United States Patent

Breuers

[15] **3,655,287**

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[54] PHOTOCOPYING MACHINE

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[51] **Int. Cl.**.....**G03b 27/04**

[58] **Field of Search**.....355/35, 50, 51, 69, 71, 83, 355/97, 115, 121

[56] **References Cited**

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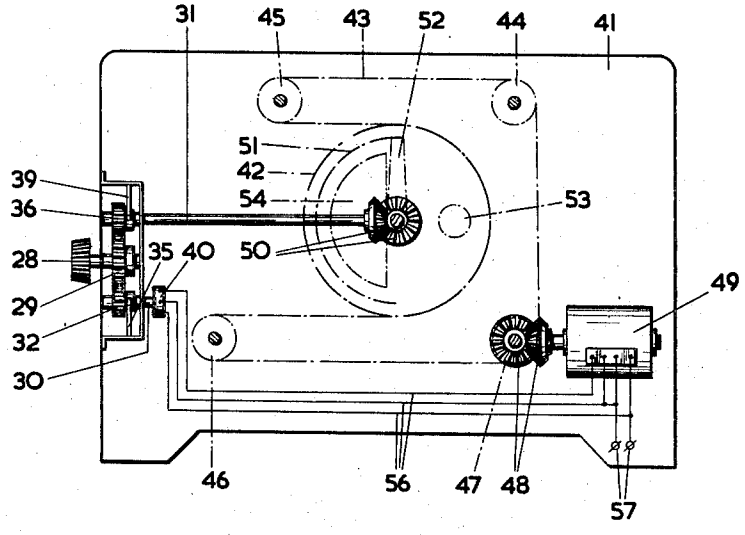
[57] **ABSTRACT**

A photocopying machine with one adjusting member for controlling the exposure by varying the conveying speed of the copy material and by varying the luminous flux. During a part of the adjusting range the luminous flux is kept at a constant maximum value and the conveying speed is varied and in another part of the adjusting range of the same adjusting member the conveying speed is kept at a constant maximum value and the luminous flux is varied.

3 Claims, 5 Drawing Figures



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SHEET 1 OF 3

Fig. 1

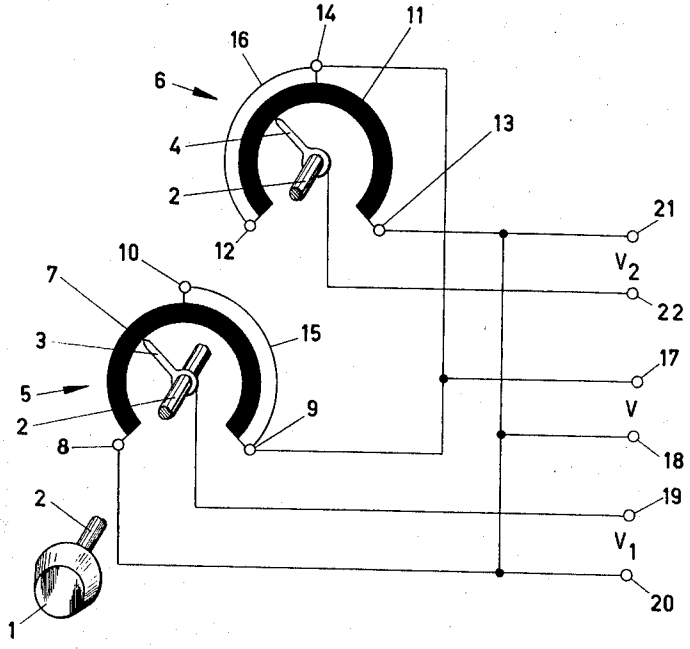

Fig. 2

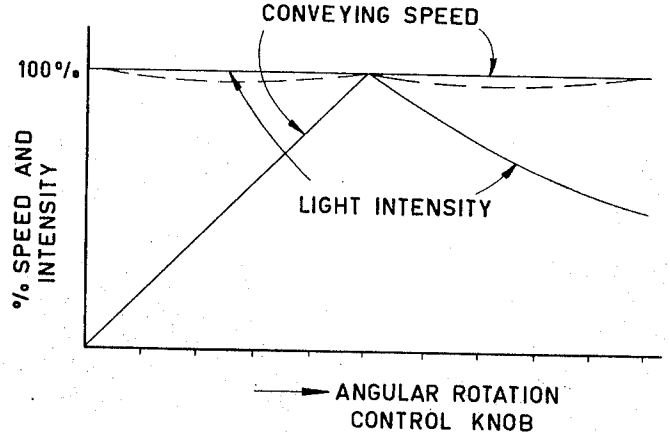

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Fig. 3

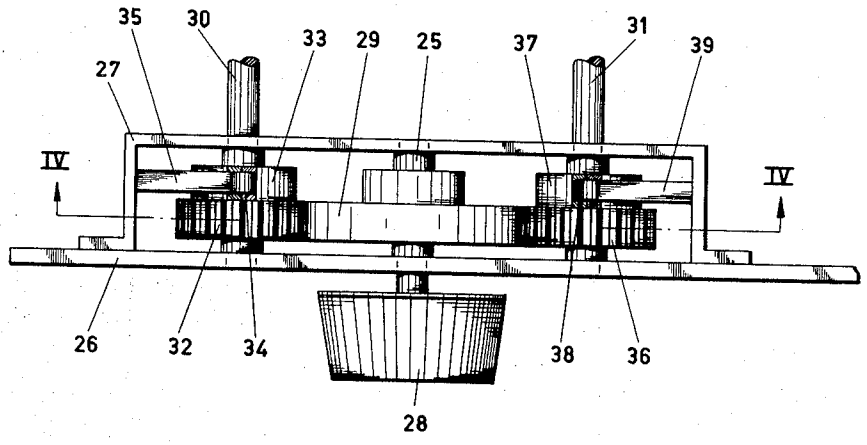

Fig. 4

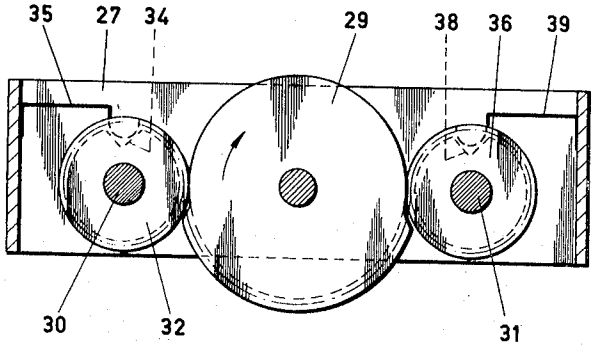

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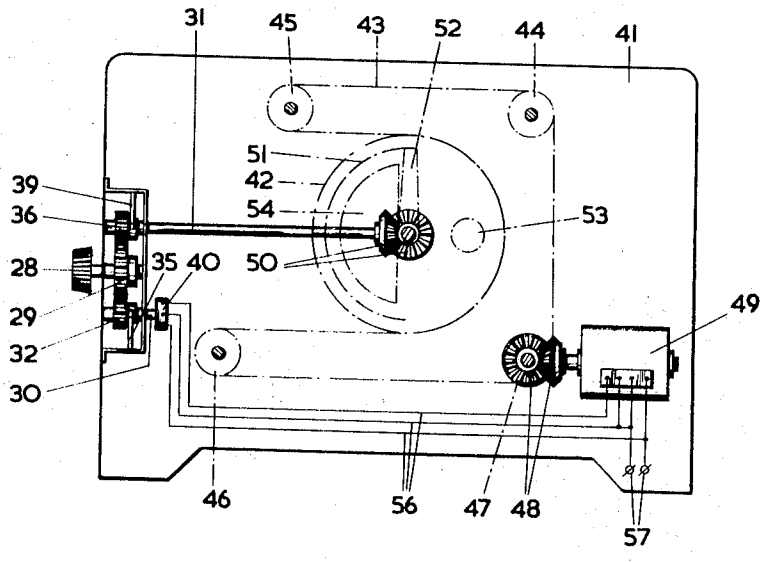
Fig. 5



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PHOTOCOPYING MACHINE

This invention relates to an exposure apparatus for photocopying, in which the material to be exposed is conveyed through the exposure area in a continuous motion, and which is provided with means for varying the conveying speed and with means for varying the luminous flux of the copying light source.

Apparatus of this kind are known in many embodiments; often they comprise a rotating glass cylinder inside of which a copying lamp is mounted, and a conveyor belt system by which the exposure set (light sensitive sheet and superimposed original) is pressed against the cylinder and traversed past the copying light source. In these apparatus the means for varying the conveying speed comprises a drive mechanism which can be set mechanically or electrically, whilst variation of the luminous flux can be achieved by varying the radiation intensity of the light source or by shading off a larger or smaller part of the radiation emitted by the light source.

As the transparencies of the originals, used in practice, as well as the light-sensitivities of the copying materials applied may widely vary inter se, it will be necessary to adapt the exposure to the nature of the exposure set from the case to case. If the original to be copied is highly transparent and/or the copying material highly light-sensitive, then the conveying speed must be higher and/or the luminous flux must be smaller than when the original is less transparent and/or the copying material less light-sensitive.

For controlling the exposure the known apparatus are provided with at least two adjusting members, for example in the form of control knobs, one of which is connected to the means for varying the conveying speed and the other to the means for varying the luminous flux. For every adjustment the operator of the apparatus has to set each adjusting member in a favorable position. In doing so, mistakes and inefficient use of the apparatus frequently occur.

It is the object of the invention to improve this situation. To that end an apparatus of the above type is according to the invention provided with one exposure setting member, which for controlling the exposure is movable through a path between an initial position and an end position and which, during such a movement, over a first part or range of its movement only actuates the means for varying the conveying speed, and over an ensuing second range of its path of movement, e.g., in the remaining part of its path wherein the control for the conveying means is in the position providing the maximum conveying speed, only actuates the means for varying the luminous flux, so that the over the first mentioned part the exposure is controlled by varying the conveying speed while holding the exposing light at a constant maximum luminous flux, and over the second adjusting range the exposure is controlled by varying the amount of light applied to the material while maintaining at a constant maximum conveying speed. In this way the exposure is each time set by a single movement of the hand, while the conveying speed and the luminous flux always have the best values for an efficient use of the apparatus.

What the maximum value of the conveying speed will be is of course among others determined by the kind of apparatus. For simple apparatus, on which the operator has to feed the original and the copying material into the apparatus, to separate them after exposure and to feed the copy material into the developing section, all by hand, this value will have to be chosen lower (for example 4.5 – 5m/min) than for automated apparatus, for example, those on which the operator needs only to feed in the original and the supply of the copying material and the separating is automatically effected.

The control member in the apparatus according to the invention can be coupled to the means for varying the conveying speed and to the means for varying the limunous flux in many ways. For instance depending upon the nature of those means use can be made of electrical means (variable resistors, potentiometers and the like) or of mechanical means (screw spindles, gears and the like). In an attractive embodiment of the invention the control mechanism comprises a rotary knob

connected with a gear wheel segment which upon rotation of the knob from the initial position towards the end position, successively rotates a first gear wheel which is coupled to the means for varying the conveying speed, and thereafter a second gear wheel which is coupled to the means for varying the luminous flux, the gear wheel segment being out of engagement with the second wheel when the first one is rotated thereby, and vice versa, with at most a slight overlap.

The invention will be further described with reference to the accompanying drawings, of which

FIG. 1 diagrammatically illustrates how the invention can be realised, by way of example only, with electrical setting means;

FIG. 2 is a graphical representation of how the conveying speed and light intensity develop in an apparatus according to the invention;

FIG. 3 is a diagrammatic cross-section of an embodiment in which mechanical setting means are used;

FIG. 4 is a diagrammatic cross-section of the same unit according to line IV—IV in FIG. 3, and

FIG. 5 gives diagrammatically a photocopying machine with adjusting member and control means according to the application.

In FIG. 1 there is a rotary knob 1 secured to a spindle rotatably supported in bearings. Also secured to spindle 2 are sliding contacts 3 and 4 of voltage regulators 5 and 6 respectively. Voltage regulator 5 comprises a resistor 7 which is provided with terminals 8 and 9 as well as with an electric connecting point 10, and voltage regulator 6 comprises a resistor 11 with terminals 12 and 13 as well as with an electric connecting point 14. In voltage regulator 5 the part of the resistor positioned between terminal 9 and connecting point 10 is short-circuited by means of connection 15, and in voltage regulator 6 the part of the resistor between terminal 12 and connecting point 14 is short-circuited by means of connection 16. Via the terminals 17 and 18 a supply voltage V is applied to the voltage regulators 5 and 6, while between the terminals 19 and 20 is the output voltage V_1 from voltage regulator 5 and between the terminals 21 and 22 is the output voltage V_2 from voltage regulator 6. When rotary knob 1 is turned from the initial position to the end position (clockwise in FIG. 1) voltage V_1 gradually increases and in this way it reaches the value of the applied voltage V when sliding contact 3 passes connecting point 10. The voltage V_2 remains constant during this time interval and had the value of the applied voltage V. When knob 1 is rotated further (the sliding contacts 3 and 4 respectively have then passed the connecting points 10 and 14 respectively) voltage V_1 does no longer change, while the value of voltage V_2 decreases until it has reached the zero-value in the end position of knob 1. The voltage V_1 is used (in a known and not further indicated manner) for varying the number of revolutions of the electrically controlled drive motor for driving the conveying means of the photocopying machine and voltage V_2 is used (equally in a known and not further indicated manner) for varying the current supply of the copying light source of the apparatus. In this way it is achieved that with a single turn of knob 1 the whole exposure range of the apparatus is controlled; over one part of the setting range by varying the conveying speed at constant intensity of the light source; over the remaining part by varying the light intensity at constant conveying speed; the foregoing as illustrated in the graph according to FIG. 2. It must be noted that the circuitry according to FIG. 1 is intended for controlling the speed and the light intensity regulating units of which the electrical resistance is high as compared with the internal resistance of the voltage regulators 5 and 6 respectively, such as will be the case, for example, when this unit contains transistor or thyristor circuits which are controlled with the aid of the voltages V_1 and V_2. If the units in question have a relatively low resistance, short-circuited parts of the resistors 7 and 11 will always have a notable effect and will cause the voltages V_1 and V_2 over the relative parts of the setting range being not absolutely constant (see the dash lines in FIG. 2).

Such deviations can of course be prevented by replacing the short-circuited parts of resistors 7 and 11 by a contact strip without internal resistance.

In FIG. 2 a course of the exposure control is illustrated in which equal increments of movement of the control knob over the whole setting range result in the same absolute variations in exposure. Of course it is also possible, for example by using resistors 7 and 11 respectively with a non-linear course, or by parallel and/or series connection of other resistors onto the voltage regulators 5 and 6 respectively, to obtain a setting whereby equal movements of the control knob result in the same relative variations in the exposure, i.e. the same percentage variations as compared with the value of the exposure at any moment.

In FIGS. 3 and 4 a spindle 25 is shown rotatably supported in frame plate 26 and in a bracket 27 secured to plate 26. To the part of spindle 25 protruding from frame plate 26, a rotary knob 28 is secured, and a gear wheel segment 29 is secured to spindle 25 between plate 26 and bracket 27. To each side of spindle 25, spindles 30 and 31 are rotatably supported in the structure. Secured to spindle 30 is a gear wheel 32 which is provided with a pinion 33 with arresting detent 34. With the aid of a leaf spring engaging into detent 34 and secured to bracket 27, gear wheel 32 is normally held in the position indicated in FIG. 4. A gear wheel 36 with pinion 37 is secured to spindle 31 and with the aid of a leaf spring 39, engaging into an arresting detent 38 of pinion 37, gear wheel 36 is held in the position indicated. When rotating knob 28 in the direction indicated by the arrow, gear segment 29 engages gear wheel 32 which then, against the pressure of spring 35, lifts the end of this spring from detent 34 and rotates until it has nearly made one complete revolution. At that moment gear segment 29 loses engagement with gear wheel 32 but engages gear wheel 36 which then starts rotating thereby. In this way it is achieved that, when knob 28 is rotated, spindle 30 is first rotated whilst spindle 31 stands still and subsequently spindle 31 is rotated whilst spindle 30 stands still. Spindle 30 is connected to a unit for varying the conveying speed of the apparatus, and spindle 31 is connected to a unit for varying the luminous flux of the copying light source. The spindles 30 and 31 may be coupled to electrical means (variable resistors, potentiometers and the like) or to mechanical means (belts, chains, and the like) for driving said units, this being dependent on the nature of said units.

In FIG. 5 a photocopying apparatus is shown diagrammatically with a frame 41, on the front face of which there is a device about as given in FIG. 3, with a knob 28 and gear segment wheels 29, 32 and 36. Rod 31 of FIG. 3 has a bevel gear wheel at 50 in FIG. 5, in engagement with a bevel wheel on a shaft or trunnion supported in frame 41 and connected to a light shield 51, supported by arms 52 and present within a rotatably supported glass cylinder 42, in which there is a photocopying lamp 53 and a cooling duct 54. Shield 51 occupies about half the periphery of the inside of cylinder 42. In FIG. 5 it is in a position where it only traps light directed to the left half of the cylinder, where no copying takes place. A system of endless conveying belts 43 is slung around guide rollers 44, 45 and 46, around driving roller 47 and around half the periphery of glass cylinder 42. An electric motor 49 with variable speed drives roller 47 through bevel gear wheels 48. Motor 49 is energized through terminals 57 and its speed of rotation is varied through electric leads 56 from potentiometer 40 rotatably connected to gear segment wheel 32. Potentiometer 40 may be embodied in the same way as given for potentiometers 5 and 6 in FIG. 1. Cylinder 42 is rotatably supported in frame 41, but is only driven by belts 43 through contact therewith.

Originals and photocopying paper are introduced from the left at the top or the bottom of cylinder 42 between belts 43 and this cylinder, move with these apparatus parts around stationary lamp 53 and thus the copy paper is exposed. Originals and copies are removed at bottom or top of cylinder 42, all in a manner quite usual for the expert.

Dotted lines indicate that part of the structure is present behind a plate of frame 41 as will be easily understood.

When gear segment wheel 36 is rotated by knob 28 and wheel 29, light shield 51 is rotated to decrease the total light flux on the copy paper by shielding off part of the light from lamp 53 through glass cylinder 42 to the copy paper. The operation will for the rest by clear from the preceding description of the other Figures. When the light flux is varied by shield 51, the conveying speed of belts 43 by motor 49 is at a maximum value and when the speed of belts 43 is varied by motor 49, the shield 51 is in the position shown, so that it does not prevent the maximum amount of light from lamp 53 to fall on the copy paper, as explained above.

What is claimed is:

1. An exposure apparatus for photocopying, including means for conveying material to be exposed in continuous motion through an exposure zone, a source of light for exposure of the material moving in said zone, means for varying the speed of said conveying means and means for varying the amount of light applied to the material from said source, wherein there are means for controlling the extent of exposure of the material which comprise an exposure setting member displaceable through a path that includes a first range and an ensuing second range of adjusting movements and means operatively connecting said setting member with both said speed varying means and said light varying means so that by movement of said member in said first range said speed is progressively increased while said amount of light is held substantially constant and by movement of said member in said second range said amount of light is varied while said speed is held substantially constant.

2. An exposure apparatus according to claim 1, said controlling means being operative to hold said amount of light at substantially a maximum value during movement of said setting member in said first range, and to hold said speed at substantially a maximum value and to reduce said amount of light during movement of said setting member in said second range.

3. An exposure apparatus according to claim 1, and setting member comprising a manually rotatable knob and said connecting means comprising a first gear wheel connected with said speed varying means, a second gear wheel connected with said light varying means and a gear wheel segment connected for rotation by said knob and engaging successively with said first gear wheel and said second gear wheel to rotate the same in succession during rotation of said knob from an initial position towards an end position thereof, said gear wheel segment being out of operating engagement with said second gear wheel while said first gear wheel is being rotated thereby and being out of operating engagement with said first gear wheel while said second gear wheel is being rotated thereby.

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