Aug. 7, 1951 A. B. HURLEY 2,563,117

MEANS FOR INCREASING THE OPACITY OF SHEETS OR WEBS OF PAPER, OR THE LIKE

Filed Nov. 5, 1947 2 Sheets-Sheet 1

Fig. 1.

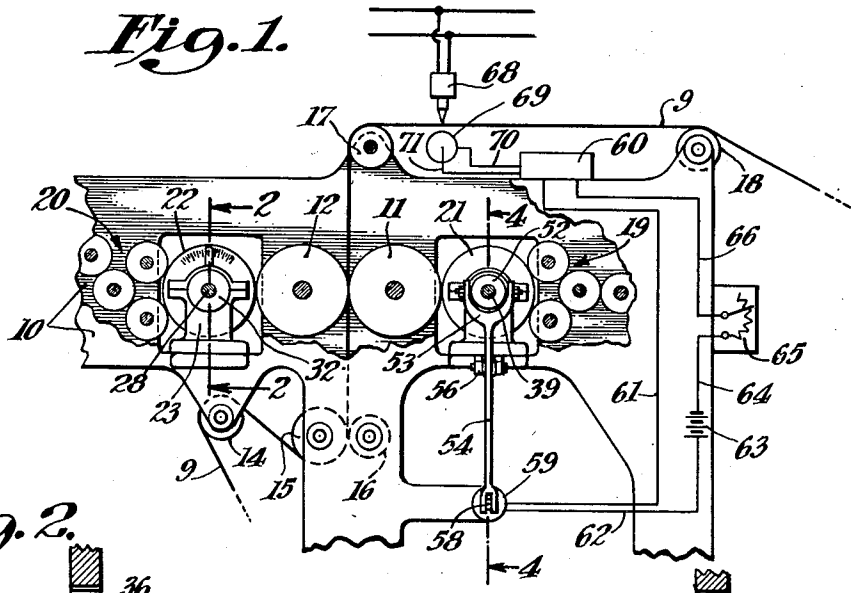


Fig. 2.

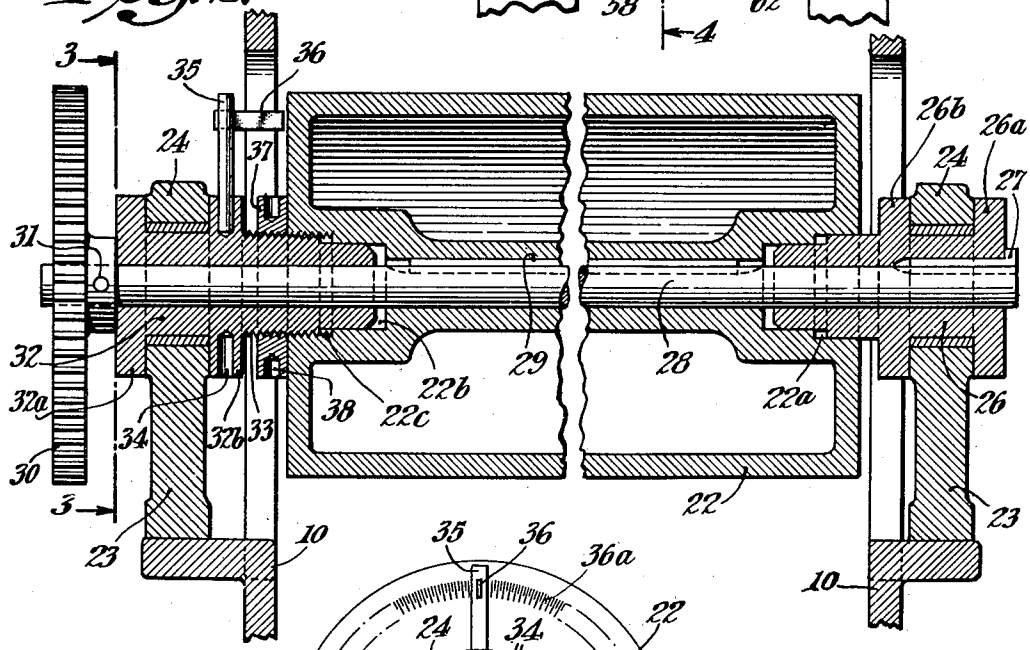
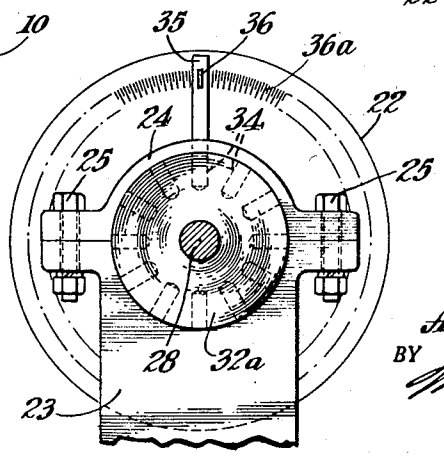


Fig. 3.



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Fig. 4.

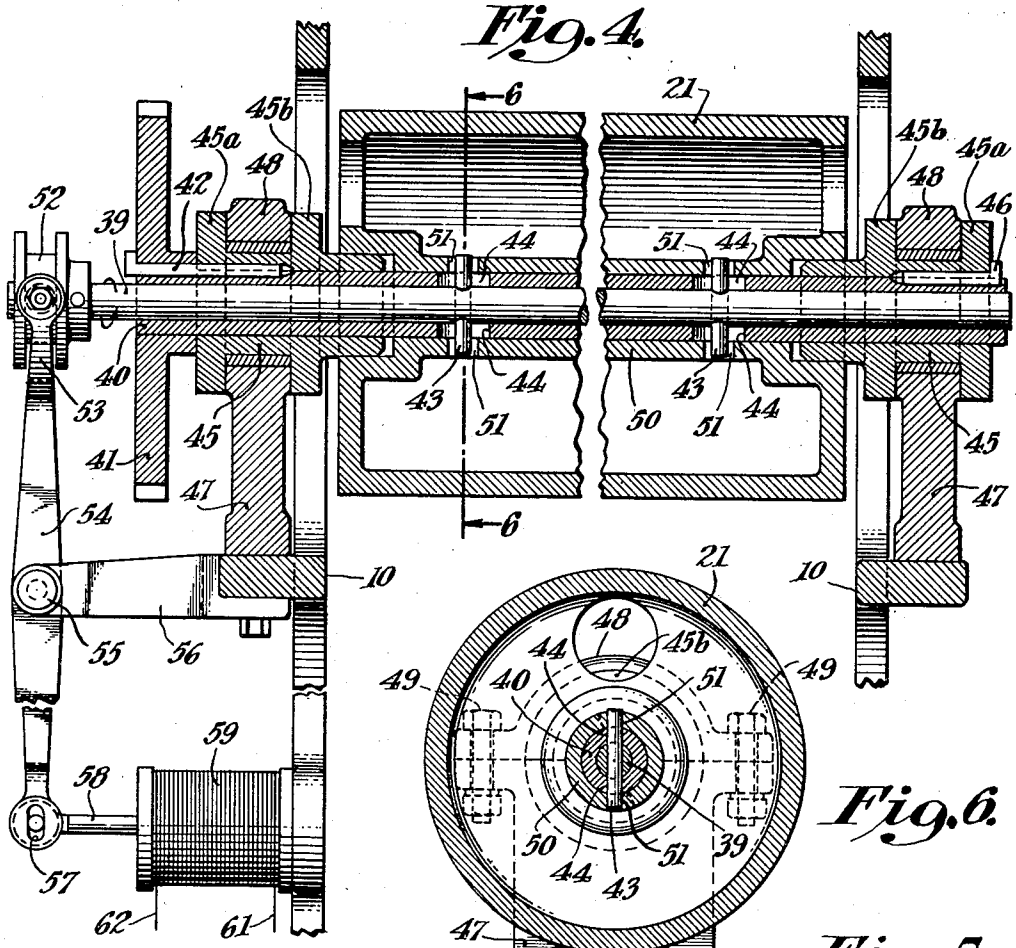
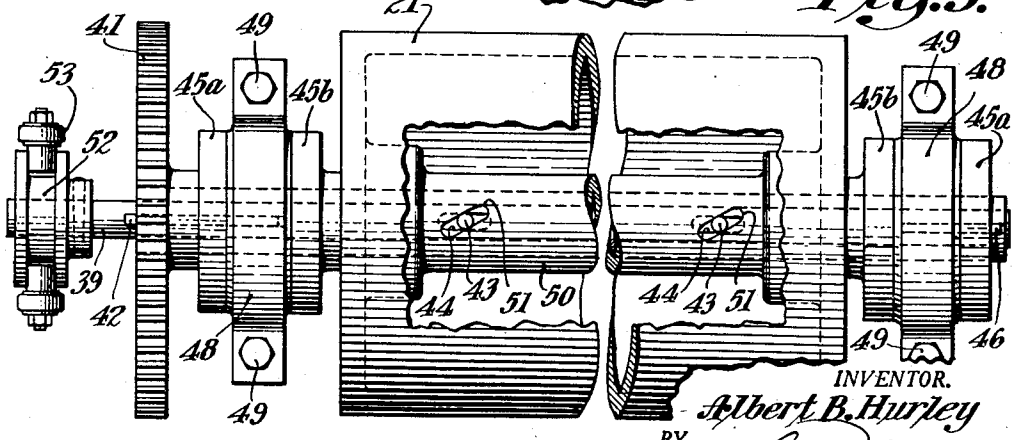


Fig. 6.

Fig. 5.



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Patented Aug. 7, 1951

2,563,117

UNITED STATES PATENT OFFICE

2,563,117

MEANS FOR INCREASING THE OPACITY OF SHEETS OR WEBS OF PAPER, OR THE LIKE

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Application November 5, 1947, Serial No. 784,186

7 Claims. (Cl. 101—248)

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This invention relates to improvements in the method described and claimed in U. S. Letters Patent No. 1,877,512 granted to me September 13, 1932 and to the provision of means for improving the paper produced thereby as described and claimed in U. S. Letters Patent No. 1,969,707 granted to me August 7, 1934.

In the aforesaid Patent No. 1,877,512 I have described a method of treating the more or less translucent papers used by the printing industry in such manner as substantially to decrease the light transmission factor thereof. These papers including, of course, book or magazine catalog, newsprint, etc. because of their quality and/or thickness are not opaque. Those papers wherein bleached pulp is used during manufacture to obtain a certain desirable degree of whiteness often have their transparency increased to an objectionable degree by the use of such bleached pulp. This is extremely undesirable because of the "show through" from one printed side of the paper to the other when the paper is incorporated in magazines, newspapers, etc., or used for writing purposes.

In the aforesaid Patent No. 1,877,512 I have disclosed a method wherein a paper sheet or web of relatively cheap quality may be provided with screens or grids at opposite sides, each screen or grid being of such fineness as to be imperceptible, as a grid, to the naked eye beyond a predetermined distance. So long as the elements or units of the grid at the aforesaid predetermined distance intercept or subtend visual angles equal, for instance, to no more than three minutes of arc, the grid is sufficiently fine for this purpose. To the naked eye spaced from a treated sheet beyond the aforesaid distance, the design of the grid is imperceptible and the surface of the sheet or web appears to be continuous and to have its color and quality substantially improved by the grid material.

As I have disclosed in the aforesaid Patent No. 1,877,512 the grid material or pigment may be tinted in such manner as to function as a filter screen whereby to filter out the objectionable portions of the spectrum in such manner that, under artificial light, paper treated by this method will appear to be more nearly white than paper with an overall coating or finish of very high quality. Likewise, as I have also pointed out in that patent, the discontinuous nature of the coating provided by the screen or grid, reduces glare to a very large extent; this is an important feature since it substantially reduces eye fatigue in artificial light.

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According to the teachings of the above designated Patents Nos. 1,877,512 and 1,969,707, similar and similarly arranged grids or screens may be applied to opposite sides of the paper. In those patents, I have illustrated grids of checkerboard design wherein the area of the coated portions approximately equals that of the uncoated portions between the coated portions i. e. the coverage achieved by each grid is approximately 50 per cent. Such grids may properly be termed 50/50 grids.

In such cases, so far as opacity is concerned, the most desirable relationship of the grids on opposite sides of the sheet occurs where the coated portions of the grid at one side coincide with the uncoated portions of the grid at the opposite side. In such case, the opacity of the treated paper sheet or web is substantially complete. Heretofore, because of slippage between the web or sheet and the offset or grid-applying rolls, and because of the difficulty of achieving and maintaining perfect relative alignment of the rolls and the grids or screens applied thereby, in the absence of the control means herein described, the occurence of such perfect conditions was extremely rare. Now, according to this invention, I have provided new and improved control means operable to maintain the coated opaque portions of the grid at one side of a treated sheet substantially coincident with, or in register with, the portions of the sheet area uncovered by the grid at the opposite side of the sheet.

Thus, the minimum coverage provided by similar 50/50 grids at opposite sides of a sheet is maintained at substantially 100% as compared with the minimum coverage of 50% which could occur with such grids and without such control means.

It is therefore the object of this invention to provide such control means which will efficiently maintain the grids or screens at opposite sides of a paper sheet or web in such relative positions that the combined coverage provided thereby will remain substantially 100% in the case of 50/50 grids or screens with commensurate increase in the opacity of the treated sheet or web.

According to this invention, use is made of a photo-electric cell or "Electric Eye" responsive to the passage of light through passing portions of the sheet bearing the grids at opposite sides. This unit, in response to the passage of light of predetermined intensity through uncoated portions of the treated paper automatically effects adjustment of one of the grid printing

rolls in such manner that the uncoated sheet or web area is maintained always at a minimum and the increase in opacity of the sheet or web, by reason of application of the opaque portions of the grids, is maintained at a maximum.

The aforesaid object is achieved, in the illustrated embodiment of the invention wherein the grids or screens are applied by the offset method, by automatic radial adjustment of one of the plate rolls or pattern rolls with respect to its supporting drive shaft. Where the grids or screens are applied by direct printing methods the offset rolls (between the plate rolls or pattern rolls and the sheet or web) are eliminated and the adjustable roll then applies the grid or screen to one surface of the sheet or web while the grid or screen is applied to the opposite sheet surface or web surface by the opposite "etched" plate roll or pattern roll.

In the drawing:

Fig. 1 is a fragmentary, partly diagrammatic view, in elevation, illustrating the application of this invention to one known form of paper processing device;

Fig. 2 is an enlarged transverse section, partly broken away, taken substantially along the plane indicated by the line 2—2 of Fig. 1;

Fig. 3 is a section taken substantially on the plane indicated by the line 3—3 in Fig. 2;

Fig. 4 is an enlarged section, partly broken away, taken substantially on the plane indicated by the line 4—4 in Fig. 1;

Fig. 5 is a top plan view, partly broken away, of the structure shown in Fig. 4; and

Fig. 6 is a section taken substantially on the plane indicated by the line 6—6 in Fig. 4.

The press, of which a fragment is shown in Fig. 1, is similar to that illustrated and described in U. S. Letters Patents No. 1,877,512 granted to me September 13, 1932 and 1,969,707 granted to me August 7, 1934 and the control apparatus hereinafter described is particularly adapted, though not limited, to the performance of the method described and claimed in the first aforementioned Patent No. 1,877,512 for production of paper of increased opacity as described in the last aforementioned Patent No. 1,969,707.

This press comprises a frame including transversely spaced side standards 10 provided with conventional journals supporting opposed offset printing rolls 11 and 12 which transfer to webs or sheets of paper passing therebetween opacity increasing grids as described in the aforementioned patents.

The frame also provides conventional support for sheet or web guiding rolls 14, 15, 16, 17 and 18 and for conventional ink applying and spreading roll clusters 19 and 20.

The web of paper or the like is designated 9 in Fig. 1 and, as shown, it passes upwardly over the guide roll 14, between guide rolls 15 and 16, and thence between the offset rolls 11 and 12 which apply the desired opacity increasing grid thereto, and finally upwardly over the guide rolls 17 and 18. It will be understood that the portions of the webb 9 above the offset rolls 11 and 12 have the desired opacity increasing grids applied to opposite sides thereof.

The grids are applied as follows: The roll cluster 19 supplies a film of grid forming material to the etched plate roll, or impression roll 21 which, by reason of its etched surface, transfers a predetermined grid design in this material to the offset roll 11. The offset roll 11 then applies this grid to one side of the web 9. The roll cluster 20 likewise applies a similar film of grid forming material to the etched plate roll or impression roll 22 which applies the grid forming material in the form of a predetermined desired grid to the offset roll 12. This offset roll then applies the grid to the opposite side of the web 9. As is conventional in the art, the roll clusters, plate rolls and offset rolls are synchronously driven by means of engaging drive gears (not shown) secured thereto in conventional manner. As will be readily understood, the transverse relationship of the respective grids may be controlled through control of the relative axial (or transverse) adjustment of the etched designs on the plate or impression rolls 21 and 22.

To achieve this control, I have provided the structure illustrated in Figs. 1, 2 and 3 by means of which the impression roll 22 can be manually adjusted axially with respect to its supporting journals and, likewise, with respect to the other plate or impression roll 21. As shown in Figs. 2 and 3, the journal structure comprises a bracket 23 fixed to each side standard 10 each with a cooperating cap 24 secured thereto by means of bolts 25.

The bearing provided by one bracket 23 and corresponding cap 24 supports, for free revolution, a flanged journal member 26 to which is secured by means of the key 27 the drive shaft 28. Axial movement of the journal member 26 is, naturally, prevented by the cooperation of the flanges 26*a* and 26*b* thereof with the bracket 23 and cap 24. As shown in Fig. 2, the inner end of the journal member 26 is reduced and is complementary with a stepped socket 22*a* at the adjacent end of the plate or impression roll 22. The roll 22, as also shown in Fig. 2, is keyed to the drive shaft 28 by means of the key 29. Thus, the roll 22 may be adjusted axially with respect to the freely rotatable journal member 26 for a purpose which will hereinafter appear.

To the opposite end of the shaft 28, the drive gear 30 is secured by means of a key or pin 31. A freely rotatable flanged journal member 32 supports that end of the shaft for free rotation and is itself retained against axial movement in bearings provided by the adjacent bracket 23 and cap 24. The inner end portion of the journal member 32 is reduced and substantially complementary with the stepped socket 22*b* provided in that end of the roll 22. Complementary screw threads 22*c* are provided in the outer portion of the socket 22*b* for cooperation with complementary screw threads 33 provided on the outer adjacent surface of the journal member 32. Corresponding with the flanges 26*a* and 26*b* of the journal member 26, the journal member 32 is provided with the outer flange 32*a* and inner flange 32*b*, the latter being provided with a plurality of regularly disposed recesses or sockets 34 adapted removably to receive an adjusting rod or pin 35. The pin or rod 35 is provided with a pointer 36 at its outer end which cooperates with a suitable angular scale or graduation 36*a* (Fig. 3) on the end of the roll 22 to indicate the linear distances through which the roll 22 is adjusted longitudinally with respect to the shaft 28 and its journals.

When a desired axial adjustment of the roll 22 has been accomplished, this adjustment is rendered fixed by means of the stop nut or lock nut 37 supported on the screw threaded portion of the journal member 32. The nut 37 is provided with sockets 38 similar to the sockets 34 in the flange 32*b* of the journal member 32. After

a desired adjustment has been made by the adjusting rod 35 in the sockets 34, the adjustment may be fixed by moving the rod 35 to a convenient socket 38 whereby the lock unit 36 may be firmly engaged with the roll 22.

In order to maintain the proper, desired relative positioning of the grids at opposite sides of the web 9 longitudinally of the web, angular adjustment of the rolls 21 and 22 with respect to one another is provided. This adjustment is effected automatically through the means, hereinafter described, which controls the angular adjustment of the abovedescribed etched roll 21 with respect to its driving sleeve or hollow shaft which is designated 40.

As shown in Figs. 4 and 5, the key shaft 39 is supported in the sleeve 40 which sleeve is driven by a gear 41 secured thereto by means of a key 42. The shaft 39 is provided intermediate its ends with a plurality of keys in the form of fixed pins 43 which extend through longitudinal or axial slots 44 in the sleeve 40. The end portions of the sleeve 40 are supported by similar double flanged journal members 45 which are keyed to the hollow shaft or sleeve member 40 in one case by the abovedescribed key 42 which also secures the gear 41 thereto, and in the other case by a key 46. The outer flanges of these journal members 45 are designated 45*a* and the inner flanges thereof are indicated 45*b*. The cylindrical portions of the journal members 45 between the inner and outer flanges thereof are each supported for free rotation in journals provided between a bracket 47 similar to the abovedescribed bracket 23 and a bearing cap 48 similar to the abovedescribed bearing cap 24, the cap 48 being secured, in each case to its bracket 47 by bolts 49 corresponding with the abovedescribed bolts 25 and the brackets 47 being fixed to the side frame members 10.

Thus, the journal members 45 and the sleeve member 40 supported thereby are supported for driven rotation and are driven by the gear 41, while the key shaft 39 by means of the connection provided by the pins 43 and slots 44 is rotated therewith and is movable axially with respect thereto for a purpose which will hereinafter appear.

The roll 21 is provided with a hub 50, this hub being provided with slots 51 which are angularly disposed with respect to the longitudinal axis of the hub 50 and its roll 21. By this means, angular adjustment of the shaft 39 with respect to the roll 21 may be accomplished through axial adjustment of the shaft 39 with respect to the sleeve member 40 and its journals, since longitudinal adjustment of the key shaft 39 and its pins 43 will cause such axial adjustment.

Automatic means is provided for controlling this radial adjustment of the roll 21 with respect to the sleeve member 40. As will be understood, the drive gear 41, and sleeve member 40 are synchronized with the roll 22 since the gear 41 and 30 (abovedescribed) are connected in the same power train by intermediate gears in conventional manner, the showing of these gears being omitted in the interest of clearness.

The control of the radial adjustment of the roll 21 with respect to the synchronously driven sleeve member 40 by means of the axial adjustment of the shaft 39 is accomplished as follows.

Fixed to one end of the shaft 39 is a double flanged spindle member 52 which engages a yoke portion 53 at the upper end of the lever 54 which is fulcrumed or pivoted at 55 to the bracket 56 fixed to the frame 10. At its lower end, the lever 54 is provided with a slot 57 by which it is connected in known manner to the armature 58 of the solenoid 59 which is also fixed to the frame 10 as shown in Fig. 5. As will be readily understood, when the solenoid 59 is energized, it exerts axial force to the shaft 39 through the lever 54. The magnitude of this force, is, of course, proportional to the intensity of the field of the solenoid 59.

The energizing circuit for the solenoid 59 is controlled through an amplifier 60 which is connected by the wire 61 with one terminal of the winding of the solenoid 59. The other terminal of the winding is connected by wire 62 with one side of a source of electrical energy 63 having its other side connected by wire 64 with one post of a rheostat 65 which has its other terminal connected by wire 66 with the amplifier 60. By means of the rheostat 65, the intensity of the solenoid energizing circuit controlled by the amplifier 60 may be balanced as desired.

The means for rendering this circuit responsive to the opacity of the grid treated web 9 between the rolls 17 and 18 comprises a conventional constant voltage light source 68 at the upper side of the web 9 and a photo-electric cell 69 disposed, in alignment with the light source 68, below the web 9 as shown in Fig. 1. One terminal of the cell 69 is connected by wire 70 with one terminal of the amplifier 60 while the other terminal of the cell 69 and the other terminal of the amplifier 60 are connected by the wire 71. Said cell and source comprise in combination a photoelectric unit.

In operation, the roll 11 rotates clockwise and the roll 21 rotates counter-clockwise as seen in Figs. 1 and 6; since the roll 21 is driven counter-clockwise, the resistance to rotation is exerted clockwise. This force tends to move the roll 21 counter-clockwise with respect to the driving sleeve 40 (Fig. 6); likewise, as will readily appear from Fig. 5, the reaction between the pins 43 and the slots 51 tends to thrust the shaft 39 to the right as seen in Figs. 4 and 5. This force is opposed by the force applied to the shaft 39 through the solenoid 59 and its linkage under the control of the solenoid energizing circuit. If desired, the abovedescribed clockwise resistance to rotation or "drag" may be supplemented by the use of any suitable known means placed in opposition to the solenoid 59 and its linkage as, for instance, the use of a fluid cylinder mechanism or spring operatively connected with the lever 54 or with the shaft 39.

Since the force applied is proportional to the intensity of the circuit and since the intensity of the circuit is controlled by the light passing through the web 9 between the elements 68 and 69 of the control, any increase of this light intensity through the web 9 will increase the force applied leftwardly (Figs. 4 and 5) of the shaft 39 to cause angular adjustment of the roll 21 with respect to sleeve 40 and gear 41 which are parts of the drive train.

Any decrease in the light intensity by decreasing the intensity of energization of solenoid 50 and the force exerted thereby will permit the inertia of the roll to cause retrograde adjustment of the roll 21 angularly with respect to the roll 22. Thus, after preliminary balancing of the solenoid circuit through the rheostat 65, the operation of the control is automatic since it maintains the rolls 21 and 22 in such relative angular

adjustment that the opacity of the web 9 is greatest.

From the above description it will clearly appear that I have provided a new and improved method, and apparatus, for securing the ultimate increase in opacity by controlling the relative position of similar parts of openwork screens applied to opposite sides of paper sheets or webs wherein the openwork grids are formed of substantially opaque coating material and wherein the control of the aforesaid relative position of the grids is made responsive to the passage of light through coated portions of the paper sheet or web and by means also of manual adjusting means, which process and apparatus is particularly adaptable for the practice of the method described, illustrated, and claimed in U. S. Letters Patent No. 1,877,512 granted to me September 13, 1932.

It is, of course, to be understood that the above description is merely illustrative, and in no wise limiting, and that I desire to comprehend within my invention such modifications as are included within the scope of the following claims:

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a machine for increasing the opacity of webs of paper or the like, a pair of oppositely rotatable printing rolls; means for supporting and conveying a web between said printing rolls; and a pair of screen defining rolls each transferring relatively opaque material in the form of an openwork grid to one of said printing rolls for application to one side of said web; a gear train for driving all said rolls in synchronism; and means responsive to the opacity of a portion of the web having screens applied to both sides for varying the relative angular relationship between said screen defining rolls independently of said gear train, said last named means comprising a hollow shaft operatively connected in said gear train, said hollow shaft having an axial slot therein, a hollow supporting hub on said roll telescopically engaging said hollow shaft and having therein a slot substantially aligned with said first named slot but angularly disposed with respect to the axis of the hub, a key shaft axially adjustable in said hollow shaft and having a transverse pin extending transversely thereof through the slots in said driven hollow shaft and in said hub whereby longitudinal adjustment of said key shaft with respect to said hollow shaft causes angular adjustment between said screen defining roll and said hollow shaft and said gear train, a photoelectric unit including a light source and a light sensitive element positioned on opposite sides of the portions of the web bearing the screens applied thereto, and means operatively connected to said photoelectric unit for positioning said key shaft in response to the intensity of a light beam passing through the web from said light source to said element.

2. In a machine for increasing the opacity of webs of paper or the like including a pair of oppositely rotatable printing rolls, means for supporting and conveying a web between said printing rolls and a pair of screen defining rolls each supplying relatively opaque material in the form of an openwork grid to one of said printing rolls for application to one side of said web; a gear train for driving all said rolls in synchronism, and means responsive to the opacity of a portion of the web having screens applied to both sides for automatically varying the relative angular relationship between said screen defining rolls independently of said gear train, said last named means comprising a hollow shaft operatively connected in said gear train, said hollow shaft having a plurality of axial slots therein, a hollow supporting hub on said roll telescopically engaging said hollow shaft and having therein a like plurality of slots substantially aligned with said first named slots but angularly disposed with respect to the axis of the hub, a key shaft axially adjustable in said hollow shaft and having pins extending transversely therefrom through the slots in said driven hollow shaft and in said hub whereby longitudinal adjustment of said key shaft with respect to said hollow shaft causes angular adjustment between said screen defining roll and said hollow shaft and said gear train, and means for controlling the position of said key shaft with respect to said hollow shaft, said last named means comprising a solenoid controlled linkage and a solenoid controlling said linkage, a solenoid actuating circuit connected with said solenoid and a solenoid circuit control responsive to the passage of light through predetermined portions of said web bearing the screens for regulating the intensity of said solenoid actuating circuit in accordance therewith.

3. The structure defined in claim 1, wherein said last-named means includes a solenoid, a circuit for energizing said solenoid controlled by said photoelectric unit the light sensitive element thereof being disposed closely adjacent to one side of said web at a portion having screens applied to both sides and wherein said light source is energized by constant voltage and is substantially aligned with said photoelectric unit light sensitive element at the opposite side of said web and said light source projects a light beam of constant intensity toward the web and in the direction of said element.

4. The structure defined in claim 3, wherein said solenoid energizing circuit includes a constant source of electrical energy and a rheostat for balancing the circuit.

5. The structure defined in claim 1, wherein the force exerted by said solenoid is opposed by yielding means acting upon said solenoid controlled linkage, the force of which is additive to the force exerted in opposition to said solenoid by the drag of the roll.

6. The structure defined in claim 1, and means for manually adjusting the other screen defining roll comprising a solid drive shaft operatively connected in the roll driving gear train, a hollow hub on said roll slidably engaging said drive shaft and splined thereto, rotatable journal means supporting one end of said shaft and having slidable connection with the adjacent end of said hub, and a journal member rotatably supporting the opposite end of said shaft and having screw-threaded connection with the adjacent end portion of said hub, said journal being rotatable with respect to said roll for adjusting said roll axially with respect to said solid shaft.

7. The structure defined in claim 1, and means for manually adjusting the other screen defining roll comprising a solid drive shaft operatively connected in the roll driving gear train, a hollow hub on said roll slidably engaging said drive shaft and splined thereto, rotatable journal means supporting one end of said shaft and having slidable connection with the adjacent end of said hub, and a journal member rotatably supporting the opposite end of said shaft and having screw-threaded connection with the adjacent end por-

tion of said hub, said journal being rotatable with respect to said roll for adjusting said roll axially with respect to said solid shaft, said roll having radial graduations on one end, and said last named journal member having radial recesses for receiving an adjusting rod also cooperating with said graduations to indicate the degree of adjustment effected.

ALBERT B. HURLEY.

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