

APPARATUS FOR MAKING A PRINTING PLATE

This invention relates to apparatus for making a printing plate, and to printing plates so made. Embodiments of the invention can be applied to intaglio plates for use in gravure printing.

Various kinds of printing systems have been proposed, which effect relief printing, offset printing, intaglio printing, silk screen printing or the like. Intaglio printing is frequently used to print multiple copies of an image, such as a photograph, at high speed. A method of manufacturing a gravure printing plate, suitable for intaglio printing, will now be explained with reference to Figures 1A to 1F of the accompanying drawings.

The lights and shades of a document such as a photograph are developed on the surface of a metal plate cylinder for gravure printing in such a manner that holes are made whose areas and depths correspond to the lights and shades. Then the metal surface of the plate cylinder is etched to form collections of small cells or concave portions of different areas or of different depths. In printing, ink fills these concave portions.

Thus, a gelatin film 2 is coated on a paper 1 as shown in Figure 1A to form a carbon tissue 3, and the carbon tissue 3 is immersed in an aqueous solution of potassium dichromate so as to give a photosensitive property thereto.

As shown in Figure 1B, the carbon tissue 3 is then exposed to light through a mesh screen 4 having a mesh size of 8 lines/mm. The exposed carbon tissue 3 is subsequently exposed to light using a positive film 5 wherein a picture to be printed is recorded. the gelatin film 2 is thereby hardened where exposed.

Next, as shown in Figure 1C, the gelatin film 2 is deposited on a copper cylinder 6, and the paper 1 is removed. The portions of the gelatin film 2 that have not been hardened by the exposing process are then dissolved in hot water (about 40°C) and removed, as shown in Figure 1D. The surface of the copper cylinder 6 is then etched in an immersion-diffusion process using an aqueous solution of ferrous chloride, as shown in Figure 1E. The hardened gelatin film 2 is then removed leaving a gravure printing plate 7, as shown in Figure 5F, which can be used as a plate cylinder 7.

The plate cylinder 7 thus formed is partially immersed into solvent-type ink 10 as shown in Figure 2, and any excess ink 10 on the surface is removed by a doctor blade 11, which is a knife having a sharp edge that is urged against the surface of the plate cylinder 7 so that it removes all of the ink except that which is filled into the large number of concavities (hereinafter referred to as cells) formed in the printing surface of the plate cylinder 7.

An impression cylinder 12 presses a paper 13 to be printed against the printing surface of the plate cylinder 7, whereby the paper 13 adsorbs the ink 10 as shown in Figure 3. The concentration of the ink 10 adsorbed depends on the depths of the cells formed on the printing surface of the plate cylinder 7 by the etching process. In particular, a cell of relatively great volume (that is of relatively great area or depth) contains a relatively large amount of ink, so that the concentration of the ink is relatively high, and vice versa.

Such a plate cylinder for gravure printing is custom-manufactured for each printing job, and is suitable for producing a large number of copies. However, if this plate cylinder is used for printing only tens or even several thousands of copies, the printing cost per copy is considerably increased. Moreover, the plate cylinder not only involves a complicated manufacturing process, but also a process for making a transparent positive image film, so that an increased number of process steps is required. Furthermore, it is necessary that copper be plated on the plate cylinder 7, and that a metal cylinder be employed for the etching process. Thus the manufacture of the plate cylinder is complex and too expensive to be suitable for office use or personal use.

According to the present invention there is provided apparatus for making a printing plate, the apparatus comprising:

- a cylinder;
- a thermoplastic resin sheet wrapped around said cylinder;
- laser beam projection means including a semiconductor laser driven by pulse-number modulated drive pulses for projecting a laser beam on said resin sheet to alter the resin sheet in accordance with image information;
- first drive means coupled to said cylinder for rotating said cylinder at a predetermined rate; and
- second drive means coupled to said laser beam projection means for

moving said laser beam projection means in an axial direction of said cylinder at a predetermined rate.

According to the present invention there is also provided a printing plate made by such apparatus.

5 The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figures 1A to 1F are process diagrams illustrating successive steps in the manufacture of a gravure printing plate by a known method;

10 Figure 2 is a diagram for explaining gravure printing;

Figure 3 shows an enlarged portion of Figure 2;

Figure 4 is an exploded perspective view of an embodiment of apparatus for making a plate cylinder of an intaglio plate and according to the present invention;

15 Figure 5 is a sectional view of the assembled apparatus of Figure 4 in a plane normal to the cylinder axis;

Figure 6 is a schematic perspective view of a laser optical system used in the apparatus; and

Figure 7 is a block diagram of the laser scanning system.

20 The apparatus of Figures 4 and 5 comprises a cylinder 17 made of metal. A plate sheet 8a made of a synthetic resin is wrapped around the outer surface of the cylinder 17 and is secured to the cylinder 17 by screwing countersunk screws 8b or the like through apertures 8c bored through the plate sheet 8a into nuts 8d formed in the cylinder
25 17. The resin sheet 8a could be secured to the cylinder 17 by other suitable means such as a double-faced adhesive tape.

As the material for the plate sheet 8a, it is preferable to use a thermoplastic resin having a relatively narrow distribution range of a melting or sublimating point, and an appropriate hardness when it is
30 cooled to room temperature, and which, when heated, is easily scattered or sublimated. For example, the thermoplastic resin may be polyethylene resin, acrylic resin or polypropylene resin containing carbon in an amount of about 20% by weight. The thickness t of the resin sheet 8a is selected to be about 200 micrometers. Metal caps 19L
35 and 19R fit the left and right ends of the cylinder 17 so that they fix the left and right ends of the resin sheet 8a, thus forming the plate cylinder 8. Shafts 18L and 18R are integral with the caps 19L and 19R.

and are coupled to a plate cylinder rotating motor 36 (as will be described later in connection with Figure 7), whereby the plate

cylinder 8 is rotated at a rate of about once every 2.5 seconds in the direction shown by an arrow B in Figure 5.

5 A laser beam is caused to impinge on the resin cylinder 8 through an objective lens 23 (Figures 5 and 6), and is focused on the surface of the resin sheet 8a causing the surface to melt, scatter or sublimate.

10 If the intensity of the laser beam is modulated by an input video signal, or if the time during which one recess or cell 15 is irradiated with the laser beam is changed, the depth or size of the cell 15 from which the synthetic resin is scattered or sublimated can be adjusted. Therefore, the volume of the cell 15 can be adjusted in accordance with the tone of the image. In other words, the depth d or the area s of the cell 15 can be varied by the amount of the plate surface material that is scattered by the laser beam in response to the tone of the
15 input video signal, as shown in Figure 5.

Figure 6 is a diagram showing how a cell 15 can be formed on the resin sheet 8a using a small energy-emitting semiconductor laser 20 whose power is about 1W. A signal, derived from an image scanner or the like, is supplied from an input video signal source 21 to the laser
20 20, whereby the laser beam is directly modulated by the input video signal by pulse code modulating a drive current. As a result, the laser beam emitted from the laser 20 is turned on and off in synchronism with the video signal. The laser beam emitted from the laser 20 is collimated by a collimating optical system 22 to form a
25 parallel laser beam, and is focused at a predetermined position on the surface of the resin sheet 8a through the lens 23. The laser 20, the collimator 22 and the lens 23 form a laser block 24, which is initially located so as to focus its laser beam at a predetermined position on the leftmost side of the plate cylinder 8.

30 The plate cylinder 8 is rotated by the motor 36 (Figure 7) in the direction B so that, while the plate cylinder 8 is rotated once, the laser beam scatters the surface of the resin sheet 8a along the circumference of the plate sheet 8a, thereby forming the cells 15 of a first predetermined track. The laser block 24 is then moved in the
35 axial direction of the plate cylinder 8 a distance corresponding to the length in the axial direction of one picture element, and, while the plate cylinder 8 continues to rotate, the laser beam again scatters the

surface of the resin sheet 8a, thereby forming the cells 15 of a second predetermined track. By sequentially carrying out such scanning over the entire surface of the plate cylinder 8, it is possible to scatter the synthetic resin material on the surface of the resin sheet 8a to form thereon the cells 15 corresponding to the tones represented by the input video signal.

Figure 7 is a schematic block diagram of an arrangement by which data corresponding to the tones of the input video signal are supplied to the semiconductor laser 20. An input portion 30 supplies a status signal 31 such as a stop or reset to a microcomputer 32, hereinafter referred to as a central processing unit (CPU). The CPU 32 supplies pulses for forward or reverse rotation to a laser block moving motor driver 33 and to a plate cylinder rotating motor driver 35, thereby driving the laser block moving motor 34 and the plate cylinder rotating motor 36. The plate cylinder driving motor 36 rotates the plate cylinder 8, and the laser 20 forms the cells 15 corresponding to the data of the input video signal on the surface of the resin sheet 8a. At the end of each complete rotation of the plate cylinder 8, the laser block moving motor 34 rotates to move the laser block 24 linearly by the amount of one picture element, thereby forming the cells 15 corresponding to the tone of the picture along the circumference of the plate cylinder 8 under the control of the CPU 32.

The image signal is converted to a digital signal at a rate of four bits per pixel, and is stored in a data random access memory (RAM) 38 as image data D. The CPU 32 supplies a count pulse to an address counter 37, which sequentially supplies a read address A to the data RAM 38.

The image data D from the data RAM 38 is supplied to addresses A_6 to A_9 of a gray-scale read only memory (ROM) 41 for modulation. The gray-scale ROM 41 is supplied at its addresses A_0 to A_5 with an output of a counter 40 that counts a clock pulse of about 200 kHz generated by a pulse generator 39.

The ROM 41 has a table map for the modulation, in which the addresses A_0 and A_5 thereof change with image data in a range of from 000000 to 111111. The ROM 41 produces a pulse width modulated (PWM) pulse for each of the image data. This PWM pulse is used to gate the clock pulse in a gate 42 which supplies a laser driver 43 with clock

pulses, the number of which correspond to the density of the picture element. In this manner, the laser 20 is driven. The reason that the output of the counter 40 is produced in the form of six bits is to effect non-linear conversion such as gamma correction. Thus the size of the cells 15 formed on the surface of the resin sheet 8a is changed by varying the number of laser beam pulses in response to the image data.

In this embodiment, a heat absorbing agent such as carbon is contained in the thermoplastic resin material in order to improve its heat absorbing property, and the plate sheet surface can then be directly scattered by a small energy source such as a semiconductor laser having a power of about 1W. Thus a gravure plate can be directly made in an office or by individuals at home. Moreover, since the printing plate can be directly made by an electrical signal, various kinds of image data can be supplied, and an inexpensive plate cylinder for an intaglio plate can be made using an electrical signal.

The present invention is not limited to the precise embodiment thereof described above. For example, the cells 15 may be formed in successive axial tracks that are formed in response to actuation of the motor 34 and are caused to be displaced circumferentially by actuation of the motor 36.

CLAIMS

1. Apparatus for making a printing plate, the apparatus comprising:
a cylinder;
5 a thermoplastic resin sheet wrapped around said cylinder;
laser beam projection means including a semiconductor laser driven by
pulse-number modulated drive pulses for projecting a laser beam on said
resin sheet to alter the resin sheet in accordance with image
information;
10 first drive means coupled to said cylinder for rotating said cylinder
at a predetermined rate; and
second drive means coupled to said laser beam projection means for
moving said laser beam projection means in an axial direction of said
cylinder at a predetermined rate.
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2. Apparatus according to claim 1 wherein said thermoplastic resin
sheet includes a heat absorbing material.
3. Apparatus according to claim 2 wherein said heat absorbing
20 material is carbon included in said resin sheet in an amount of about
20% by weight.
4. Apparatus according to claim 1, claim 2 or claim 3 wherein said
laser beam sublimates a variable amount of said resin sheet in
25 accordance with said image information.
5. Apparatus for making a printing plate, the apparatus being
substantially as hereinbefore described with reference to Figures 4 to
7 of the accompanying drawings.
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6. A printing plate made by apparatus according to any one of the
preceding claims.

