Sept. 4, 1951 N. BISHOP 2,566,399

LATERAL REGISTER CONTROL MECHANISM FOR PRINTING PRESSES

Filed Dec. 31, 1946 2 Sheets-Sheet 1

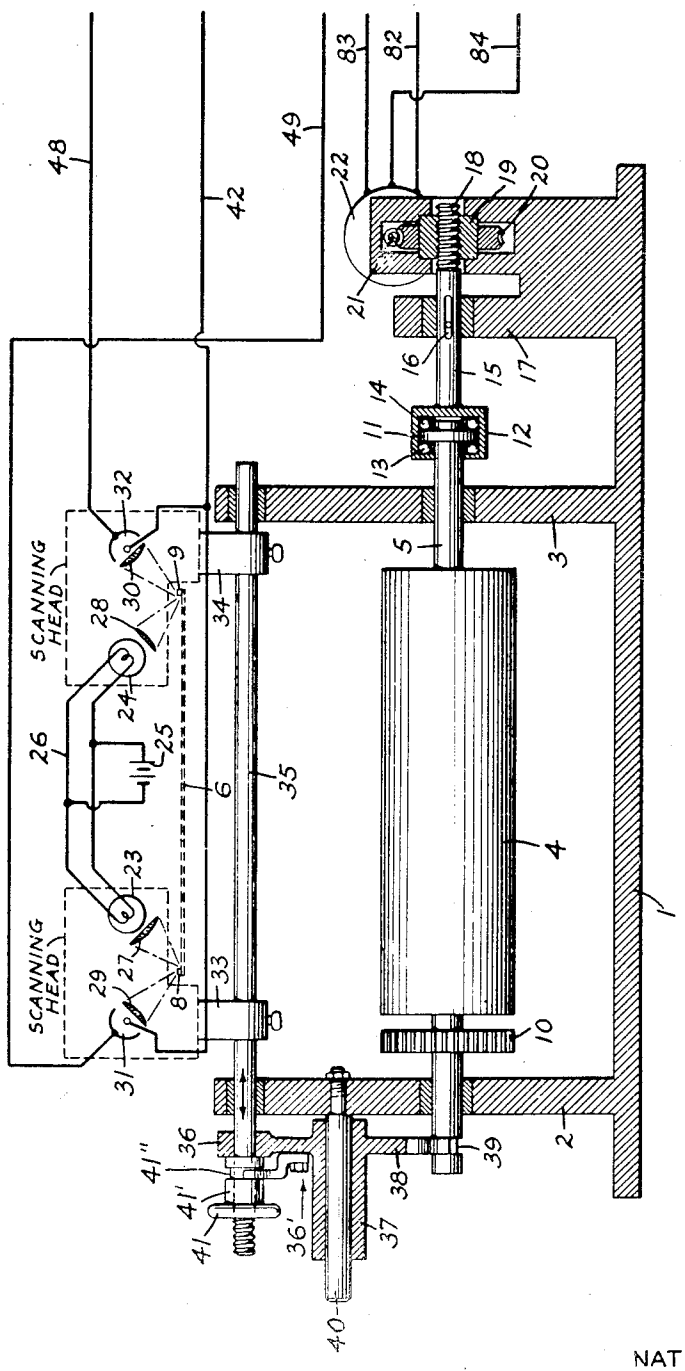


FIG. 1.

INVENTOR.
NATHANIEL BISHOP

BY
Campbell, Brumbaugh & Free
HIS ATTORNEYS.

Sept. 4, 1951 N. BISHOP 2,566,399

LATERAL REGISTER CONTROL MECHANISM FOR PRINTING PRESSES

Filed Dec. 31, 1946 2 Sheets-Sheet 2

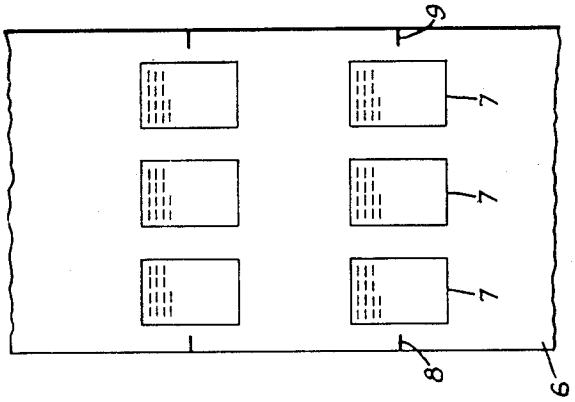


FIG. 3.

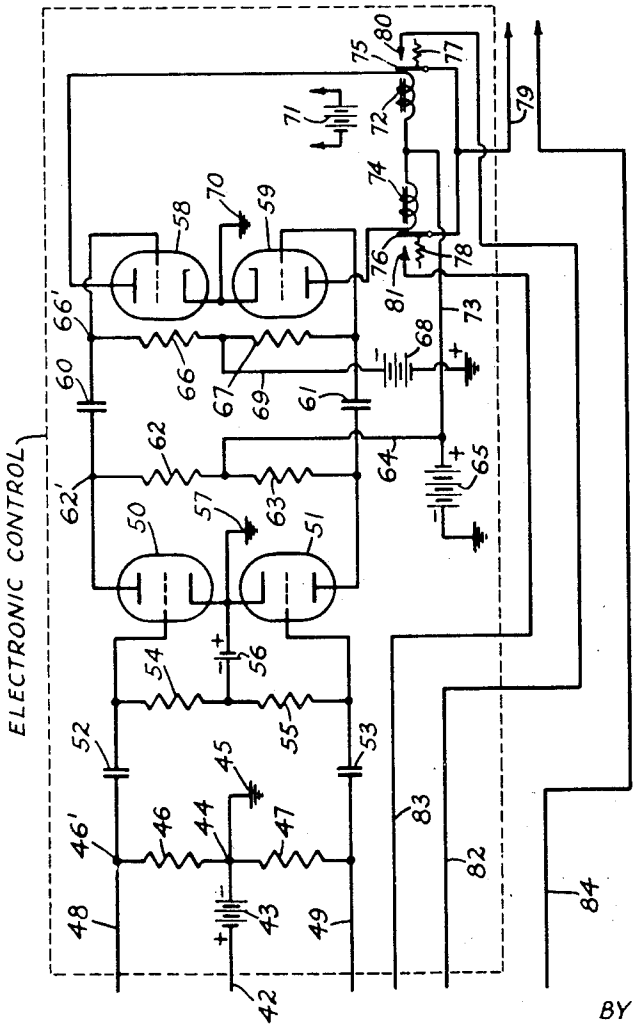


FIG. 2.

INVENTOR.
NATHANIEL BISHOP
BY
Campbell, Seumbaugh & Free
HIS ATTORNEYS.

Patented Sept. 4, 1951

2,566,399

UNITED STATES PATENT OFFICE

2,566,399

LATERAL REGISTER CONTROL MECHANISM FOR PRINTING PRESSES

Nathaniel Bishop, Fairfield, Conn., assignor to Time, Inc., New York, N. Y., a corporation of New York

Application December 31, 1946, Serial No. 719,415

1 Claim. (Cl. 101—248)

1

The present invention relates to mechanisms for controlling the register of subsequent operations that are to be performed upon a web of paper or similar material with respect to an earlier operation that has been performed upon the web. More particularly, the invention relates to mechanisms by means of which subsequent printing operations upon a web may be registered properly with respect to an earlier operation that has been performed upon the web, the invention being concerned particularly with successive printing operations.

In the operation of printing two or more superimposed impressions upon a web of paper, such as is accomplished in multicolor printing, it is of great importance that the several impressions be in proper register so that the resulting composite printed impression will reproduce the desired degree of perfection in simulating the subject to be printed. In printing operations that are now commercially used, a continuous web of paper is furnished to the printing press and, as the web travels continuously through the press, two or more impressions are applied to each unit area of the web in order to produce the desired multicolor reproduction. Although devices have been provided, the object of which is automatically to control the proper register of one impression over another in the direction of movement of the web, no effective mechanism has been provided by means of which lateral register (that is, in a direction transversely to the direction of the movement of the web) may be accomplished.

It is an object of the present invention to provide a mechanism by means of which two successive operations may be performed upon a continuously moving web, the location of the operations being controlled in such fashion that they will be in proper spaced relation with respect to a unit area of the web.

A further object of the invention is to provide a mechanism of the above character wherein two successive operations are performed upon a web in such fashion as to control the relative lateral positions of the operations so that the operations may be superimposed upon a unit area of the web with each operation properly spaced laterally of the web, that is, transversely of the direction of movement of the web.

Yet another object of the invention is to provide an improved web register control mechanism by means of which two or more successive printing operations may be performed upon a web in superimposed relation with the lateral positions of each of the operations effectively controlled.

2

Another object of the invention is to provide a mechanism of the above character which will function automatically to maintain proper lateral register of successive impressions. The foregoing and other objects are attained by utilizing an electronic control system which is accurately responsive to the existence of a previously printed register mark or indicia carried by the web. The invention may also utilize certain interrelations between the printing cylinder that is to be controlled and the mechanism that is responsive to a previously printed impression on the web, all of which will be more fully understood in connection with the accompanying drawings, wherein

Figure 1 is a schematic view, partly in vertical section, showing a typical printing unit, together with the scanning heads that are to be utilized in one form of the present invention;

Figure 2 is a diagrammatic illustration of the electrical circuits and mechanisms utilized to accomplish the control of printed impressions upon the web in accordance with the invention; and

Figure 3 is a plan view of a portion of the web upon which the successive operations are to be carried out in accordance with the present invention.

Referring to the above drawings, a typical printing unit is illustrated as being formed of a base frame 1, side frame members 2 and 3, and a printing cylinder 4 carried by a shaft 5. A web of paper 6 is suitably controlled by conventional drive and guide mechanisms and, by means of a previous printing operation, has had printed thereon periodically a series of successive printed impressions as indicated at 7. With each printed impression the web has also received register marks 8 and 9 that have been printed thereon and that are to serve as guides or controls in order to maintain subsequent operations in proper register with respect to the first operations which, in the form of the invention here shown, have been printed impressions. In the interest of clarity, the details of the web drive and guiding mechanism, as well as the details of the printing machinery, are omitted herein, only the essential elements necessary to the operation of the present invention being shown.

The printing cylinder 4 may be driven by any suitable conventional drive mechanism and, for the purpose of the present description, a gear 10 is illustrated as the driving mechanism for the cylinder 4. The cylinder shaft 5 is provided with a thrust disc 11 about which is mounted a housing 12 within which thrust bearings 13 and 14 are received. The housing 12 is carried upon

a thrust shaft 15 that is keyed at 16 to a standard 17 carried by the base frame 1. The spline connection 16 thus permits axial movement of the shaft 15 while preventing turning motion thereof.

The shaft 15 is formed with a threaded portion 18 which carries a hub 19 having a worm wheel 20. Worm wheel 20 is engaged by a worm 21 carried by the shaft of a reversing motor 22, the operation of which in either direction effects a corresponding axial motion of the printing cylinder shaft 5. In this fashion, the lateral position of the printing cylinder 4 with respect to the web 6 may be changed.

In order to accomplish the change or adjustment of the lateral position of the cylinder 4 through the motor 22, an electronic control system is provided and will now be described.

Pulses of electrical current are utilized as a means for operating the reversing motor 22. These pulses are derived from a change in the output of photoelectric cells which scan certain areas of the web as they move underneath the respective photoelectric cells. The system by means of which the foregoing is accomplished includes two sources of light 23 and 24, which are supplied with electricity from a suitable source 25 through electrical circuits 26. Light from the respective sources 23 and 24 is focused upon the web 6 by means of optical systems 27 and 28, respectively, the point of focus being just inside the path of travel of the register marks 8 and 9, respectively. The light thus focused upon the web is reflected to optical systems 29 and 30, respectively, which direct such light upon photoelectric cells 31 and 32, respectively. The mechanism just described constitutes what may be termed scanning heads indicated by appropriate legends in Figure 1, and these scanning heads may be mounted as a unit upon brackets 33 and 34, respectively, the brackets being adjustably mounted upon a shaft 35.

Shaft 35 is slidably mounted in the side walls 2 and 3 and is secured to an arm 36 carried by a bushing 37 which is formed with another arm 38. The extremity of the arm 38 is received within a groove 39 formed in the shaft 5, and bushing 37 is slidably mounted upon a stub shaft 40 which is carried by the side frame member 2. The position of shaft 35 with respect to the arm 36 and bushing 37 may be varied by means of a hand wheel or similar mechanism 41, which is threaded to the extremity of shaft 35, and which is carried on the arm 36 so that it may turn with respect to arm 36, but not move axially with respect thereto. For example, the wheel 41 is formed with a hub 41' having a peripheral groove 41'' formed therein, adapted to be engaged by the yoke extremity of a plate 36' secured to the arm 36.

Each of the photoelectric cells 31 and 32 is connected through wire 42 to a source of polarizing voltage 43 which, in turn, is connected to point 44 that is connected to ground at 45 and also to load resistors 46 and 47 for the respective photoelectric cells 32 and 31, wires 48 and 49 being provided for this purpose. Resistor 46 is connected to wire 49 at point 46'.

Triode amplifier tubes 50 and 51 are provided for the respective photoelectric cells 32 and 31. These tubes consist of heaters (not shown), cathodes, grids, and plates, the grid of tube 50 being connected to wire 48 through a grid coupling capacitor 52, while the grid of tube 51 is connected to wire 48 through a similar capacitor 53. Grid resistors 54 and 55 are provided for the respective tubes 50 and 51, a source 56 of negative grid voltage being provided for the tubes 50 and 51, this source 56, together with the cathodes of tubes 50 and 51 being grounded at 57.

A second set of triode amplifier tubes 58 and 59 are connected in the output or plate circuits of the respective tubes 50 and 51, the grids of tubes 58 and 59 being connected to the respective plates of tubes 50 and 51 through grid blocking capacitors 60 and 61, respectively.

Plate load resistors 62 and 63 are connected to the plates of the respective tubes 50 and 51 and, through a wire 64, to a source of plate potential 65. Resistor 62 is connected to the plate circuit of tube 50 and capacitor 60 at point 62'. Grid resistors 66 and 67 are provided for the respective tubes 58 and 59, a source of negative grid potential for the amplifier tubes 58 and 59 being furnished at 68 through circuit 69 to the resistors 66 and 67. Resistor 66 is connected to the grid circuit of tube 58 at point 66'. The cathodes of the tubes 58 and 59 are grounded at 70.

The heaters for the tubes 50, 51, 58, and 59 are supplied with a source of heater supply voltage indicated schematically at 71, and it is believed unnecessary to illustrate the conventional heater circuits for the four such tubes.

The plate of tube 58 is connected to the winding of a relay 72 which is also connected through a wire 73 to the source of plate potential 65. The plate of tube 59 is connected to the winding of a relay 74, which is also connected to the circuit 73. The movable contacts 75 and 76 of relays 72 and 74, respectively, are held normally in the closed position by means of springs 77 and 78, respectively. These contacts are connected to a source of power through a wire 79. Stationary contacts 80 and 81 of the relays 72 and 74 are connected to the respective fields of reversing motor 22 through wires 82 and 83, respectively, the fields also being connected to the source of power for the motor 22 through a wire 84.

The operation of the foregoing can be described as follows. It is assumed that the scanning heads have been adjusted so that their position corresponds to the proper position, laterally, of the printing cylinder 4 with respect to the web 6. As the web moves past the scanning heads, light from the light sources is reflected uninterruptedly to the respective photoelectric cells 31 and 32.

If it be assumed that the web 6 has been displaced laterally to the left as viewed in Figure 1, then the register mark 9 moves beneath the point of focus of light from the light source 24, and the light falling upon the photoelectric cell 32 is diminished. This diminution occurs periodically as the register marks move beneath the focusing point of the optical system 28, and thus periodically the photoelectric current through the resistor 46 is reduced. The rate and duration of this interruption depends upon the speed of the web as it travels through the press and beneath the scanning heads. As a result, the potential at 46' is periodically lowered. The reduction in positive potential at point 46' is equivalent to a negative pulse, and the negative pulse passes through the coupling capacitor 52 to the control grid of tube 50. The pulse is amplified by the tube 50 and appears as a positive pulse across the resistor 62. In other words, at the point 62', there is a positive pulse that is in time phase with the negative pulse at point 46'.

The positive pulse at point 62' is transmitted to the control grid of tube 58 through the capacitor 60.

Each of tubes 58 and 59 has a steady negative bias applied to its control grid from the source 68 through the resistors 66 and 67. The value of this grid bias is adjusted so that, in the absence of grid pulses, sufficient plate current flows in the plate circuits on tubes 58 and 59 to pull up the armatures 75 and 76 of respective relays 72 and 74, thereby maintaining their contacts open, as illustrated in Figure 2.

When the positive pulse at point 62' is applied to the control grid of tube 58, it overcomes the negative grid bias of source 68, and grid current will flow from the grid to the cathode of tube 58. When the positive pulse ceases, the charge accumulated on the plate of capacitor 60 adjacent to point 66', which charge will be negative, will be added to the original bias of source 68, and the result will be to cut off the plate current of tube 58, which has been flowing through the winding of relay 72. When the relay 72 loses its excitation current, its armature will drop out due to its spring 77, and contacts 75 and 80 will close.

The interval of time during which the plate current of tube 58 will be blocked by the accumulated charge on the capacitor 60, which charge appears on the control grid of tube 58, is regulated by the proper choice of capacity for the capacitor 60 and of grid resistor 66, since this accumulated charge must leak off through the resistor 66. It is also important that the sensitivity of the photoelectric system and the gain of the amplifier 50 must be sufficient to produce a positive pulse at the point 62' of sufficient magnitude to block the tube 58.

The closing of contacts 75 and 80 is effected through the circuit 82 to operate the reversing motor 22 in the proper direction. The motor 22, through its worm 21, will rotate the collar 19, and through the connections previously described, move the cylinder 4 in the proper direction.

In operation there will be a certain mechanical lag between the first pulse indicating lateral misregister and the application of the necessary correction to the lateral position of the printing cylinder 4. During this lag, positive pulses continue to be applied to the control grid of 58 and, in this fashion, the cylinder 4 is eventually brought into a proper position of register.

Misregister of the web 6 to the right, as viewed in Figure 1, produces a corresponding corrective action through the photoelectric cell 31, tubes 51 and 59 and relay 74, the circuits connected thereto, and the motor control circuit 83 which causes the motor 22 to rotate in the reverse direction from the rotation previously described.

It will be seen that, to establish a stable condition of lateral register, the scanning heads mounted on brackets 33 and 34 must be moved with cylinder 4, so that when the cylinder 4 is brought into proper lateral register, the scanning heads will be properly related to the register marks on the web 6. This is accomplished through the mechanical connection between the cylinder shaft 5 and the slidable shaft 35, upon which the scanning heads are mounted, all as previously described. As a result, when the cylinder 4 reaches its proper position of lateral register, the light beams from the light sources 23 and 24 will no longer be interrupted by register marks, and the system will be brought into a condition of equilibrium.

The proper design of the electronic control system requires that proper time constants for the grid blocking capacitors 60 and 61 and the grid resistors 66 and 67 be selected. It will be observed that, in accordance with the description hereinabove given, the first corrective pulse received by the system initiates corrective measures by the motor 22, and this corrective measure continues until correct register is accomplished.

In its preferred form, the tubes 50, 51, 58, and 59 are hard (evacuated) tubes. It will be apparent that soft (gas-filled) tubes may be used, if desired, and instead of the direct mechanical connection between shafts 5 and 35, the scanning heads could be operated by suitably designed electrical servo systems. Moreover, instead of shifting the cylinder 4 laterally to correct for register, mechanism could be provided for shifting the web laterally with respect to the cylinder 4, but the principle of operation of the system would be the same as hereinabove described.

I claim:

Web register control mechanism for a continuous web having periodic first operations, including register spots, formed thereon, first means for performing periodic second operations on the web in predetermined lateral relationship to the first operations, means to vary the lateral position of said first means in either direction with respect to the web, electric motive means for driving said lateral position varying means, switching means for controlling the operation of said motive means, relay means for actuating said switching means, an electron tube network connected to said relay means and normally biased to maintain said switching means in the position to render said motive means inoperative, photosensitive web scanning means movable with said first means and disposed to scan areas adjacent the spots when the web is in proper register with respect to said first means, electrical means connected to said web scanning means for providing positive electrical pulses upon the occurrence of a spot on the web in operative relation to said scanning means, and a resistance-capacitance network energized by said positive pulses for providing a positive voltage to overcome the bias on said electron tube network and operate the relay means to change the position of said switching means to render said motive means operative, said resistance-capacitance network comprising a condenser connected in series with the control grid electrode of an electron tube in said electron tube network, and a resistor connected from said grid electrode to ground.

NATHANIEL BISHOP.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,677,472	Fuchs	July 17, 1928
1,972,075	Clark	Sept. 4, 1934
2,075,111	Gulliksen et al.	Mar. 30, 1937
2,183,045	Presby	Dec. 12, 1939
2,203,706	Stockbarger	June 11, 1940
2,208,447	Berry	July 16, 1940
2,249,820	Gulliksen	July 22, 1941
2,356,567	Cockrell	Aug. 22, 1944
2,396,706	Kott	Mar. 19, 1946
2,438,787	Nicholas	Mar. 30, 1948
2,444,261	Kelling	June 29, 1948