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(54) Method of controlling dot gain on proof print.

(57) Disclosed is a novel method of controlling dot gain of the halftone dots on a proof prints, which comprises the steps of: printing an object to be proofed including a control patch at different velocities, to obtain proof prints; obtaining dot gain values in respective prints; inputting the dot gain values to a memory of a proof press to be used for proof printing; calculating on the basis of the dot gain values and the printing velocities at which the printing is carried out; obtaining an approximate expression representing the relationship between the printing velocity and the dot gain value; inputting a desired dot gain value; obtaining an actual printing velocity corresponding to the desired dot gain value on the basis of the approximate expression; and carrying out an actual proof printing of the object at the actual printing velocity.

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Croydon Printing Company Ltd.

TITLE OF THE INVENTION

Method of Controlling Dot Gain on Proof Print

BACKGROUND OF THE INVENTION

The present invention relates generally to proofing with ink by a proof press, and particularly to a method of controlling so-called dot gain (this word means the undesirable printing of dots as larger areas than their actual size, which is also called "dot spread" or "dot enlargement) on a proof print produced by a proof press.

It is well known that, during offset process, halftone dots are generally apt to spread undesirably as larger areas than their actual size on a printing plate, when a printing plate bearing an image of halftone dots thereon is used in a production press. The amount of such dot gain is much smaller in highlight dots, but is larger in middle tones to deep tones.

It is also well known that, in comparison with prints produced by a production press and a proof press, dot gain of the halftone dots on the print produced by the proof press is generally less, though it is apt to occur. On the other hand, dot gain on the print produced by the production press is widely spread relative to the actual dot size of a printing plate.

Such difference in the amount of dot gain between on a proof press and on a production press raises serious problems.

There disclosed several known techniques in the publication "PHOTOMECHANICS HANDBOOK", 1980, pp. 128-130, (published by Japan Association of Graphic Arts Technology).

According to the publication, it is commonly considered that a print produced by a production press should be produced so as to approach a proof print produced by a proof press, since the proof print is to be an original of printing on a production press. However, it will be impossible to reduce the amount of dot gain in printing on the production press up to such amount of dot gain as on the proof press, for the reasons that printing on the production press is produced at a very high velocity in comparison with printing on the proof press, that a printing pressure on the production press is different from one on the proof press, and so on. Thus, the publication shows several methods for resolving such dot gain effects as follows.

It has been generally adopted that the dot size of a printing plate for use in printing on the production press is reduced in comparison with that of a proof plate, whereby the amount of dot gain on the production press is cancelled out, so that the resultant dot size of the print produced by the production press is consistent with that of the proof print produced by the proof press.

Another method is that a print produced by the proof press is produced so as to approach a print produced by the production press. In this case, appropriate printing conditions on the production press must be determined before proof printing on the proof press is carried out. Such printing conditions will be determined on the basis of a printing pressure, an ink viscosity, an atomospheric temperature, humidity and so on, by taking account of various factors peculiar to printing on the production press, e.g. trapping, dot gain, printing stability, image density and so on.

These methods conventionally adopted relies upon the operator's ripe experience and requires an operator to be well acquainted with such operations.

Accordingly, an object of the present invention is to provide a novel method of controlling dot gain on a proof print effectively and easily.

The aforementioned object is accomplished by the present invention, with a method of controlling dot gain on proof print which includes the steps of: previously printing an object to be proofed including a control patch at different velocities, to obtain proof prints; obtaining dot gain values in respective prints; inputting said dot gain values to a memory of a proof press to be used for proof printing; calculating on the basis of said dot gain values and the printing velocities at which the previous printing is carried out; obtaining at least one approximate expression representing the relationship between the printing velocity and the dot gain value; inputting a desired dot gain value; obtaining an actual printing velocity corresponding to said desired dot gain value on the basis of said approximate expression; and carrying out an actual proof printing of the object at the actual printing velocity.

Other novel features and advantages of the invention will become apparent in the course of the following detailed description taken together with the accompanying drawings, which are directed only to the understanding of the present invention and not to the restriction of the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a block diagram of a controlling circuit for controlling dot gain;

Fig. 2 shows a perspective view of a proof press;

Fig. 3 shows a schematic sectional view of a proof press shown in Fig. 2; and

Figs. 4 through 6 respectively shows a graph which represents the relationship between the dot gain value and the printing velocity.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 2 and 3, which show a perspective view of a proof press to be used and a schematic view thereof respectively, the proof press generally comprises a horizontal base frame 1 and a carriage 3 movable horizontally along the base frame 1 by a motor 31 mechanically connected thereto.

The base frame 1 includes a plate bed 5 on which a desired proof plate 9 is mounted and a paper bed 7 on which a sheet paper 11 to be printed is mounted. At the left end of the base frame 1 a damping mechanism 13 is provided, which mechanism 13 includes a pair of damping rollers by which an appropriate amount of damping water is supplied to the surface of the proof plate 9. At the other end of the base frame 1 there provided an inking mechanism 15 including a plurality of inking rollers 29, by which an appropriate amount of a desired ink is supplied to the surface of the proof plate 9.

The carriage 3 comprises within a housing 17 a damping mechanism 19 including a plurality of damping rollers 21, an inking mechanism 23 including a plurality of inking rollers 25 and a blanket cylinder 27. All these mechanisms and the cylinder are movable vertically, and the damping mechanism 19 is engaged with the damping mechanism 13 provided on the base frame 1 when the carriage 3 is moved up to the left end position, whereby an appropriate amount of damping water is transferred to and held by the damping rollers 21 of the damping mechanism 19, then the damping water thus transferred and held is supplied to the entire surface of the proof plate 9 as the carriage 3 travels rightwards along the base frame 1. In this connection, it will be apparent that the damping mechanism 19 is lifted not to contact with the proof plate 9 nor the sheet paper 11 during movement of the carriage 3 to the left position, and is lowered to contact with the rollers 13 and the proof plate 9 at the time that damping water is transferred to the mechanism 19 and in turn to the proof plate 9.

The carriage 3 rests at the right end portion of the base frame 1, at which the inking rollers 29 are engaged with the rollers 25 of the inking mechanism 23. A desired ink to be used for proof printing is supplied to the rollers 29 and is transferred to and kneaded by the inking mechanism 23 including rollers 25. The ink thus transferred and kneaded is supplied to the entire surface of the proof plate 9 mounted on the plate bed 5 as the carriage 3 travels leftwards along the base frame 1.

After that, the carriage 3 returns to travel rightwards, and the inking mechanism 23 is lifted not to contact with the proof plate 9 nor the paper sheet 11. Simultaneously, the blanket cylinder 27 is lowered to contact with and rotate on the proof plate 9, whereby ink of the image is transferred to the peripheral surface of the blanket 27, and is in turn transferred to the surface of the sheet paper 11 as the carriage 3 travels rightwards.

As mentioned above the carriage 3 reciprocates on the base frame 1 by means of the motor 31, by which a desired number of proof prints can be obtained.

When full-color proofing is made, the above operations are repeated upon respective color separations, e.g. yellow, magenta, cyan and black.

Such a proof press as mentioned above is well known to a person having ordinary knowledge in the art, and accordingly further detailed description on the structure and operations of the proof press is omitted here.

Referring to Fig. 1 which shows a block diagram of a control circuit for controlling dot gain on the proof press, the control circuit 41 comprises a central processing unit (CPU) 43 including a processing section 45 and a controlling section 47, a random access memory (RAM) 49, which is connected to the CPU 43, including a memory for measured data 51, a memory for designated data 53, a memory for approximate expressions 55 and a memory for printing velocity 57. The controlling circuit 41 further comprises a read only memory (ROM) 59 connected to the CPU 47 and an input-output unit 61 connected also to the CPU 43 respectively.

In the ROM 59 there stored four kinds of standard velocity of the carriage 3 including the highest and lowest ones. Stored is also functional data, e.g. in the form of a simple equation:

$$v = aG + b \tag{1}$$

where v is a moving velocity of the carriage 3,
a and b are respectively a coefficient, and
G is a dot gain value

The control circuit 41 is connected to a driving control unit 63 through a digital-analog convertor 59 and an amplifier 61, and the driving control unit 63 is in turn connected to the motor 31. The driving unit 63 controls the rotation of the motor 31 on the basis of a signal outputted from the input-output unit 61. A keyboard 67 is connected to the control circuit 41 through an interface 65. As shown by broken lines, it may be possible to connect a densitometer 69 to the interface 65 either directly or through keyboard 67 by an operator.

A proof print produced by the proof press is measured by the densitometer 69, and the density value measured by it is inputted to the input-output unit 61 either directly or through the keyboard 67 by an operator.

An approximate expressions under given conditions, i.e. specific printing pressure, ink viscosity to be used, temperature or humidity, are previously obtained and stored in the memory 55. The approximate expressions represent the appropriate relationship between the moving velocity of the carriage 3 (i.e. printing velocity) and the amount of dot gain.

It will be apparent that such an approximate expression or approximate expressions as mentioned above are greatly relies upon the given conditions under which proof printing is carried out, e.g. printing pressure of a proof press to be used, ink viscosity to be used, temperature or humidity. Accordingly, it will be preferrable to renew the approximate expressions, in the case that either one of the given conditions as mentioned above is changed.

Prior to the actual operations of proof printing, the approximate expressions are obtained as follows:

First, the lowest velocity Va is read out from the ROM 59, the carriage 3 is moved at the velocity Va by means of the motor 31, whereby producing a proof print. The density of a control strip, preferrably at the area of middle tone thereof, of the proof print is measured by a densitometer 69, to obtain the dot gain value Da. Then, the measured dot gain value Da is inputted to the memory 51 of the RAM 49 either through the keyboard 67 or directly from the densitometer 69.

Next, the highest velocity Vb is read out from the ROM 59, the carriage 3 is moved at the velocity Vb by means of the motor 31, whereby producing another proof print. The density of the control strip of the proof print is measured by the densitometer 69 in the same manner as above, to obtain the dot gain value Db. Then, the measured value of dot gain Db is inputted to the memory 51 of the RAM 49 through the keyboard 67.

In the above operations, it is necessary to maintain the solid ink density (i.e. 100 % halftone dot area) at a constant value, in order to obtain correct measured data.

As shown in Fig. 4, the relationship between the printing velocity and the dot gain value is represented, in which a point A denotes the measured value of dot gain when the proof printing is carried out at the lowest velocity Va, and a point B denotes the measured value of dot gain when the proof printing is carried out at the highest velocity Vb.

On the basis of both the measured values stored in the memory 51 of the RAM 49 and the functional data stored in the ROM 59, the approximate expression is obtained, on which a detailed explanation is given later together with experimental examples.

The functional data is to connect both points A and B by an appropriate curve or line, which will be changed on the conditions under which proof printing is carried out.

EXAMPLE 1

Now, an experimental example of the way how to obtain the approximate expressions is given, which is carried out under such conditions as follows:

Temperature: 23° C.
Humidity: 57 %
Ink used: BSP-S (indigo blue) manufactured by Dainippon Ink and Chemicals, Inc.
Proof Press used: Model KF-124-GL manufactured by Dainippon Screen Mfg. Co., Ltd.

* note: The proof press was remodelled so as to adjust the moving velocity of the carriage 3 within the range of 0.3 m/sec. to 0.6 m/sec.

Densitometer used: Model DM-400 manufactured by Dainippon Screen Mfg. Co., Ltd.
Printing Paper used: Art Paper of 0.13 mm thickness

The moving velocity of the carriage 3 was set at 0.3 m/sec. as the lowest printing velocity Va. Proof printing was made under the conditions that the solid ink density be maintained at 1.60, to obtain ten prints with that velocity. The density area of a 50% screen patch of a control strip of respective prints was measured by the densitometer, to obtain density values. Then, respective density values were substituted to the Murray Davis' equation:

$$D = -\log\left\{1 - c(1-10^{-Ds})\right\} \qquad (2)$$

where D is a density of the dot area;
c is a the dot size value; and
Ds is a solid ink density, which was maintained at 1.60, in this case, as mentioned above,

to obtain a the dot size value of the respective prints, and to obtain an average dot gain value thereof.

Then, in the same manner as above, the moving velocity of the carriage 3 was set at 0.4 m/sec., 0.5 m/sec. and 0.6 m/sec. respectively, and the average dot gain values at the respective velocities were obtained, which are listed in Table 1.

Table 1

moving velocity		amount of dot gain	
0.3 m/sec.	(v_a)	16.0 %	(D_a)
0.4 m/sec.	(v_m)	14.5 %	(D_m)
0.5 m/sec.	(v_n)	13.5 %	(D_n)
0.6 m/sec.	(v_b)	13.0 %	(D_b)

These data are stored in the memory 51 of the RAM 49 as measured data. Then, from the measured data approximate expressions are obtained as follows:

$$v_{(a-m)} = -\frac{1}{5}G + \frac{16}{5} \quad (13.0 \leq G \leq 13.5) \tag{3}$$

$$v_{(m-n)} = -\frac{1}{10}G + \frac{37}{20} \quad (13.5 \leq G \leq 14.5) \tag{4}$$

$$v_{(n-b)} = -\frac{1}{15}G + \frac{41}{30} \quad (14.5 \leq G \leq 16.0) \tag{5}$$

The relationship between the printing velocity and the dot gain value is represented as kinked line shown in Fig. 5. The approximate expressions are stored in the memory 55.

EXAMPLE 2

The second example was also carried out under the same conditions as the first example. In this example, the functional data stored in the ROM 59 was in the form of a cubic equation:

$$v = dG^3 + eG^2 + fG + h \qquad (6)$$

where v is a moving velocity of the carriage 3,
G is an dot gain value, and
d, e, f and h are respectively a coefficient

The approximate expression is obtained by substituting the measured values listed in Table 1 to the Murray Davis' equation as follows:

$$v = -\frac{8}{450}G^3 + \frac{358}{450}G^2 - \frac{5363}{450}G + \frac{27063}{450} \qquad (7)$$

The relationship between the printing velocity and the dot gain value is represented as a curve shown in Fig. 6. The approximate expression is stored in the memory 55.

Then, an operator inputs a desired dot gain value through the keyboard 67, which is stored in the memory 53. In response to the input of the desired dot value, reading out both the desired dot gain value and the approximate expression, and on the basis of these, a corresponding printing velocity is obtained, which is stored in the memory 57.

The desired printing velocity is read out from the memory 57, which is outputted to the driving unit 63 through the digital-analog convertor 59 and the amplifier 61. The motor 31 is driven under the control of the driving unit 63, and accordingly the carriage 3 moves at the corresponding velocity, whereby desired amount of dot gain can be obtained.

In order to confirm the efficiency of the proof printing according to the invention, the following experiments were carried out.

COMPARATIVE EXAMPLE 1

Substituting G=15 to the formula (5), the moving velocity of the carriage 3 was obtained, which resulted in v=0.367. The proof printing was carried out under the same conditions as described in Example 1, in which the printing velocity was set at v=0.367 (m/sec.), then the dot gain value was measured as 15.2 %. From this, there was an error of 0.2 % in the actual amount of dot gain, which is apparently permissible in a practical use.

COMPARATIVE EXAMPLE 2

Substituting G=15 to the formula (7), the moving velocity of the carriage 3 was obtained, which resulted in v=0.373 (m/sec.). The proof printing was carried out under the same conditions as described in Example 2, in which the printing velocity was set at v=0.373 (m/sec.). Then the dot gain value was measured as 15.1 %. From this, there was an error of 0.1 % in the actual amount of dot gain, which is apparently permissible in a practical use.

While the invention has been illustrated and described as embodied a method of controlling dot gain, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

For example, though in Example 1 the approximate expression is represented as a kinked line, it may be obtained by interpolation on the basis of the respective points of the highest and lowest velocities and intermediate points therebetween.

Further, though in Example 1 the approximate expression is obtained on the basis of four kinds of printing velocities, it can be done on the basis of only the highest and lowest printing velocities velocity.

In the above mentioned embodiments, the amount of dot gain is obtained by measuring the halftone density of a control strip, but it may be applicable that, instead of measurement by the densitometer, the dot gain value is directly obtained by a dot-gain meter, or that comparative contrast value K expressed by the formula:

$$K = 1 - (\frac{Dh}{Ds})$$

is used instead of the dot gain value.

Accordingly, any value convertable to the dot gain value can be available in the method according to the invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by

letters patent is set forth in the appended claims.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

CLAIMS

1. A method of controlling a dot gain on a proof print, comprising the steps of:

printing an object to be proofed including a control patch at different velocities, to obtain proof prints;

obtaining dot gain values in respective prints;

inputting said dot gain values to a memory of proof press to be used for proof printing;

calculating on the basis of said dot gain values and the printing velocities at which the printing is carried out;

obtaining an approximate expression representing the relationship between the printing velocity and the dot gain value;

inputting a desired dot gain value;

obtaining an actual printing velocity corresponding to said desired dot gain value on the basis of said approximate expression; and

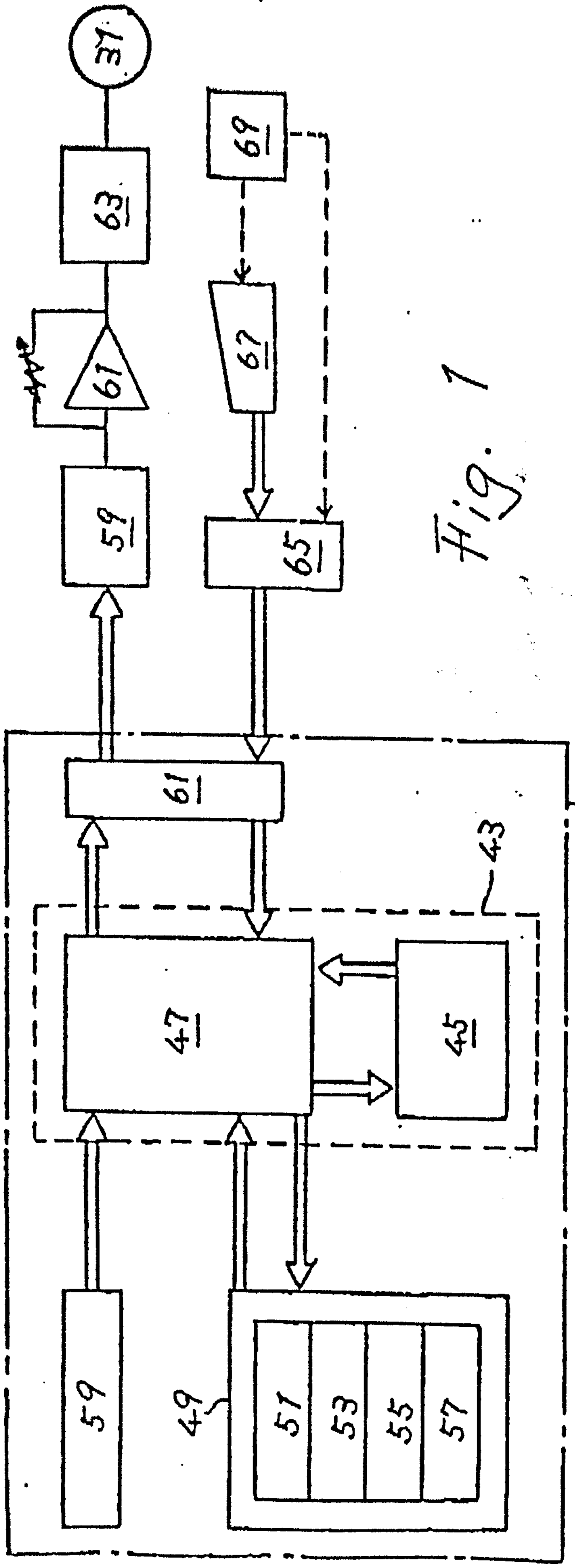
carrying out an actual proof printing of the object at the actual printing velocity.

2. A method as set forth in claim 1, wherein the step of printing an object is repeatedly carried out at least at two different velocities.

3. A method as set forth in claim 2, wherein the different velocities at which the object is printed includes

both the highest and lowest ones of the proof press to be used.

4. A method as set forth in claim 1, wherein the step of inputting dot gain values is carried out by measuring the print by means of a densitometer, the measured value of which is converted to a dot gain value.



31
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Fig. 1

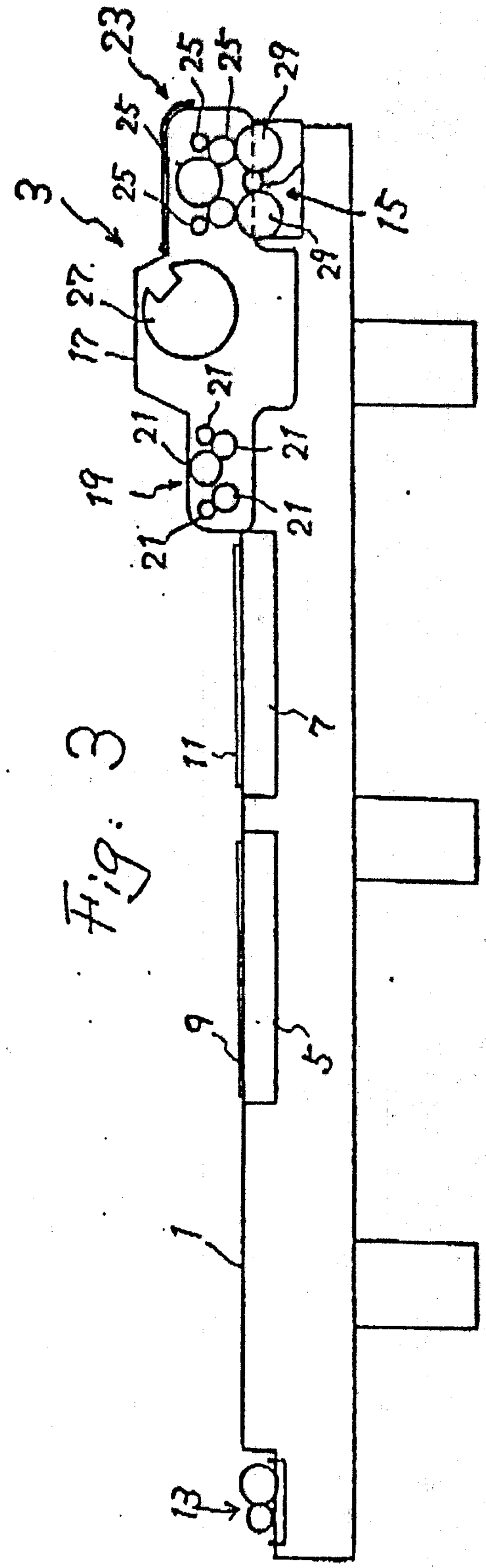

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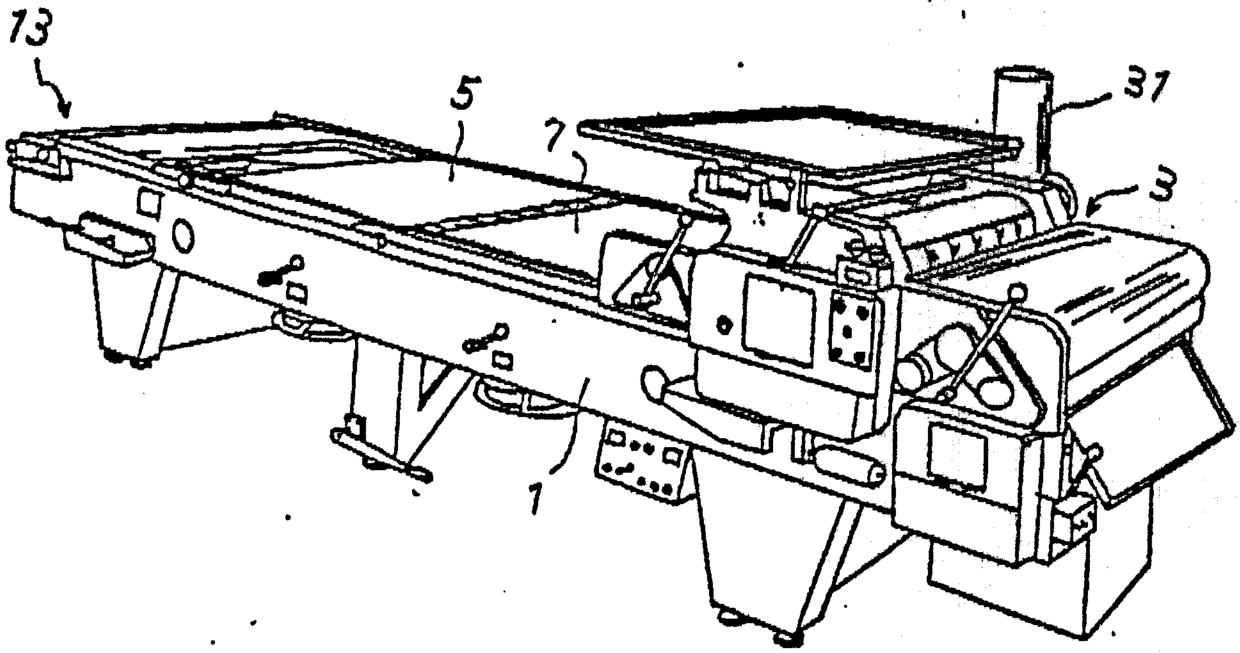
Fig. 3

Fig. 2



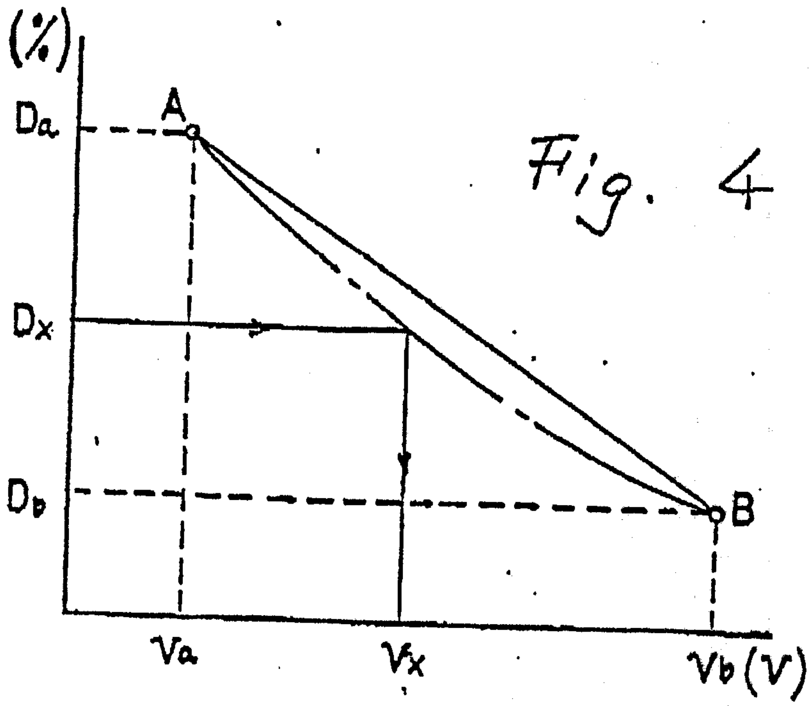


Fig. 4

Fig. 5

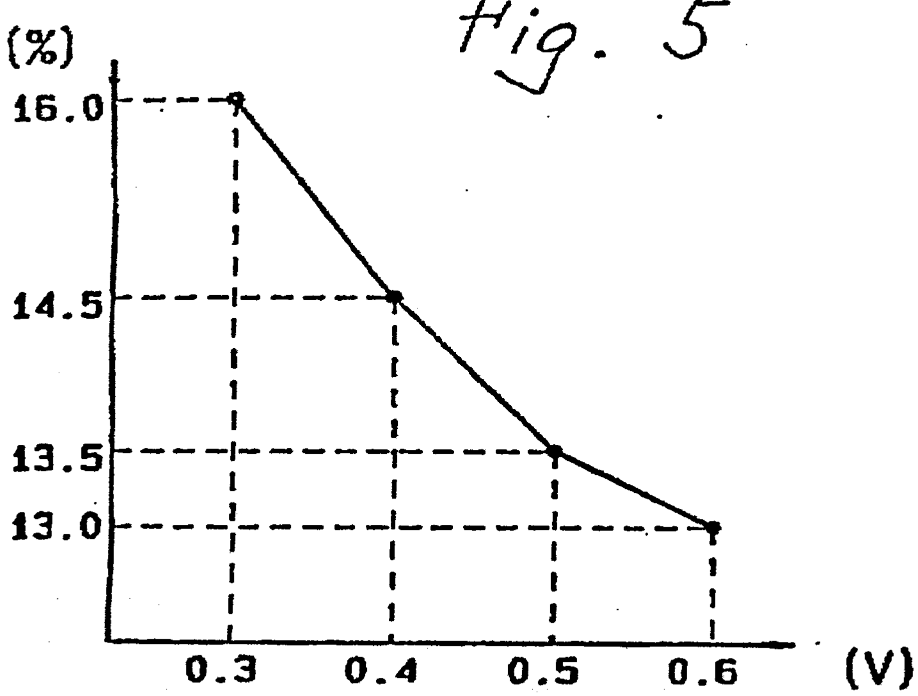


Fig. 6