May 30, 1961 R. HELL 2,986,598

MACHINE FOR PRODUCING PRINTING PLATES WITH VARIABLE REPRODUCTION SCALE

Filed May 8, 1958

Fig. 1.

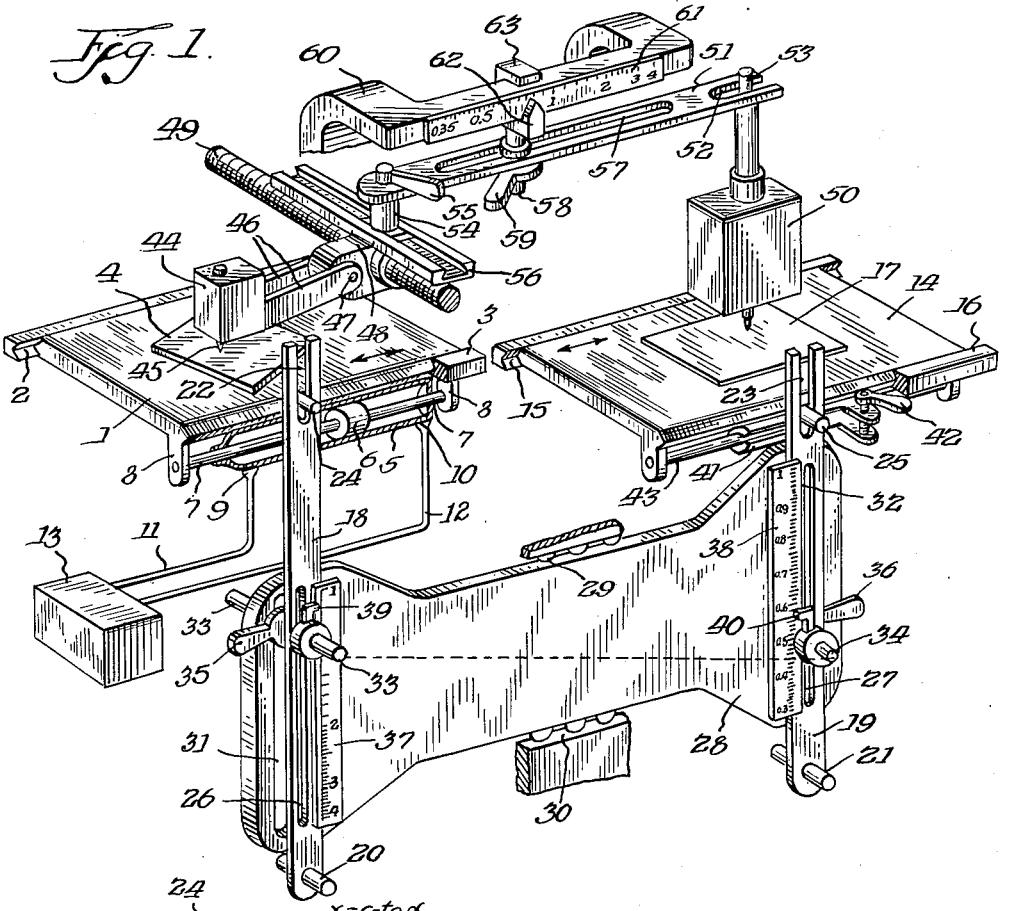
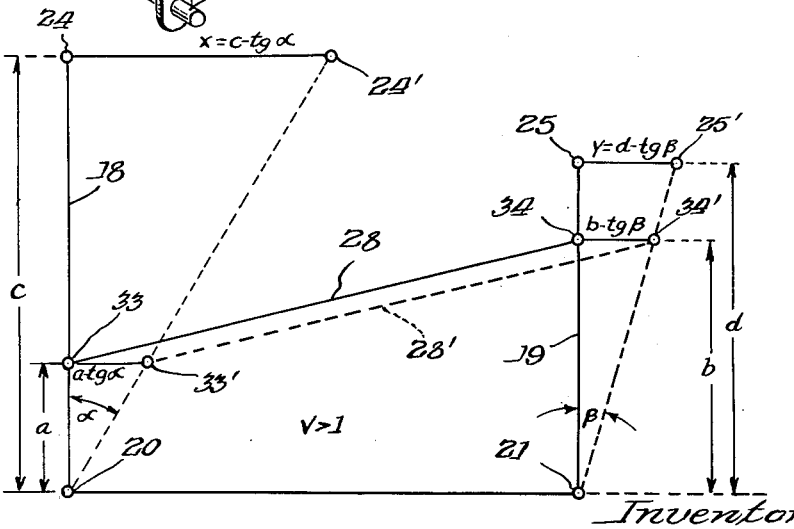


Fig. 2.



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MACHINE FOR PRODUCING PRINTING PLATES WITH VARIABLE REPRODUCTION SCALE

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6 Claims. (Cl. 178—6.6)

This invention is concerned with a machine of the two-table type for electromechanically producing printing plates with continuously variable reproduction scale.

Systems are known for electromechanically producing printing plates, whereby the reproduction scale, that is, the ratio between dimensions on the printing plates and on the copies to be reproduced, can be selectively and adjustably changed. Thus, there are methods and devices known in which the copy and the printing plate blank are respectively mounted each upon a rotating drum, whereby both drums are advanced axially, with the scanning and engraving elements in fixed positions, or else wherein the two drums are in fixed position, while the scanning and engraving elements are advanced with respect to the circumference of one of the drums. The scanning and engraving is effected either along equidistant circles or along helical lines. The enlargement or reduction of the scale on the printing plate, as compared with the scale of the copy to be reproduced, is obtained either by the use of drums of different diameter, to be selectively used for one of the drums, and operating both drums at identical speed of rotation, or by using drums of identical diameter but rotating them at different speeds. The ratio of the advance steps per drum revolution and advance speeds of the scanning and engraving elements, corresponding respectively to the enlargement and reduction and the selected screen, is produced by corresponding step-up and step-down gear means.

There are also systems known, comprising horizontally extending tables adapted to reciprocate in parallel planes, one table carrying the copy to be reproduced, which is scanned by a scanning element point for point in successive lines, the other table carrying the printing plate blank to be processed which is simultaneously engraved, by a suitable tool, point for point along successive lines. Upon conclusion of the scanning and engraving of each line, the scanning and engraving elements each execute a stepwise line advance motion, perpendicular to the scanning and engraving directions, by the distance of two scanning lines and engraving lines, respectively, such spacing corresponding respectively to the screening applied and to the reproduction scale desired. The enlargement or reduction of the scale on the printing plate, as compared with the copy to be reproduced, is thereby effected by step-up and step-down gears or by lever mechanisms respectively interposed between the drives of the two tables and the drives for the line shifting or advance of the scanning and engraving elements.

It is further known to impart either to the scanning or to the engraving element or to both auxiliary motions in the scanning and engraving directions, respectively relative to drums of identical diameter rotating with identical speed of rotation or relative to tables reciprocating with identical speed, and employing suitable step-up and step-down gears for the purpose of producing the desired ratio of line advance or shifting motion of the scanning and engraving elements.

Another known system uses, instead of two separate tables respectively for the copy to be reproduced and for the printing plate blank which is to be engraved according to variable reproduction scale, a single reciprocating table carrying upon one side the copy to be reproduced and upon the other side thereof the printing plate blank which is to be engraved. In such known system, either the scanning element or the engraving element executes relative to the reciprocating table in auxiliary motion in the respective scanning and engraving direction or else, both elements execute such auxiliary motions.

A further known system is of the hybrid table-drum type, in which a flexible printing plate foil is wrapped about a rotating drum, an engraving head being moved with respect thereto parallel to the drum axis, such head carrying a heated tool for engraving the foil along a helical line by burning out the screen elements. The copy to be reproduced is carried by a horizontally disposed table which executes a translatory motion parallel to the drum axis. The copy to be reproduced is scanned by an optical scanning device swinging forth and back about a fixed axis, in a plane perpendicular to such axis, along successive lines transverse to the drum axis. The reproduction scale is changed by alteration of the ratio between the swinging amplitude of the scanning system and the constant speed of rotation of the drum, and by corresponding alteration of the ratio between the speed of translatory motion of the table carrying the copy and the invariable translatory speed of the scanning head along the drum.

Other known systems project by optical means including a picturing objective, an enlarged or reduced picture image of the copy to be reproduced onto a frosted plate or screen, and such projected picture is photoelectrically scanned point by point along successive lines, thereby producing fluctuating photoelectric currents for controlling the depth of penetration of an engraving tool which engraves a printing plate of a size corresponding to the optically projected picture, point by point in successive lines.

Further systems have become known in which the enlargement or reduction of scale on the printing plate as compared with the scale of the copy to be reproduced, is likewise carried out by means of a picturing objective, without, however, projecting the copy to be reproduced in its entirety, as in the system noted in the preceding paragraph, but instead scanning the original copy by a dot of light whose diameter and path correspond to the optically enlarged or reduced image of the diameter and path of a punctiform light source, such source being fixedly connected with the engraving system which engraves a printing plate blank simultaneously with the scanning of the copy, the depth of penetration of the engraving tool being controlled by means of a plurality of photocells fixedly disposed in the neighborhood of the objective and ascertaining the relative brightness of the picture point which is being scanned upon the copy.

Finally, a system has become known in which the alteration of the reproduction scale on the printing plate, as compared with the scale on the copy to be reproduced is effected by optical picturing of the copy with electrical means. The alteration of the reproduction scale is thereby obtained by picturing the copy to be reproduced, by means of a picturing optics with variable picturing scale, always in the identical size upon the photo cathode of a picture chopping tube, scanning the optical picture upon the photo cathode line for line by an electron beam, controlling the depth of penetration of the engraving tool in the printing plate blank by the picture currents produced by the tube, controlling the deflection of the electron beam in one coordinate direction by the

relative motion of the engraving table with respect to the engraving system in the engraving direction while controlling the deflection of the electron beam in the coordinate direction perpendicular to the first direction by the relative line advance or shift motion of the engraving system with respect to the engraving table perpendicular to the engraving direction, such, that one deflection voltage for the electron beam is proportional to the table stroke while the other deflection voltage is proportional to the line advance or shift path of the engraving system with respect to the engraving table.

Due to recent advances which have made it possible to engrave metallic printing plates electromechanically, demands for such engraving have arisen with increasing frequency. Systems employing rotating drums cannot satisfy the requirements for the electromechanical engraving of metal plates on account of the relative rigidity of such plates. Systems employing tables or drums in which the screen elements are burned out from printing plate blanks made of foils of synthetic material, by means of heated engraving tools are likewise unsuitable for the processing of metallic printing plates. Systems employing tables, in which the variable reproduction scale is produced mechanically by means of step-up and step-down gears have the drawback of permitting setting of the reproduction scale only in fixed increments or stages but not continuously. One of the oldest two-table machines for making printing plates, employing for continuous variation of the reproduction scale a lever mechanism resembling a parallelogram, has the serious drawback that there is no linear relation between the motions of the two tables but a complicated non-linear relation, so that the image on the printing plate will not agree in smallest details with the copy to be reproduced, thus furnishing a printing plate carrying an engraved image which is distorted as compared with the picture copy.

The invention proposes a two-table machine employing lever mechanisms for the continuous setting of the reproduction scale and for the coupling of the similarity motion of both tables.

The invention avoids the previously noted drawbacks by coupling the two table motions which are in identical sense in the engraving direction and also the two oppositely directed line advance or shift motions of the scanning and engraving heads perpendicular to the table motions, by two continuously adjustable similar swing-lever mechanisms, in such a manner, that the ratios between the two table strokes and the two line advance or shift strokes as well as the ratios between the two table speeds and the two line advance or shift speeds are, independent of the selected screening and at a selected reproduction scale, constant and equal to the reproduction ratio.

The machine according to the invention comprises a reciprocable copy table carrying the picture copy to be reproduced, a similarly reciprocable engraving table carrying a printing plate blank, a scanning head for scanning the picture copy, an engraving head for engraving the printing plate blank in accordance with the scanning of said scanning head, means for advancing said scanning head and said engraving head in a direction perpendicular to the direction of reciprocating motion of said copy table and said engraving table, a pair of single-arm swing levers disposed for motion, forth and back, in identical direction within a vertical plane, means for rotatably journalling the lower ends of said swing levers at structural parts of the machine, means for rotatably journalling the upper ends of said swing levers at said engraving table and the copy table, respectively, a slide for interconnecting said swing levers, said slide extending in a plane perpendicular to the planes of said tables and parallel to the planes of said swing levers, means for positively guiding said slide for forth and back motion corresponding to the reciprocating motion of said tables, pivot means for rotatably journalling said swing levers on said slide intermediate the ends of said levers, means for

selectively adjusting the respective pivot means longitudinally of the corresponding swing levers in accordance with the desired reproduction scale, a double-armed horizontally extending lever for interconnecting said engraving head and said scanning head for the purpose of coupling said heads for the line advance motion thereof, means for rotatably journalling one end of said double-armed lever at the engraving head and the other end thereof at the scanning head at respectively vertically extending axes, vertically disposed pivot means extending from a structural part of the machine for rotatably journalling said double-armed lever intermediate the opposite ends thereof, and means for selectively adjusting the position of said last named pivot means with respect to the opposite ends of said double-armed lever in accordance with the desired reproduction scale.

The invention will now be explained with reference to the accompanying drawing, wherein—

Fig. 1 shows in schematic manner essential parts of a machine according to the invention; and

Fig. 2 is a diagram to aid in explaining the kinematic operation of the swing-lever mechanisms.

In Fig. 1, numeral **1** indicates a rectangular horizontally disposed engraving table guided in rails **2** and **3** for reciprocating motion, numeral **4** indicating the printing plate blank mounted on the table **1** which is to be engraved in accordance with parallel or diagonal engraving cutting. Numeral **5** indicates a cylinder mounted on structural parts of the machine, containing a piston **6** connected with the piston rod **7** which is fastened to ears **8** extending from the engraving table **1**. The cylinder **5** is provided with two orifices **9** and **10** formed therein to which are connected hydraulic pressure lines **11** and **12** terminating in a hydraulic control device **13** for governing the feed and return of hydraulic fluid so as to effect reciprocation of the piston **6** and therewith reciprocation of the engraving table **1**. The drive of the engraving table **1** may also be effected by means of a rotating spindle threadedly guided within a nut carried by the engraving table, with suitable reversing gear means for reversing the direction of rotation at the conclusion of engraving of each line. The reversal of the table motion is effected by suitable control means, always when the engraving tool reaches an edge of the printing plate blank.

Numeral **14** in Fig. 1 indicates the rectangularly shaped horizontally disposed copy table which is guided in rails **15** and **16** for reciprocating motion in the same direction as the engraving table **1**. The two tables may be positioned in the same plane or in different parallel planes or levels. The latter arrangement of the tables in different planes or levels is advantageous for reasons of saving space; the two tables may overlap incident to their motions, resulting in a shortening of the machine dimensions. The copy table **14** carries the copy or picture **17** which is to be reproduced.

There are provided two swing-levers **18** and **19** which are respectively rotatably journalled upon axes **20** and **21** fixed to structural parts of the machine, the two levers moving in identical directions in a plane extending perpendicular to the plane of the tables. At the upper ends of the levers are formed longitudinal slots respectively indicated at **22** and **23**, stub shafts or pins indicated at **24** and **25**, extending respectively from the engraving table and the copy table and entering the respective slots. Incident to reciprocation of the tables, the swing levers **18** and **19** will be displaced with the corresponding slots gliding along the respective stub shafts **24** and **25**. The copy table **14** is in the illustrated example at a lower level than the engraving table **1**, and the swing-lever **19** is, accordingly, shorter than the swing-lever **18**, by the level difference. The swing-lever **18** is also provided with a longitudinal slot **26** and the swing-lever **19** is provided with a similar longitudinal slot **27**.

The coupling of the swing-levers **18** and **19** and there-

with the coupling of the tables **1** and **14** is effected by a slide **28** which is disposed in a vertical plane extending in parallel to the plane of the swing levers. Bearings **29** and **30** provide positive guidance for the slide **28** in its horizontal displacement, the slide, accordingly, executing a reciprocating motion in parallel with the reciprocating motion of the tables **1** and **14**. Vertically extending slots **31**, **32** are formed in the slide **28** respectively in line with the two lever pivots **20**, **21**, which are respectively engaged by pivots **33** and **34**. Numerals **35**, **36** indicate means for fixing the pivots **33**, **34** in any adjusted position with respect to the respective slots **31**, **32**. The positions of the pivots **33**, **34**, are, accordingly, adjustable on the slide **28**. The two pivots **33**, **34** extend respectively through the slots **26**, **27** formed in the swing levers **18**, **19**, these slots permitting sliding of the levers along the pivots incident to angular displacement of the levers and resulting reciprocation of the slide **28**, the swing-levers coincidently rotating about the pivots **33**, **34**. Scales **37**, **38** are provided, respectively carried by the swing levers **18**, **19**, upon which may be set the distance of the pivots **33**, **34** from the axes **20**, **21**, in the vertical zero position of the two swing-levers, by means of the pointers **39**, **40**, respectively associated with the pivots **33**, **34**. The coupling of the two swing levers **18**, **19**, by means of the slide **28**, effects a linear similarity motion of the two tables **1** and **14**, such, that the ratios of the table strokes and speeds are at any instant constant and in accordance with the adjusted reproduction ratio. It is possible, by alteration of the adjustment of the two pivots **33**, **34** with respect to the slots **31**, **32** in the slide **28**, to set the machine in accordance with reproduction ratio which is within certain limits steadily variable as desired.

Considered kinematically, the slide **28** with its pivots **33**, **34** which are adjustable within slots **31**, **32**, constitutes a rod of variable length. Incident to reciprocating motion of the two tables, this rod always remains parallel to itself, and the vertical distances of its rotation and gliding pivots **33**, **34**, from the connecting line of the two lever axes **20**, **21**, remain during the reciprocation constant. The horizontal paths of the two pivots **33**, **34**, considered from the vertical zero position of the two swing-levers, are always equal one to the other. However, the angles of the two swing-levers, measured from the vertical zero position about which they are displaced incident to the table motion, are generally speaking different. They will be equal to one another only when the connecting line of the two pivots **33**, **34** is parallel to the connecting line between the axes **20**, **21**. However, the reproduction ratio is in this case not 1 to 1 since the tables **1** and **14** have different constant vertical distances from the lever axes **20**, **21**. Moreover, the reproduction ratio is not determined by the absolute amounts of the vertical spacings of the pivot **33** from the axis **20** and of the pivot **34** from the lever axis **21**, but by their ratio, thus making the level setting of one of the two pivots **33**, **34**, for obtaining a desired reproduction ratio, arbitrary. However, in order to produce for facilitating operation unambiguous conditions, the absolute amounts of the spacing of the pivots from the respectively associated lower lever axis is in connection with the reproduction ratio 1 to 1 fixed by the scale marking "1" and "1" upon the scales **37** and **38**.

In connection with all enlargements to appear on the printing plate as compared with the picture copy, the pivot **34** is invariably set on the right hand scale to the scale mark "1" and the pivot **33** is set on the left hand scale underneath the scale mark "1" the greatest enlargement being effected when the pivot **33** is set to the scale mark "4." In connection with all reductions to appear on the printing plate as compared with the picture copy, the pivot **33** is set invariably on the mark "1" of the scale **37**, and the pivot **34** is set to a mark underneath "1," the greatest possible reduction resulting when the pivot **34** is set opposite the scale mark 0.33. The scales **37** and **38** are not provided with linear subdivisions.

The kinematic conditions incident to similarity of motion of the two tables are represented in Fig. 2 in abstract manner. The constant vertical distance of the guide axis **24** from the lower lever axis **20** is assumed to be c, and the constant vertical distance of the guide axis **25** from the lower lever axis **21** is assumed to be d. It is further assumed that $c>d$, that is, that the engraving table **1** moves in a level extending above the level of the copy table **14**. The adjustable spacing of the pivot **33** from the lever axis **20** shall be assumed to be a, and the adjustable spacing of the pivot **34** from the lever axis **21** shall be assumed to be b. It shall further be assumed that $a<b$, that is, that the machine is set for enlargement of the image on the printing plate as compared with the picture copy, as contrasted with the conditions illustrated in Fig. 1 in which it is assumed that reduction of the image on the printing plate as compared with the picture copy, is to be effected. The angle of swing of the lever **18** from its vertical position shall be assumed to be α and the angle of swing of the lever **19** shall be assumed to be β. The slide **28** so far as its kinematic effect is concerned may be considered to be substituted by a rod **28** which interconnects the pivots **33** and **34**, thereby holding the spacing therebetween, at an adjusted reproduction ratio, constant. Due to the positive horizontal guiding of the pivots **33** and **34**, upon angular displacement of the levers **18** and **19**, the pivot **33** will be shifted by an amount $a.tg\alpha$, reaching the position **33'**, and the pivot **34** will be shifted by an amount $b.tg\beta$, moving into the position **34'**. The shifting of the pivots **33**, **34** are, due to the rigid interconnection therebetween, by means of the rod **28**, equal to one another, that is

$$a.tg\alpha=b.tg\beta$$

and the rod **28** is in the shifted position **28'** in parallel with its initial position. The stroke of the engraving table **1** is

$$x=c.tg\alpha$$

and the stroke of the copy table is

$$y=d.tg\beta$$

Upon considering this relation, there will result for the ratios of the two table strokes x and y, that is, for the reproduction scale v,

$$v=\frac{x}{y}=\frac{c}{d}\cdot\frac{b}{a}$$

or, upon introducing the machine constant $c/d=k$,

$$v=k\cdot\frac{b}{a}$$

Since it was assumed that $c>d$, therefore, $k>1$. Accordingly, there will result an enlargement $v>1$ on the printing plate as compared with the picture copy, when $k.b/a>1$; a reproduction scale 1 to 1, that is, $v=1$, when $k.b/a=1$; and reduction of the printing plate image as compared with picture copy $v<1$, when $k.b/a<1$.

The foregoing considerations show that it does not depend upon the absolute values of a and b but upon the ratios thereof. They also show that there is a strictly linear similarity motion of the tables since the reproduction scale $x:y$ is at fixedly set values a and b constant, that is, independent of x and y.

There are several possibilities for the longitudinal equalization of the two levers **18**, **19** incident to their swinging motion. Instead of effecting the longitudinal equalization by means of the slots **22**, **26** and **23**, **27**, as shown in Fig. 1, the swing-levers, to produce the same effect, may be journalled at **24**, **25** rotatably but not shiftable, and the slots for the longitudinal equalization or compensation may be provided at the lower ends of the levers, so that the levers glide up and down with respect to the axes **20**, **21**. The second longitudinal compensation between the lower ends must also be maintained

in such embodiment by the provision of the slots 26, 27. A third possibility for the compensation in length resides in providing slots in the opposite ends of the levers 18, 19 for sliding cooperation with the shafts or axes 24, 20 and 25, 21 incident to the swinging motion of the levers. However, in such a case, the lever 18 and the lever 19 must be arranged merely rotatable about the pivots 33 and 34, respectively, but not movable relative to the intermediate lever slots 26, 27, contrary to the arrangement illustrated in Fig. 1, wherein the longitudinal compensation or equalization must be effected along the slots 26, 27 due to the fixed journalling of the lower lever ends at 20, 21, so that the pivots 33, 34 can slide relative to the intermediate slots 26, 27, and therewith also relative to the scales 37 and 38. This applies, of course, only in case the two levers are fixedly journalled at their upper ends, the longitudinal compensation being effected by slots formed in the lower ends thereof.

The guide shaft 25 extending from the copy table 14 is connected with a bushing 41 which may be clamped to the rail 43 in any adjusted position, by means of member 42. This coupling-uncoupling device makes it possible to place the copy table 14 in the scanning direction in desired initial position with respect to the engraving table 1 as well as with respect to the scanning head 50 which will be presently described. The coupling-uncoupling device is very important, making it possible to place the scanning head prior to engraving at desired points of the picture copy so as to ascertain the brightest and the darkest points for the adjustment of the white-black level and, further, in order to make it possible to scan a picture copy section lying at any desired area of the picture copy. The coupling-uncoupling device may be also provided in connection with the engraving table 1 to obtain similar effects.

Numeral 44 indicates the engraving head containing a known electromagnetic drive system for actuating the engraving tool or stylus 45, such stylus executing during the engraving up and down motions controlled in accordance with the brightness of the picture copy. The engraving head 44 is fastened to the carrier 46 which is pivoted on the nut 48 at 47, whereby the engraving head may be lifted with respect to the engraving table 1. The nut 48 is either split midway thereof in the line shift or advance direction or is formed in the manner of a segment so as to make it possible to separate the engraving head 44 from the threaded spindle 49 for the purpose of placing it in the advance direction in alignment with a desired point on the printing plate blank 4. The threaded spindle 49 is intermittently rotated so as to move the engraving head upon conclusion of the engraving of each line in a stepwise line shift or advance motion perpendicular to the engraving direction. This intermittent rotation of the threaded spindle 49 may be effected by means of a rotary ball-wedge clutch device generally known from free-wheeling drives used, for example, in connection with bicycles. The advantage of such a clutch drive is that it permits steadily alterable adjustment of the angle of rotation of the line advance or shift spindle 49. The release of the stepwise advance motion is controlled by the reversal of the table motions, that is, a control element, for example, a contact is in known manner actuated at the conclusion of the engraving of a line, effecting known and suitable control means for reversing the table motion, and also effecting actuation of the clutch device so as to advance the engraving head 44 and the scanning head 50 in a direction perpendicular to the line engraving motion and line scanning motion, respectively, in position for respectively scanning and engraving the next line.

In case only a small number of fixed advance or shift steps is required, corresponding to a small number of fixed screen elements, the above described clutch device for the drive of the line shift or advance spindle may be replaced by a plurality of known gears with different numbers of teeth controlled by resilient stop pawls.

The scanning head 50, containing a known optical and photoelectric scanning device, serves for the line by line scanning of the picture copy 17.

A horizontally extending two-armed swing-lever 51 is provided for the coupling of the line advance or line shift motions of the engraving head 44 and the scanning head 50. The lever 51 has at the end facing the scanning head 50 a longitudinal slot 52 formed therein, a vertically disposed pin 53 extending from the scanning head 50 entering the slot 52. Incident to line advance motion of the scanning head 50, the lever 51 will be angularly displaced by the action of the pin 53 in the slot 52. The opposite end of the lever 51, facing the engraving head 44, is journalled for rotation about trunnion 54 which may be clamped, by member 55, in position at any desired place along the dovetailed bar 56, such bar being disposed on the nut 48 in parallel to the line advance motion controlled by the spindle 49. The corresponding coupling device comprising the members 54, 55, 56 permits placing of the scanning head in the line advance direction in any desired position with respect to the engraving head. The adjustment made possible by this coupling device is of value in connection with making enlargements or reductions of sections of a picture copy. The coupling device may be provided in connection with the scanning head 50 instead of with engraving head 44 to obtain similar effects.

The lever 51 has a longitudinal slot 57 formed therein intermediate its opposite ends for accommodating a stub shaft 58 in sliding cooperation therewith. The stub shaft 58 may be clamped to a stationary bar 60 which is connected with a structural part of the machine and extends in parallel to the engraving direction, in any desired position with respect to such bar, by clamping means 59, a pointer 62 extending from the stub shaft 58 cooperating with a scale 61 on the bar 60 to set and to indicate the desired reproduction ratio for the line advance motion, such ratio being generally equal to the reproduction ratio in the engraving and scanning direction. The lever 51 will be rotated about the stub shaft 58, incident to the line advance motion, the stub shaft sliding within the slot 57 and constituting the changeable or adjustable pivot for the lever 51. Enlargement of the image on the printing plate as compared with the picture copy will result when the pointer 62 extending from the stub shaft 58 is placed at the right of the scale mark "1" since the left (changeable) arm of the lever will be longer than the right (changeable) arm thereof. Reduction of the image on the printing plate will be effected when the pointer 62 extending from the stub shaft 58 is placed to the left of the scale mark "1" because the lengths of the respective arms of the lever 51 will differ in opposite sense. The lengths of the two lever arms change steadily incident to the line advance motions, but the ratio remains at any instant constant and equal to the adjusted reproduction scale which is given by the ratio of the distance of the trunnion 54 from the stub shaft 58 and the distance of the pin 53 from the stub shaft 58. The reproduction scale is set with the lever 51 in zero position, that is, when the lever extends in parallel to the engraving direction.

The lever 51, instead of having its left end journalled at a fixed point and having its right end slotted, as shown in Fig. 1, may have its right end journalled at a fixed point and its left end slotted. The operative effect will be the same, namely, the stub shaft 58 which is fixedly clamped to the rail 60, by means of member 59, will be slidable within the slot 57 in the lever 51. The lever 51 may also be disposed rotatable about the stub shaft 58 but not shiftable with respect thereto, and the stub shaft and claw 63 may be slidable on the rail 60. The adjustment or setting of the reproduction scale is effected as de-

scribed before, with the lever **51** in its zero position, that is, disposed parallel to the engraving and scanning direction.

The lever **51** may also be provided with slots formed therein at both ends thereof and may be rotatable about the stub shaft **58** but not displaceable relative thereto, and the shaft **58** may be fixedly connected with the rail **60** by means of the claw **63**. The reproduction scale may in such case be set on the scale **61** in any desired position of the lever **51**.

The line shift motions of the engraving head **44** and of the scanning head **50** are due to the two-armed lever **51** in opposite sense; the result is, that the printing plate blank will be engraved in mirror-picture image of the picture copy, as it must be to obtain side correct reproduction.

Generally speaking, the same reproduction scale must be set on the scale **61** as on the scales **37** and **38** to obtain a printing plate image which corresponds geometrically to that on the picture copy. However, it is possible to set a reproduction ratio for the tables, on the scales **37** and **38**, different from that for the line advance or shift motions set for the lever **51** on the scale **61**. This is important in connection with making a printing plate from a picture copy bearing an image which is differently distorted in two directions perpendicular to one another and when such distortions are to be corrected. The reproduction scale, in such a case, must be different in the two directions extending perpendicular one to the other. Such distortion correction may, however, be considered an exceptional case. The requirement for producing a printing plate bearing a distorted image of a picture copy may arise, for example, when it is desired to produce distortions for the sake of creating amusing or cartoon-like effects.

In the production of screen printing plates, the line advance or line shift motion of the engraving head is regardless of the reproduction scale, solely dependent upon the selected number of screening lines. The total number of scanning lines upon the picture copy is equal to the total number of engraving lines upon the printing plate. However, the density of the scanning lines, that is, the number of scanning lines per unit of length, will depend upon the selected number of screening lines as well as upon the reproduction scale.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. In a machine for producing printing plates having a reciprocable copy table carrying the picture copy to be reproduced, a similarly reciprocable engraving table carrying a printing plate blank, a scanning head for scanning the picture copy, an engraving head for engraving the printing plate blank in accordance with the scanning of said scanning head, means for advancing said scanning head and said engraving head in a direction perpendicular to the direction of reciprocating motion of said copy table and said engraving table, the combination for effecting variable reproduction scale in the production of printing plates, comprising a pair of single-arm swing levers disposed for motion, forth and back, in identical direction within a vertical plane, means for rotatably journalling the lower ends of said swing levers at structural parts of the machine, means for rotatably journalling the upper ends of said swing levers at said engraving table and said copy table, respectively, a slide for inter-connecting said pair of swing levers, said slide extending in a plane perpendicular to the planes of said tables and parallel to the planes of said swing levers, means for positively guiding said slide for forth and back motion corresponding to the reciprocating motion of said tables, pivot means for rotatably journalling said pair of swing levers on said slide intermediate the ends of said levers, means for selectively adjusting the respective pivot means longitudinally of the corresponding swing levers in accordance with the desired reproduction scale, means associated with the repective single-arm swing levers for effecting compensation of the length of the latter, incident to displacement thereof, a double-armed horizontally extending lever for interconnecting said engraving head and said scanning head for the purpose of coupling said heads for the advance motion thereof, means for rotatably journalling one end of said double-armed lever at the engraving head and the other end thereof at the scanning head at respectively vertically extending axes, vertically disposed pivot means extending from a structural part of the machine for rotatably journalling said double-armed lever intermediate the opposite ends thereof, means for selectively adjusting the position of said last named pivot means with respect to the opposite ends of said double-armed lever in accordance with the desired reproduction scale, and means associated with said double-armed lever for effecting compensation of the length of the latter incident to displacement thereof.

2. A structure according to claim 1, comprising means cooperatively associated with said first and said second named pivot means for visually indicating the reproduction scale respectively adjusted thereby.

3. A structure according to claim 1, wherein the means for compensation of length of said single-arm swing levers incident to displacement thereof is positioned at said pivot means and at the upper ends thereof which are respectively journalled at said engraving table and at said copy table.

4. A structure according to claim 1, wherein the means for compensation of length of said double-armed lever incident to displacement thereof is positioned at said last named pivot means and at one of the ends of said lever.

5. A structure according to claim 1, wherein said tables are reciprocated along mutually parallel and partially overlapping planes.

6. A structure according to caim 1, comprising journal means for journalling the upper end of one of said single-arm swing levers at said copy table, and means for selectively adjusting the position of said journal means with respect to such table.

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