a gear 68 on a drive shaft 69 of a transmission mechanism T^4 of the type already described. The driven shaft 70 has a gear 71 in mesh with a gear 72 on a screw shaft 73. As will be seen from Fig. 5, the shaft 73 has an unthreaded portion provided with an integral collar 74. A nut 75 is arranged to travel along the shaft 73 away from the collar 74, when the shaft is turned in one direction, and toward the collar when it is turned in the opposite direction. It will be observed,

however, that there is an unthreaded portion of the shaft 73 on the opposite side of the collar 74 from the gear 72 which the nut will reach in its movement toward the collar. When this position is reached the nut will stop, having cleared the threads, even when the shaft keeps on turning. The nut bears an insulated arm 76 arranged to close spring contacts v^1 carried by a block 77 rigidly secured to casing of the transmission gearing T^1 . When the nut is in the position shown in Fig. 5 it is under spring tension in holding the contacts v^1 closed so that on the first movement of the shaft 73 in the opposite direction the nut will be forced onto the threaded position and will be caused to move away from the contacts thereby permitting them to separate. The nut is recessed so as to fit over the collar which centers the nut when it is on the unthreaded portion and insures its immediate start when the motion of the shaft is such as to move the nut away from the collar. The nut has a lug 75^a having an opening arranged to receive a rod 78 by means of which the nut is prevented from turning.

The screw shaft 73 is journaled at one end in a plate 79. A second screw shaft 80 is journaled at one end in the plate 79 and at the other in the casing of the transmission T^4 . Disposed on the shaft 80 is a traveling contact bearing nut or block 81 provided with spring contacts v^2 . The block 81, (see Fig. 6) is preferably made of insulating material having embedded therein a metal sleeve 82, threaded internally to receive the screw shaft 80. The spring contacts are in electrical connection with the arms 83 which bear against rods 84 which are suitably insulated at their ends. The members 83 and 84 serve the double function of being means for preventing the turning of the block 81 as the screw 80 is turned and also as conductors which may be used instead of attaching flexible cables to the spring contacts.

The arm 76 is caused to travel back and forth and engages the contacts v^1 and v^2 which control the switch that cuts off or on the current of the motor M^2 and thus starts or stops the carriage 30 as will be explained later. By setting the block 81 and its contacts v^2 at predetermined distances from the contacts v^1 , the desired distance between the printing positions may be secured. The means by which the block 81 is adjusted or moved is as follows. A gear 85 on the end of the shaft 80 is in mesh with a gear 86 on a shaft 87 (see Fig. 13) which bears a gear 88 in mesh with a gear 89 on a shaft 90. The shaft 90 projects through the end of the traveling frame 26 and bears a handle 91 which is arranged to move over a dial 92 having holes into which the spring pressed locking member 93 can enter so as to lock the shaft 90

in any position in which it is set. It is obvious that by moving the crank handle 91 the screw shaft 80 may be turned to cause the contact bearing block 81 to move to any desired position. The dial 92 is provided with any suitable scale.

It is convenient in making prints to be able to locate the center of those prints which are at the ends of the row or column at any desired distance from the edge of the sensitized plate; in other words, to leave as large a margin as desired. To accomplish this I provide a screw shaft 94 upon which are located two contact bearing nuts or blocks 95 and 96 respectively. The screw shaft 94 is threaded in opposite directions from its center, so that when the shaft is turned the blocks approach each other or recede from each other according to the direction in which the shaft is turned. The shaft 94 is of the same size as the screw shaft 28 and has the same number of threads to the inch. When the carriage 30 is in its initial position, *i. e.*, as far to the right in Fig. 2 as it can go, for reasons explained later, an insulating lug 97 engages and closes the contacts r^1 carried by the block 96. The opposite end of the screw shaft 94 bears a wide gear 98, while the screw shaft 28 bears a gear 99 of the same diameter but of less width. An intermediate gear 100 is rotatably carried on a shaft 101 and is in constant mesh with the gear 98. The shaft 101 is slidably mounted in the end of the frame 26 and may be moved to bring the gear 100 into mesh with the gear 99 by grasping a handle 102 and pulling outwardly. The handle 102 has a spring locking pin 103 arranged to enter holes in a dial plate 104. With the gears 98, 99 and 100 in mesh the handle is rotated so as to cause the blocks 95 and 96 to approach each other any given distance. The carriage 30 will be moved toward the center of the sensitized plate the same distance, the contacts r^1 moving with the carriage and still remaining closed.

The automatic means by which the eccentric shaft E is turned to press the negative against the sensitized plate includes the electric motor M^1 which operates the transmission gearing T^1 of the type already described. This gearing is connected by means of a shaft 105 bearing a gear 106 meshing with a gear 107 on the shaft E (see Fig. 2).

The frame 26 is provided with a downwardly extending arm 108 which is threaded to receive a screw shaft 109 which is journaled at one end of the casing 1 and at the other end in the wall of the transmission gearing T^3 . A motor M^3 is connected with the transmission gearing and drives the screw shaft 109 in the manner hereinafter described. The means for stopping the motor M^3 after a predetermined movement of the frame 26 is as follows. The screw

shaft 109 is connected with a transmission gearing T^5 by means of which motion is transmitted to a screw shaft 110. This bears a traveling nut or block 111 like the block 75 (see Figs. 2 and 5) which has an insulated arm 112 arranged to engage and close contacts x^1 carried by a fixed block 113 and also the contacts x^2 carried by the adjustable nut or block 114 on the screw shaft 115. The block 115 has arms 116 arranged to engage rods 117 to keep the nut from turning, and also to serve as conductors. The means for stopping the motor M^3 is precisely the same as that set forth in detail for stopping the motor M^2 with the exception that the shaft 115 is extended through the casing 1 and is provided with a crank handle 118 having a spring pin 119 arranged to enter holes in a dial 120. The position of the block 114 is determined by rotating the handle 118 a definite number of times or to a given position on the dial. The pin 119 locks the shaft 115 in position.

The initial position of the movable frame 26 may be set at any desired place by turning the screw shaft 109 manually. This can be done without interfering in any way with the subsequent automatic driving of the screw shaft because of the fact that the clutches of the transmission gearings T^3 and T^5 are in their neutral or disconnected positions until their solenoids are energized. A removable crank handle 121 is applied to the projecting squared end of the shaft 109 and the shaft may be turned until the dial 122 indicates the desired position, after which the handle is preferably removed. The means for automatically stopping the printing operation at any desired position, that is to say after a predetermined number of rows or columns have been printed, comprises a screw shaft 123 which is journaled in the opposite ends of the casing. One end is provided with a crank handle 124 and dial 125 like that shown in Fig. 1. The other end is threaded as far as desired and is provided with a traveling switch of the form shown in Fig. 7. This switch has a casing H the bottom of which is threaded to receive the screw shaft. An arm 127 is provided which receives a rod 128 to keep the casing from turning. A push rod h extends through the casing from one side to the other. The rod h has a spring pressed pawl 130 which engages a ratchet 131 on a shaft 132. Secured to the ratchet is a square lug 133 upon which a leaf spring 134 presses. A disk 135 is provided with insulating lugs 136. When the rod h of the switch H is engaged by the lug 138 on the forwardly moving frame 26 (see Fig. 1) it is pushed inwardly, turning the ratchet 131. The spring 134 at first tends to resist this movement but after the lug 132 has passed its dotted line position in Fig. 130

7 the spring 134, aided by a spring 139, gives the ratchet a sudden throw causing the disk to bring one of the studs past the contacts j momentarily closing them. The closing of the contacts j operates a switch which controls the circuit of the motor M^2 thereby stopping the latter. Now when the crank handle is reversed to bring the switch back to its normal position at the end of the casing the projecting end of the rod h shown in dotted lines in Fig. 7 will engage the casing wall and will be pushed back into its operative position, the pawl 130 riding over the teeth of the ratchet. When the switch H reaches its normal position the insulating arm 137 closes the contacts k . Any other suitable form of switch for effecting a momentary closure of the contacts j might be used in lieu of that shown.

20 In Fig. 19 which shows the circuit connections, the switches A, B, C, F and G are of the step-by-step type shown in Figs. 8 and 9. A plate 141 bears a magnet 142 whose armature 143 is at the end of a lever 144 which is normally retracted by means of a spring 145. The lever bears a pawl 146 which engages a ratchet 147 having an arm 148 which engages contacts 149 carried by a plate 150, a stop pawl 151 being provided. When the magnet is energized the arm is stepped around to the next contact, and when the circuit is broken the armature resumes its normal position. Any other suitable step-by-step switch might be used in lieu of that shown.

35 The switches A, B and C each has a double ring of contacts, the contacts designated by the same reference character being electrically connected together. This is merely for the purpose of providing a short instead of a long throw of the switch arm. The switch D takes a step each time the magnet d is energized and each time it is deenergized. This is effected by providing an arrangement like that shown in Fig. 16 in which the lever arm 152 pivoted at 152^x, has two pawls 153 and 154 arranged to engage the ratchets 155 and 156 respectively so that when the magnet 157 is energized the ratchet 155 is turned and when the magnet is deenergized and the lever is retracted by the spring the ratchet 156 is turned. The ratchet 156 is on a shaft 158 bearing a gear 159 in mesh with a gear 160 loosely mounted on a shaft 161 which bears the contact arm 162 arranged to engage contacts 163. The ratchet 155 is loosely mounted on the shaft 161 and has a pawl 164 arranged to engage a ratchet 165 fast on the shaft 161. The gear 160 has a pawl 166 also engaging the ratchet 165. It will thus be seen that each upward and each downward movement of the lever will actuate the shaft 161 so as to step the arm 162 to the next contact.

In Fig. 10 I have shown a time retarded solenoid S which controls the time that the lamp L is lighted. It consists of a coil 167 whose core 168 has a plunger head 169 disposed in a cylinder 170. The cylinder has an opening 171 into which the needle valve 172 extends. The core fits loosely in the coil so that when the latter is deenergized it descends by gravity. When the coil is energized it pulls up slowly, the valve 172 regulating the escape of air and hence the time of movement of the core. The latter has an insulating arm 173 arranged to open the contacts s^2 and close the contacts s^1 in the upward movement and to open the contacts s^1 and to close the contacts s^2 in the downward movement.

From the foregoing description of the various parts of the device the operation thereof may be readily understood.

Let us assume that a sensitized plate 24 inches wide by 36 inches long is to have designs printed thereon, the centers of the designs of the outer rows being 4 inches from the side edges of the plate and the centers of the designs of the outer columns being 6 inches from the ends of the plate, the columns running the shorter dimension of the plate and the rows the longer. Assume that the distance between centers of the designs of any column is 4 inches and that the columns are 6 inches apart. There will be five designs in each column and five columns. The normal or initial positions of the various parts of the apparatus are those shown in Fig. 19. The switch Y is open. The contacts at r^1 , e^1 , v^1 , x^1 , t^2 , and p^2 are closed. All other contacts are open. The arm g^x is on point g^6 of the switch G . The arm c^x is on point c^1 of the switch c . The arm a^x is on points a^6 and a^7 of switch A . The arm b^x is on points b^2 and b^3 of switch B . The arm d^x is on point d^1 of switch D . The arm f^x is on point f^1 of switch F .

The operator first loosens the set screws 174 and 175 (see Fig. 2) on the hubs of the worm gears 176 and 177 respectively so that the shafts 28 and E may turn freely. Now by means of the handle 102 he moves the carriage 30 inwardly four inches as noted on the dial 104. The arm 180 on the carriage 30, see Fig. 2, which holds the contacts p^2 closed when the carriage is in its initial position, permits the contacts p^1 to close and the contact p^2 to open. The contact blocks 95 and 96 will also be moved inwardly. When the operator lets go of the handle 102 a spring 178, (see Figs. 1 and 14) will take the gear 100 out of mesh with the gear 99 so that the shaft 28 will rotate freely when the motor M^2 is energized. Now by means of the handle 121, (see Fig. 1) he moves the frame 26 six inches as noted by the dial 122, afterward removing the handle. The movement of the lug 181 on

the frame 26, (see Fig. 1) away from the spring contacts closes the contacts t^1 and opens the contacts t^2 . By means of the handle 124 he moves the switch H six inches inwardly as noted by the dial 125. By means of the handle 91 the contacts v^2 are set to space the designs four inches apart as noted by the dial 92 and by means of the handle 118 he moves the contacts x^2 to space the column six inches apart as noted by the dial 118. It is immaterial as to the order of these operations.

The switch Y is now closed. The arm g^x of the switch G is moved by means of the key 179, (see Fig. 1) from g^6 to g^1 . This arm first engages the elongated contact g^7 before it reaches g^1 whereupon a circuit is established from wire 1', through 3', arm g^x , contact g^7 , wire 8', wire 11', wire 11^a, contacts s^2 , wire 4', contacts e^1 , 5', contacts v^1 , 6', core a of step switch A, and by wire 7' to lead wire 21. Arm a^x is moved by step switch to points a and a^2 . Current also flows from the wire 11 through coil b of step switch B, 9', contacts x^1 , 10', contacts r^1 to lead 2'. The arm b^x is thereupon moved from points b^2 — b^3 to point b^1 .

When the arm g^x reaches the contact g^1 of the switch G, current flows from wire 1' through 3', arm g^x , g^1 , 12', arm a^x to a , through 13', 14', motor M^1 and 15' to wire 2'. It also flows from a^2 through 16', controlling transmission T^1 and wire 17' to wire 2'.

The motor M^1 starts up and turns eccentric shaft E breaking contact at e^1 and pressing plunger 33 upwardly. When e^1 is broken, coil a is deenergized and its armature drops back. When arm e^x reaches contacts e^2 it closes them and causes the coil a to become energized, since contacts e^1 and e^2 are in multiple. Step switch A now moves arm a^x to a^3 , breaking the motor circuit. Current now flows from a^3 through 18', lamp L, 19', solenoid S, and 20 to wire 2'. The lamp is lighted and the core of the solenoid slowly pulls up. After a predetermined time it breaks the contacts at r^2 and since the latter contacts are in series with the contacts e^2 the energizing circuit of the coil a is broken and its armature drops back.

Further movement of the solenoid core causes the closing of the contacts at s^1 , thus energizing the coil a and the arm a^x is stepped around to a^4 a^5 , breaking the light circuit. Current now flows from a^4 through wire 21', reversing coil R^2 , controlling transmission T^1 , and by wire 17' to wire 2'. It also flows from a^5 through 14', M^1 , and to wire 2', by way of wire 15'. The motor M^1 starts up but the eccentric shaft E is reversed. Its first movement breaks the circuit of coil a , whose armature drops back. The movement of the shaft E continues

until the arm e^x again closes the contacts at e^1 , when the arm a^x will be moved to the contacts a^6 a^7 , stopping the motor.

Current now flows from a^6 through wire 22', arm e^x , to one of the contacts c^1 (all of these contacts c^1 being connected together by a common conductor) thence by wire 23', through coil R^3 , controlling transmission T^2 , and by wire 17' to wire 2'. Current also flows from a^7 by wire 24' to arm b^x of step switch B, then through b^1 (all of the contacts b^1 are connected together by common conductor) wire 25', motor M^2 , and by wire 26' to wire 2'. The coil d of the step switch D being in multiple with the motor M^2 , is energized and the arm d^x is moved from d^1 to d^2 . The motor M^2 starts up, moving the carriage forwardly. The engagement of the contact d^2 by the arm d^x causes current to flow from wire 1' through wire 27', arm d^x , d^1 , and by wire 28' through coil R^3 of transmission T^1 and wire 29' to wire 2'. The coil R^3 controls the clutch which causes the arm 76 (see Fig. 2) to move forwardly and at the first movement of this arm the spring contacts at v^1 open, thereby causing the coil a to become deenergized and its armature to drop back. The first movement of the carriage also breaks the energizing circuit of the coil b of the step switch B at the contacts r^1 and its armature falls back. The carriage continues to move forward and so does the arm 76 until finally the latter engages the spring contacts at v^2 and closes them, whereupon the coil a is energized, since the contacts v^1 and v^2 are in multiple, the arm a^x steps around to the points a^1 a^2 , breaking the motor circuit and stopping the motor M^2 and hence the screw shaft 28 which drives the carriage 30. Since the arm 76 is driven by the shaft 28 through the transmission T^1 it also stops. It will thus be seen how the adjustment or positioning of the spring contacts v^1 and v^2 a predetermined distance apart determines the movement of the carriage from one printing position to the next.

As has been stated before, the step switch D steps its arm d^x around whenever the circuit of the motor M^2 is either made or broken. When the circuit of motor M^2 is broken, the arm d^x moves to the point d^3 which breaks the circuit of the coil R^3 . The arm a^x is now on the points or contacts a^1 — a^2 and the motor which operates the eccentric shaft E is energized over the circuit already traced. The motor is stopped and the light L switched on as already described; the light is cut off after a predetermined time, and the shaft E is reversed so as to permit the negative to be withdrawn from engagement with the sensitized plate so that the movement of the carriage can take place.

Now when the motor M^2 is energized, *i. e.* when the arm a^x is shifted to the contacts $a^6 a^7$ in the manner already described and the motor moves the carriage forward, the contact closing arm 76 will be moved in the opposite direction from its initial movement because of the fact that current for driving motor M^2 steps the switch arm d^x to the contact d^4 . (The arm d^x of the switch D in passing from d^3 to d^4 does not engage the contact d^5 , this contact being engaged momentarily by an insulated arm as explained later.) This establishes a circuit from wire 1' through 27', arm d^x , d^4 , 30', reversing coil R^4 of transmission T^4 , 31', to wire 2'. The energization of coil R^4 causes the contact closing arm 76 to move in the direction of the contacts v^1 . At its first movement the contacts at v^2 are broken causing the armature of the coil a to retract, but when it reaches the contacts v^1 it closes the actuating circuit of the coil a and steps the arm a^x around, causing the stopping of the motor M^2 with the carriage in printing position. This cycle of operations will be continued until the carriage engages the contacts v^2 and closes them. These contacts, it may be stated, are set just within the desired movement of the carriage in order to insure their being closed by the carriage prior to the closing of one of the sets of contacts v^1 or v^2 by the traveling contact closing arm 76. The closing of the contacts at v^2 will cause the energization of the coil b , the energizing circuit being from wire 11' through coil b , 9', contacts x^1 , 10', 32', contacts v^2 and by wire 33' to wire 2'. The arm b^x will now be moved to contacts b^2 and b^3 .

In the meantime the printing operation will continue while the carriage is at the limit of its movement from one side of the plate to the other.

After the light has been extinguished and the negative retracted the arm a^x is stepped around to the contacts $a^6 a^7$ as explained heretofore. Current will then flow from a^7 through 24', arm b^x , b^3 , 34', 36', motor M^3 , and by wire 37' to wire 2'. Also by wire 35' through coil R^5 of transmission T^3 and wire 38' to wire 2'. The motor M^3 will start up in a forward direction and will move the slidable frame which bears the carriage in a direction at right angles to the movement of the carriage. At the same time the switch arm f^x will be moved from the point f^1 to f^2 and the coil R^7 of the transmission T^5 will be energized, current flowing from wire 1' through 39', arm f^x , contact f^2 , wire 40', coil R^7 and by wire 41' to wire 2'. The energization of the clutch coil R^7 will cause the traveling contact closing arm 112 to move toward the spring contacts x^2 . The first movement of the arm will break the circuit of the coil b at x^1 ,

but the circuit will be closed again when the arm reaches the contacts x^2 , the contacts x^1 and x^2 being in multiple, and the motor M^3 will stop when the arm b^x is shifted by the coil off from the contacts b^2 and b^3 . It will be noted that the motor circuit is through the contact b^3 . The contact b^2 is in a circuit from the arm b^x , through b^2 , 42', coil c of the step switch C and by wire 43' to wire 2. This steps the arm c^x to the contact c^2 . When the arm b^x reaches the contact b^1 then the motor M^2 will be energized over the circuit already traced, but the energization of the reversing coil R^{10} will occur because the arm c^x is on the contact c^2 , the current flowing from the contact a^6 by wire 22' to arm c^x , thence by contact c^2 through wire 44', coil R^{10} , and by wire 17' to wire 2.

The carriage will now reverse its movement breaking the energizing circuit of the coil a at v^2 and will be brought to a stop when the traveling contact closing arm 76 closes the circuit again at v^1 since the arm a^x will then step around to contact a^3 . As the carriage retraces its movement the printing operations will be carried out at each position of rest and these positions will be in alinement in directions at right angles to the line of movement of the carriage. When the opposite side of the device is reached the carriage will again engage the contacts v^1 and close them, thus energizing the coil b and stepping the arm b^x around to the contacts $b^2 b^3$. The motor M^3 will be energized to move the frame forward and the coil c will be energized to move the arm c^x so that current will flow through the coil R^9 to cause the carriage to move forwardly when the motor M^2 is again brought into play.

The course of the carriage bearing the negative is shown diagrammatically in Fig. 15.

When the printing operation has been carried out in the last row and the carriage bearing frame is moved forward it comes into engagement with the arm h of the switch H and causes it to suddenly move, this switch being of the "snap" type. One of the switch arms h^1 in its movement, momentarily closes the contacts at j and an impulse will be sent through the coil g , the current flowing from wire 1', through 45', contacts j , 46', 47', coil g , 48' and by wire 7' to wire 2. The arm g^x is now moved to g^2 and this breaks the actuating circuit of the motor M^3 , stopping it. It will be noted that when this circuit is broken the arm a^x rests on the contacts $a^6 a^7$, the arm b^x on the contacts b^2 and b^3 , and the arm c^x either on the contact c^1 or contacts c^2 depending on which direction the carriage was last traveling when the final printing operation was completed.

The movement of the arm h of the switch H closes contacts at h^x which causes the sounding of the audible signal 126 to indicate that the printing operation has been completed.

The operator now pulls out the spring locking pin 103 of the handle 102 from the dial 104 and rotates the handle backward as far as it will go without, however, pulling outwardly on the handle itself. This will rotate the shaft 94 but not the shaft 28 since its gear 100 is only in mesh with the gear 98 which is wider than the gear 99 on the screw shaft. The blocks 95 and 96, bearing the contacts r^2 and r^1 respectively, will retract to their initial positions or until the block 96 engages the collar 136. The contacts at w will be closed by the block 95. The arm 124 is also unlocked and rotated backwardly as far as it will go. The resetting of the arm 124, moves the switch H back so that its stem h engages the frame 1, and is pushed forwardly into position to be again engaged by the carriage bearing frame when another plate is being printed. The resetting of the arm 124 also closes the contacts at k . Current now flows from wire 1' through contacts w , k , and by wire 49' through contacts t^1 , wire 50', 47', coil g , 48', 7', to wire 2', stepping the arm g^x to g^3 .

The motor M^3 will start up and the reversing coil R^8 will be energized, the energizing circuit being from wire 1', through 3', arm g^x , g^3 , 51, 51^a, motor M^3 , 37', to wire 2'. The circuit divides at coil R^8 and passes through the coil and by wire 38' to wire 2. Current also flows from wire 51' through wire 56', reversing coil R^8 , and wire 57' to wire 2', energizing the coil and throwing in the reverse clutch for the traveling contact arm 112. The traveling arm 112 will be moved toward the contacts x^1 and on arriving there will stop because the threaded block 111 on which the traveling contact closing arm is carried will pass off of the threaded portion of its actuating shaft.

The motor M^3 now moves the frame back and its movement continues until the frame reaches the contacts t^1 . These are opened by the engagement of the frame with them. The coil g is momentarily deenergized and its armature retracts but it is immediately energized again by the closing of the contacts t^2 , steps the arm g^x to the contacts g^4 and g^8 , and stops the motor M^3 by breaking its actuating circuit.

The motor M^2 is now energized and also the reversing coil R^{10} by a circuit from g^4 , through 52', coil R^{10} , which, it will be noted, has a double winding, and 17 to wire 2, also through wire 53' through motor M^2 and wire 26' to wire 2. The carriage is now returned to its initial position. The re-

versing coil R^4 is also energized by current from g^8 through wire 60', through wire 30', coil R^4 and wire 31' to wire 2'. This will return the contact closing arm 76 to a position to close the contacts v^1 .

When the carriage reaches the contacts 70 p^1 it engages them and opens them, the coil g being momentarily deenergized, but it is energized immediately by the closing of the contacts p^2 and steps the arm g^x around to the point g^6 which has no electrical connection with any part of the apparatus. The arm g^x momentarily effects an electrical connection with the point or contact g^5 in its passage from contact g^4 to g^6 . Now g^5 is connected by wires 54' and 61' with an arm c^x which is insulated from the arm c^x . If the arm c^x should happen to rest on a contact c^1 in position to energize the coil R^9 at the next printing operation, then the arm c^x will not be on a contact c^3 , but if the arm c^x should rest on a contact c^2 the arm c^x will rest on a contact c^3 and current will flow from g^5 through 54', 61', arm c^x , c^3 and by wire 55' through coil c . The switch will then move the arm c^x so that it will always rest on a contact c^2 at the end of the printing operation ready to energize the coil R^9 to move the carriage forward after the first printing operation on another plate.

To make the switch arm always come to rest on the contact d^1 at the end of the printing operation, I provide an extra magnet d^m . The arm d^x bears an insulated contact d^6 which engages a stationary contact d^5 when the arm d^x reaches d^3 . The contact d^5 is long enough to cause the switch to step the arm d^x from d^3 to d^4 on the energization of the magnet d^m and from d^4 to d^1 on its deenergization. This only occurs when the arm g^x is on g^8 . Thus the coil R^3 is always energized before the coil R^4 at the beginning of the printing operation.

It will be thus seen that all that the operator has to do after the sensitized plate is in position is to set the arms which control the various spacing operations to the desired positions, turn on the two starting switches, and reset certain of the arms when the printing has been done. The apparatus will then be in position to print another plate.

In case any accident should occur to the electric circuit, as where a storm should cut off the source of current, the device may be operated manually, for it will be noted that all the clutches are normally in neutral position. To this end I provide the shaft 185 having a key way 186. A worm 187 is feathered to the shaft but may slide therealong. This worm is engaged by ears 188 carried by the slidable frame 26 and therefore moves with the frame. The worm engages a gear 177 having a hub which may be secured to

the shaft E by the set screw 175. When the shaft 185 is turned by the handle 189 the shaft E is operated.

The shaft 28 is operated in a similar manner by means of the shaft 190 which is rotated by the handle 191. The shaft 190 has a worm precisely like the worm 187 which drives a gear 176, the latter being secured, if desired, to the shaft 28 by means of the set screw 174. The shaft 109 may be used to move the slidable frame 26. Dials are provided to indicate the distances the parts move. At S^m in Fig. 19 I have shown a switch which may be used to light the lamps L from the main feed wires or, if they are out of commission, from a storage battery (not shown), or any other suitable source of electrical energy.

In order to simplify as far as possible the diagrammatic view of the circuit connections in Fig. 19 I have purposely omitted therefrom certain resistances the use of which permits all of the electrical devices shown to be operated on one circuit, as for instance a 110 volt D. C. circuit. It will be understood however, that such resistances may be used wherever needed.

I claim:—

1. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate and means for automatically moving the negative holder intermittently to different printing positions.

2. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate and means for automatically controlling the movement of said holder for spacing the printing positions thereof equal distances apart.

3. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate and means for automatically pressing the negative against the sensitized plate at each printing position.

4. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, means for automatically pressing the negative against the sensitized plate at each printing position, a source of light carried by the negative holder, and means for automatically energizing said source of light during the periods of contact of the movable negative holder.

5. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different

printing positions with respect to the plate, manual means for determining the first and last printing positions of a column of prints and means for subsequently automatically moving the negative holder intermittently to different printing positions of the column.

6. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, manual means for determining the first and last printing positions of a column of prints, means for subsequently automatically moving the negative holder intermittently to different printing positions of the column, and means for automatically controlling the movements of said holder for spacing the printing positions thereof equal distances apart.

7. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, means for automatically moving the negative holder intermittently to different printing positions in a column and means for automatically shifting the negative holder to a printing position in another column.

8. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, means for automatically moving the negative holder intermittently to different printing positions in a column, means for automatically shifting the negative holder to a printing position in another column and means for automatically moving the negative holder in a reverse direction from its movement in the first mentioned column to different printing positions in said second named column.

9. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, means for automatically moving the negative holder intermittently to different printing positions in a column, means for automatically shifting the negative holder to a printing position in another column, means for automatically moving the negative holder in a reverse direction from its movement in the first mentioned column to different printing positions in said second named column, and automatic means for spacing the printing positions of the negative holder to maintain the columns a predetermined distance apart.

10. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, means for automatically moving the nega-

tive holder intermittently to different printing positions in a column, means for automatically shifting the negative holder to a printing position in another column, means
 5 for automatically moving the negative holder in a reverse direction from its movement in the first mentioned column to different printing positions in said second named column and adjustable automatic
 10 means for spacing the printing positions of the negative holder to maintain the columns any desired distance apart.

11. In a device for printing on sensitized plates, a frame for holding the sensitized
 15 plate, a negative holder movable to different printing positions with respect to the plate, means for automatically moving the negative holder intermittently to different printing positions, and adjustable means for automatically controlling the movements of said
 20 holder for spacing the printing positions thereof any desired equal distances apart.

12. In a device for printing on sensitized plates, a frame for holding the sensitized
 25 plate, a negative holder movable with respect to the plate, manual means for determining the printing positions of the negative holder, and automatic means for moving the negative holder to bring the negative to
 30 the positions determined.

13. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder movable with respect to the plate, manual means for determining the printing positions of the negative holder, and automatic means for moving
 35 the negative holder to bring the negative to the positions determined and for printing in said positions.

14. In a device for printing on sensitized plates, a frame for holding the sensitized
 40 plate, a negative holder movable with respect to the sensitized plate, manual means for determining the end positions of the negative holder for a column of printing positions, manual means for determining the uniform distances between adjacent printing
 45 positions of the negative holder in the column, and means for automatically printing in the positions determined.
 50

15. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder movable with respect to the sensitized plate, manual means
 55 for determining the end positions of the negative holder for a column of printing positions, manual means for determining the uniform distances between adjacent printing positions of the negative holder in the
 60 column, means for automatically printing in the positions determined, and means automatically brought into operation after the column has been printed for shifting the negative holder to another column.

16. In a device for printing on sensitized

plates, a frame for holding the sensitized
 plate, a negative holder movable to different printing positions with respect to the sensitized plate, manual means for determining the end positions of the negative holder
 70 for a column of printing positions, manual means for determining the uniform distance between the adjacent printing positions of the negative holder in a column, manual means for determining the desired uniform
 75 distances between a plurality of columns of said printing positions, means for automatically printing in the first column determined, and means for subsequently shifting the negative holder to print in each of the
 80 columns successively.

17. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder movable to different printing positions with respect to the sensitized
 85 plate, manual means for determining the printing positions of the negative holder for a plurality of columns, manual means for determining a desired uniform distance between the columns, and automatic means
 90 for printing in the positions determined.

18. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder movable to different printing positions with respect to the sensitized
 95 plate, manual means for determining the printing positions of the negative holder for a predetermined number of columns, manual means for determining a desired uniform distance between the columns, and
 100 automatic means for printing in the positions determined.

19. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder having a normal
 105 position of rest, and movable to different printing positions with respect to the sensitized plate, manual means for determining the printing positions of the negative holder for a predetermined number of columns,
 110 manual means for determining a desired uniform distance between the columns, automatic means for printing in the positions determined, and means for automatically stopping the printing means when the pre-
 115 determined number of columns has been printed.

20. In a device for printing on sensitized plates, a frame for holding the sensitized
 plate, a negative holder having a normal
 120 position of rest, and movable to different printing positions with respect to the sensitized plate, manual means for determining the printing positions of the negative holder for a predetermined number of columns,
 125 manual means for determining a desired uniform distance between the columns, automatic means for printing in the positions determined, means for automatically stopping the printing means when the prede-
 130

mined number of columns has been printed, and a signal for automatically indicating the end of the printing operation.

21. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder having a normal position of rest, and movable to different printing positions with respect to the sensitized plate, manual means for determining the printing positions of the negative holder for a predetermined number of columns, manual means for determining a desired uniform distance between the columns, automatic means for printing in the positions determined, means for automatically stopping the printing means when the predetermined number of columns has been printed, and means actuated by the manual resetting of certain of said determining means for automatically returning the negative holder to its initial position of rest.

22. In a printing device, a stationary frame for holding a sensitized plate, a movable frame carried by said stationary frame, a negative carried by the movable frame and movable thereon in a direction at right angles to the movement of the movable frame, means for automatically moving the negative intermittently on the said movable frame, means for automatically moving the movable frame intermittently on the stationary frame, and means for automatically spacing the positions of rest of the negative uniformly.

23. In a printing device, a stationary frame for holding a sensitized plate, a movable frame carried by said stationary frame, a negative carried by the movable frame and movable thereon in a direction at right angles to the movement of the movable frame, means for automatically moving the negative intermittently on the same movable frame, means for automatically moving the movable frame intermittently on the stationary frame, means for automatically spacing the positions of rest of the negative uniformly, and means for automatically spacing the positions of rest of the movable frame uniformly.

24. In a printing device, a stationary frame, a movable frame carried by said stationary frame, a negative carried by the movable frame and movable thereon in a direction at right angles to the movement of the movable frame, means for automatically moving the negative intermittently along said movable frame and means for automatically moving the movable frame intermittently on the stationary frame.

25. In a printing device, a stationary frame, a movable frame carried by said stationary frame, a negative carried by the movable frame and movable thereon in a direction at right angles to the movement of the movable frame, means for automatically moving the negative intermittently along said movable frame, means for automatically moving the movable frame intermittently on the stationary frame, and means for automatically reversing the direction of movement of the negative at each position of rest of the movable frame.

26. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable with respect to the plate to different printing positions, means for determining said printing positions and means for causing the negative holder to bring the negative into contact with the sensitized plate automatically at the determined positions.

27. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate and automatic means for causing the movement of said negative holder to print a plurality of columns successively.

28. In a device for printing on sensitized plates, a frame for holding the sensitized plate, a negative holder movable to different printing positions with respect to the plate, automatic means for causing the movement of said negative holder to print a plurality of columns successively and means for spacing the prints in each column equal distances apart.

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