Aug. 9, 1966 YOSHIHIRO MACHIDA ETAL 3,264,889

ELECTRONIC ENGRAVING MACHINE

Filed Oct. 22, 1963

Fig. 1

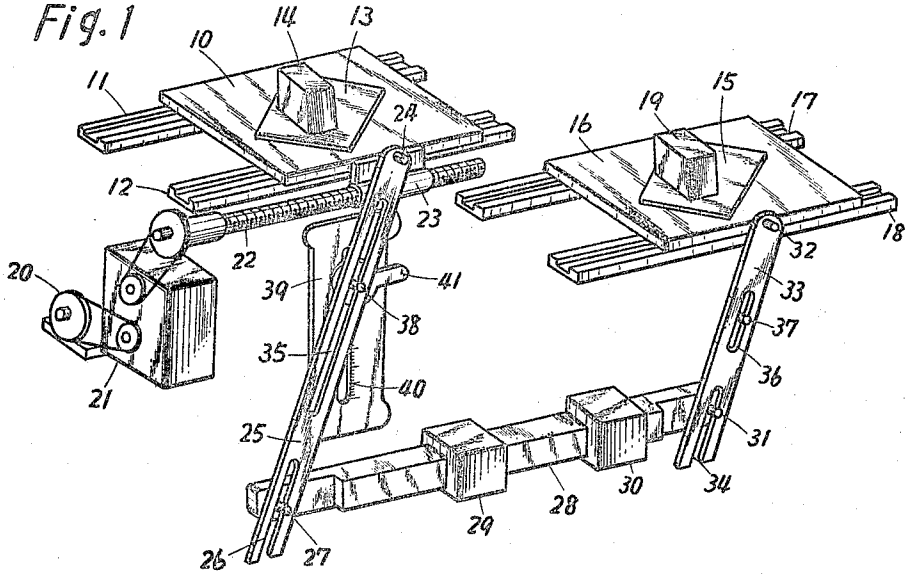


Fig. 2

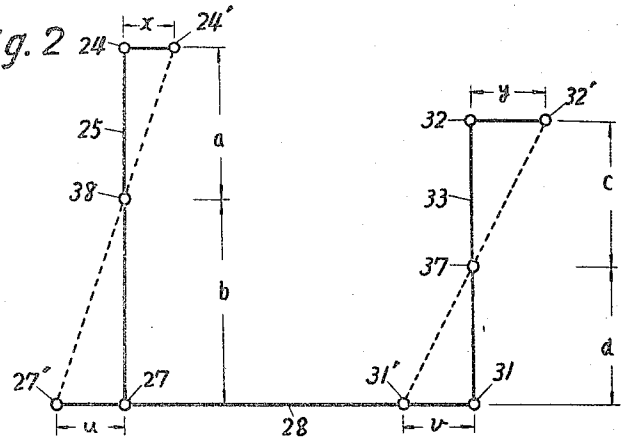
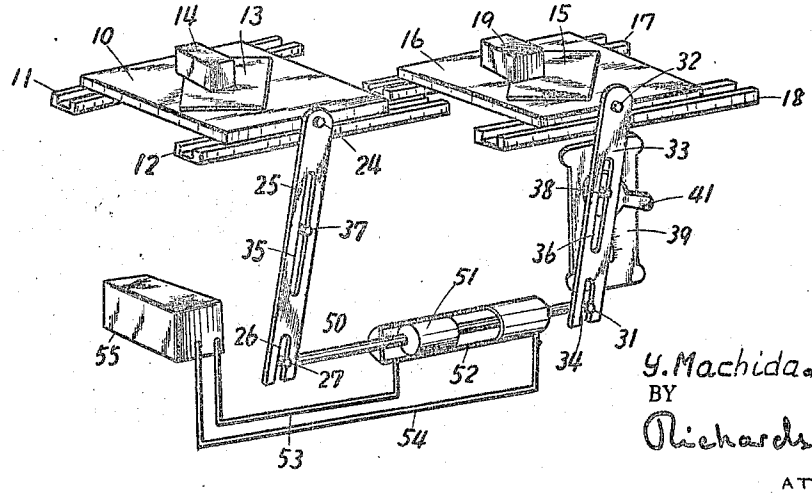


Fig. 3



INVENTORS:
Y. Machida and F. Nishida
BY
Richards & Geier
ATTORNEYS

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ELECTRONIC ENGRAVING MACHINE

Yoshihiro Machida, Shugakuin, Sakyo-ku, and Fumihiko Nishida, Nishi-iru, Kamikyo-ku, Kyoto, Japan, assignors to Dainippon Screen Seizo Kabuishiki Kaisha (Dainippon Screen Mfg. Co., Ltd.), Kyoto, Japan

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This invention relates to an electronic engraving machine with continuously variable reproduction scale, and more particularly to machines of this type wherein two tables carry the original picture to be reproduced and a printing plate material, respectively, a scanning head for scanning the original picture and an engraving head for engraving the printing plate material being advanced on the above tables in a direction perpendicular to the direction of reciprocating motion of said tables.

A successful type of the two-table machine has been developed by Dr. Hell as shown and described in U.S. Patent No. 2,986,598. In such machine, the copy table and the engraving table are coupled by a somewhat heavy slide through operating levers which engage the tables with their upper end and have the lower journalled to structural parts of the machine, with the respective middle portions of the levers rotatably and adjustably connected to the slide. According to this machine, one of the operating levers is restricted to enlarge the machine and the other lever is used for reduction.

An object of the present invention is the provision of an improved lever mechanism in a two-table type electronic engraving machine with a continuously variable reproduction scale.

Other objects of the invention will become apparent in the course of the following specification.

In the accomplishment of the objectives of the present invention it was found advisable to provide a lever mechanism which comprises a lever rotatably journalled at its upper end to the engraving table, a lever rotatably journalled at its upper end to the copy table, pivots for rotatably journalling the middle portions of these two levers to structural parts of the machine, a connecting rod which is constrained so as to reciprocate longitudinally and which has at its ends pins engaging in slots at the free ends of the respective levers, and means shifting the turning axis of either lever in a direction normal to the direction of movement of the connecting rod so as to produce a reciprocating motion of the two tables in accordance with the desired reproduction scale. The connecting rod may serve as the driving means for the lever mechanism.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing by way of example, preferred embodiments of the inventive idea.

FIG. 1 is a perspective view of essential parts of a machine constructed in accordance with the principle of the invention;

FIG. 2 is a diagram to explain the kinematic operation of the lever mechanism; and

FIG. 3 is a view similar to FIG. 1, but showing a somewhat modified form of construction.

The same reference numerals are applied to corresponding parts in these two embodiments.

Referring first to FIG. 1, reference numeral **10** designates a horizontally disposed engraving table mounted and guided by rails **11** and **12** for reciprocating motion. Numeral **13** indicates the printing plate material which is to be engraved by an engraving head **14**.

An original copy **15** is carried by a copy table **16** mounted and guided by rails **17** and **18** for reciprocating motion. Numeral **19** indicates the scanning head electrically connected with the engraving head **14** which has a known engraving tool or stylus (not shown), which stylus is controlled, by said scanning head **19**, its up and down motion in accordance with the brightness of the original copy **15**.

The reciprocating motion of the engraving table **10** is effected by driving an electric motor **20**. The drive of the motor **20** is transmitted, through a reversing device **21**, to a screw threaded spindle **22** which engages with a nut **23** fastened to an edge of the engraving table **10**. The reversing device **21** is controlled by an electric signal produced when the stylus comes to an end of the printing plate material **13**, so that the reciprocation of the engraving table **10** is effected by reversing the direction of rotation of the screw threaded spindle **22**.

The nut **23** carries a stub shaft **24** to which is pivotally connected the upper end of a lever **25**. At the lower end portion of the lever **25** is formed a longitudinal slot **26**. The slot **26** receives the pin **27** at an end of a reciprocating rod **28** which is constrained by guides **29** and **30** to a horizontal reciprocating motion in the longitudinal direction thereof. The other end of the reciprocating rod **28** is provided with a pin **31**.

The copy table **16** carries, at a side thereof, also a stub shaft **32** to which is pivoted the upper end of a lever **33**. The lower end portion of the lever **33** is provided with a longitudinal slot **34** into which enters the pin **32** of the reciprocating rod **28** mentioned above.

While, the levers **25** and **33** are provided at their middle portions with longitudinal slots **35** and **36**, respectively, the slot **36** of the lever **33** receives a pivot or pin **37** extending from a structural part of the machine.

The slot **35** of the lever **25** also receives a pivot or pin **38**. The pivot **38** is so constructed that it is capable of having its position shifted in a direction normal to the direction of movement of the rod **28**. Thus a structural part of the machine is provided with a scale plate **39** having a vertically extending slot **40** along which the reproduction ratio is marked. The pivot **38** can be adjusted in its position along the slot **40** provided with the scale and can be fixed in any adjusted position by means of a fastening member **41** which clamps the pivot **38** to the structural part of the machine. The adjustment or setting of the reproduction scale is effected by shifting the pivot **38** upwardly or downwardly along the slots **35** and **40**. When the adjusting pivot **38** is set at the lower-most position, the picture on the copy table **16** will be enlarged to the maximum of the capacity of the machine. On the other hand, a minimum reduction takes place when the adjusting pivot **38** is placed in the upper-most position.

As illustrated above, the engraving table **10** and the copy table **16** are coupled by two levers **25** and **33** through the rod **28**. That is to say, if the engraving table **10** moves for a certain distance there is produced a couple to turn the lever **25** about its axis **38**. This couple is transmitted, through the rod **28**, to another lever **33** as a moment to turn said lever **33** about the axis **37**. Then, the copy table, which is pivoted at **32** to the lever **33**,

moves in the same direction as that of the engraving table **10**. The rate of movement of the copy table **16** resulting from turning of the lever **33** will depend, in case its turning pin **37** is fixed, on the internal division ratio of the lever **25**.

Referring now more specifically to FIG. 2, which illustrates kinematically the lever mechanism of the present invention, the vertical distance between shaft **24** and pivot **38** of the lever **25** is assumed to be *a*, and the vertical distance between pivot **38** and pin **27** is assumed to be *b*. Similarly, the vertical distance between shaft **32** and pivot **37** of the lever **33** is assumed to be *c*, and the vertical distance between pivot **37** and pin **31** is assumed to be *d*. And, the movement of the engraving table **10** is represented by *x* from the point **24** to **24'**, and similarly, the movement of the copy table **16** is represented by *y* from the point **32** to **32'**. Let the distance of respective movement of the lower ends **27** and **31** of the levers **25** and **33** be represented by *u* and *v*, respectively, then

$$x=\frac{a}{b}u, \text{ and } y=\frac{c}{d}v$$

Since the pins **27** and **31** are connected to each other by means of the rod **28**,

$$u=v$$

Therefore,

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

Assumed that the turning axis of the lever **33** is fixed at **37**, that is, that *d/c* is constant, and when the turning axis of the lever **25** is adjusted and fixed at **38**, that is, *a/b* is made constant, the ratio *x/y* will be constant independent of the rotation of the levers. Then, the movement of both tables **10** and **16** is in proportions. This means that, if the ratio *a/b* changed by shifting the pivot **38**, the ratio x/y will be changed accordingly.

In operation of the machine, the stroke ratio of the engraving head **14** and the scanning head **19** is adjusted to the ratio corresponding to

$$\frac{a}{b}\cdot\frac{d}{c}$$

of the above-mentioned levers **25** and **33**. Assumed that

$$\frac{a}{b}\cdot\frac{d}{c}<1$$

then there will result a reduction on the printing plate **13** as compared with the original copy **15**. When

$$\frac{a}{b}\cdot\frac{d}{c}>1$$

an enlargement will be obtained. In principle, the ratio x/y will be changed from infinitesimal to infinity, by shifting the position of the turning pivot **38**. Due to the mechanical condition, however, the reproduction ratio will be limited to a certain range.

In one embodiment of the machine, the turning axis or pivot **37** of the lever **33** is positioned midway between the lever ends **31** and **32**, so that the distance of movement of the lower end at **27** of the lever **25** is same

with that of the movement of the upper end **32** of the lever **33**. However, the pivot **37** is so constructed that it is able to shift its fixing position, similarly to the pivot **38**, between the upper and the lower ends of the lever **33**. The reproduction scale is adjusted on the basis that when

$$\frac{a}{b}=\frac{c}{d},$$

an equal size of reproduction is obtained

FIG. 3 shows a modified form of construction of the machine, wherein the lever **25**, the upper end of which is pivoted at **24** to the engraving table **10**, has a fixed turning axis, while the scale plate **39** together with the reproduction adjusting pin **38** is associated with the lever **33**, the upper end of which is pivoted at **32** to the copy table **16**. The coupling of the levers **25** and **33** is effected by a piston rod **50**. The piston rod **50** is provided with a piston **51** contained in a cylinder **52** which has two orifices connected with hydraulic lines **53** and **54** terminating in a hydraulic control device **55** for governing the feed and return of hydraulic fluid so as to effect reciprocation of the piston **51** and therewith rocking of two levers **25** and **33** as mentioned above. In this second form of construction, both levers **25** and **33** are driven directly at their respective lower end **27** and **31**, so that the machine construction will be simple and it will improve the accuracy of reproduction. The driving of the lever mechanism is not, of course, limited to be such a hydraulic piston device. A screw threaded spindle such as shown in FIG. 1 can satisfactorily be used instead of the hydraulic piston.

What we claim is:

1. In a two-table type electronic engraving machine with continuously variable reproduction scale, a lever mechanism comprising a lever rotatably journalled at its upper end to an engraving table, a lever rotatably journalled at its upper end to a copy table, means rotatably journalling the middle portions of said two levers to structural parts of the machine, a connecting rod, means longitudinally reciprocating said connecting rod, pins carried by the ends of said connecting rod and engaging in slots at the free ends of said levers, and means shifting the turning axis of either lever to produce the reciprocating motion of said two tables in accordance with the desired reproduction scale.

2. A two-table type electronic engraving machine as claimed in claim **1**, in which the connecting rod is the driving shaft of the lever mechanism.

3. A two-table type electronic engraving machine in accordance with claim **1**, wherein the means moving the connecting rod comprise a piston and a cylinder enclosing said piston.

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MILTON KAUFMAN, *Primary Examiner.*