(No Model.) 7 Sheets—Sheet 1.

W. H. FORBES & J. W. OSBORNE.

ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 1.

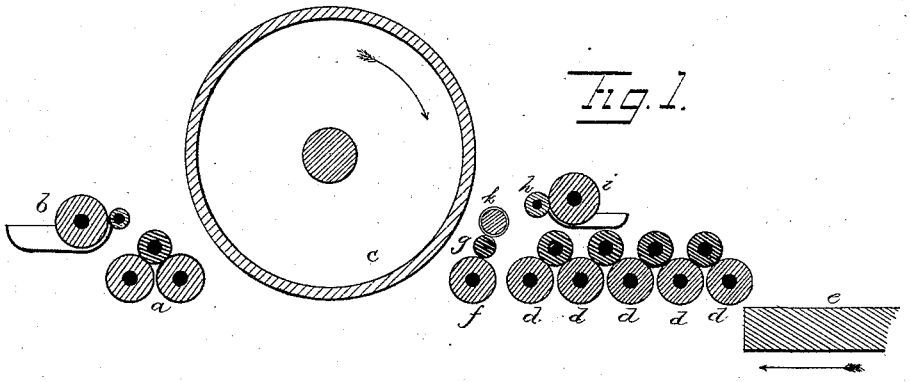


Fig. 2.

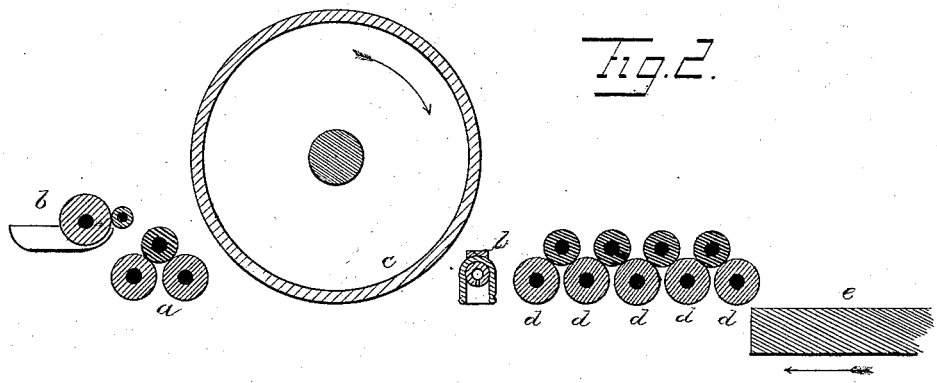


Fig. 9.

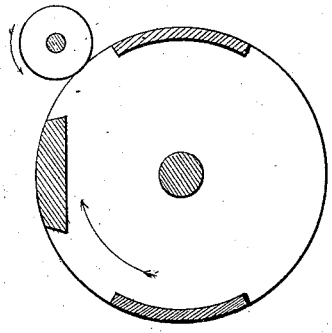
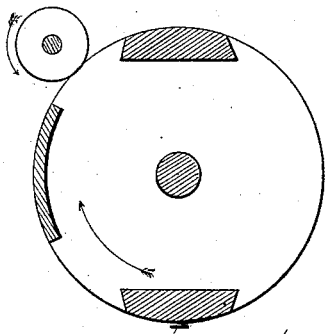


Fig. 10.



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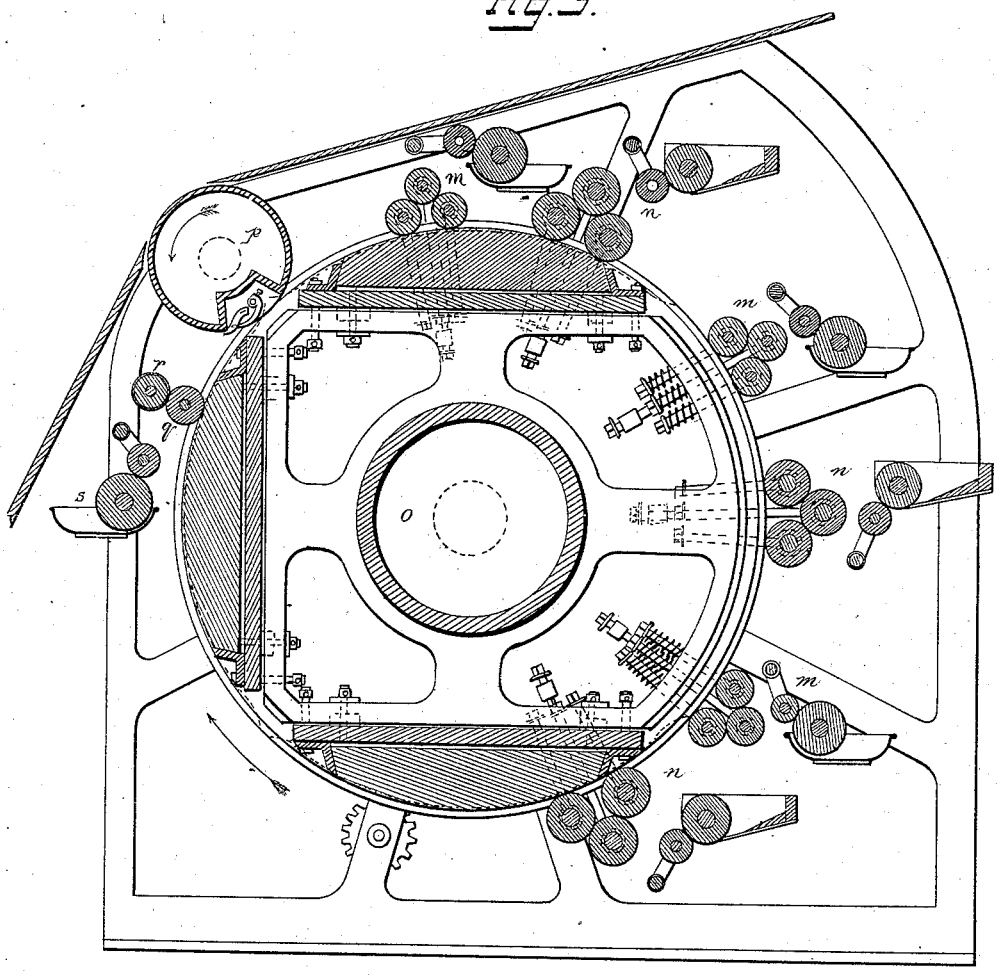
ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 3.



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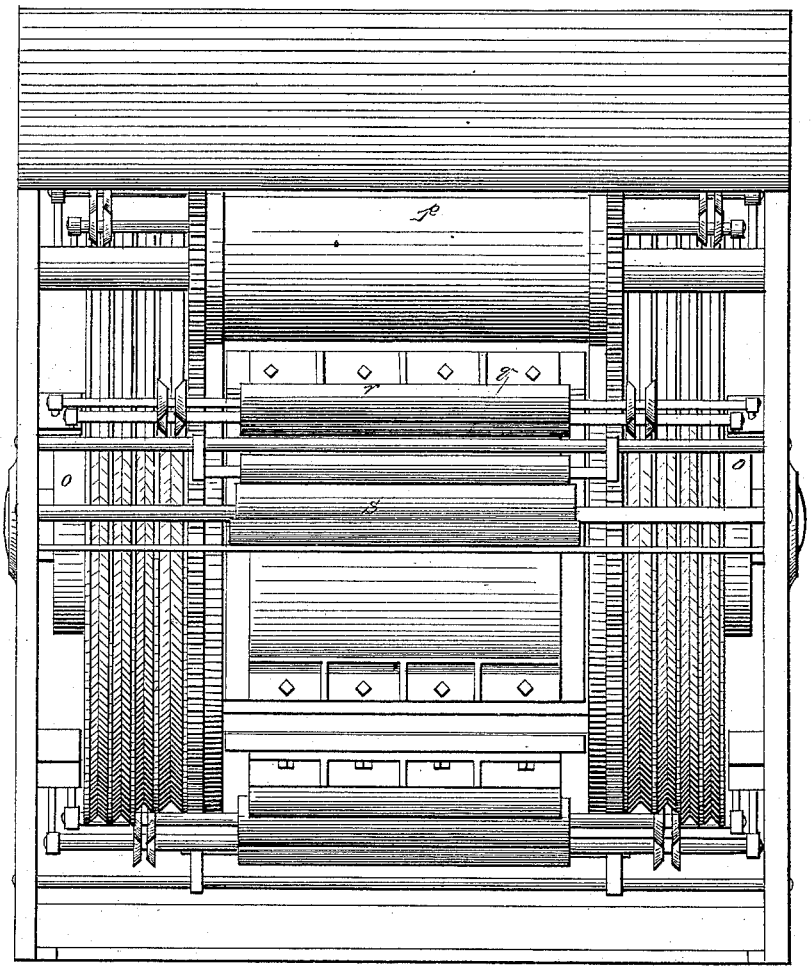
ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 4.



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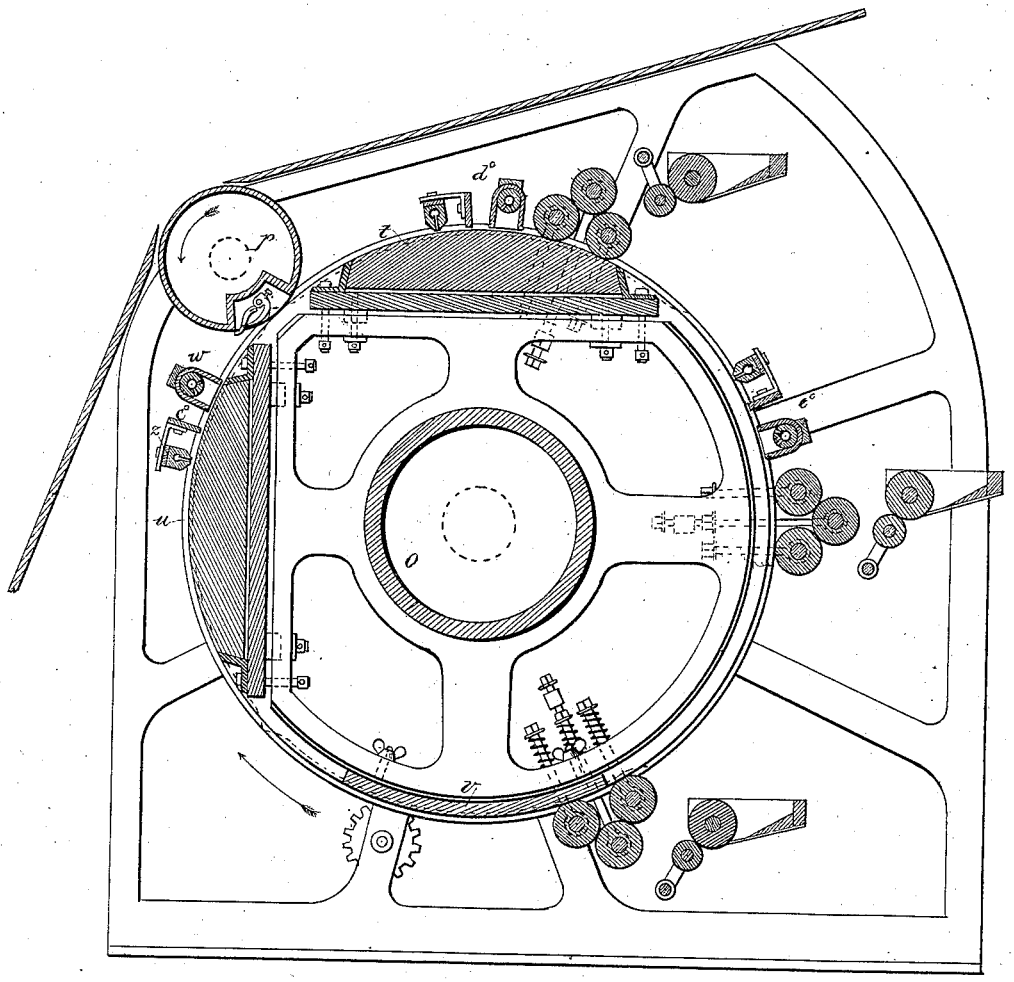
ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 5.



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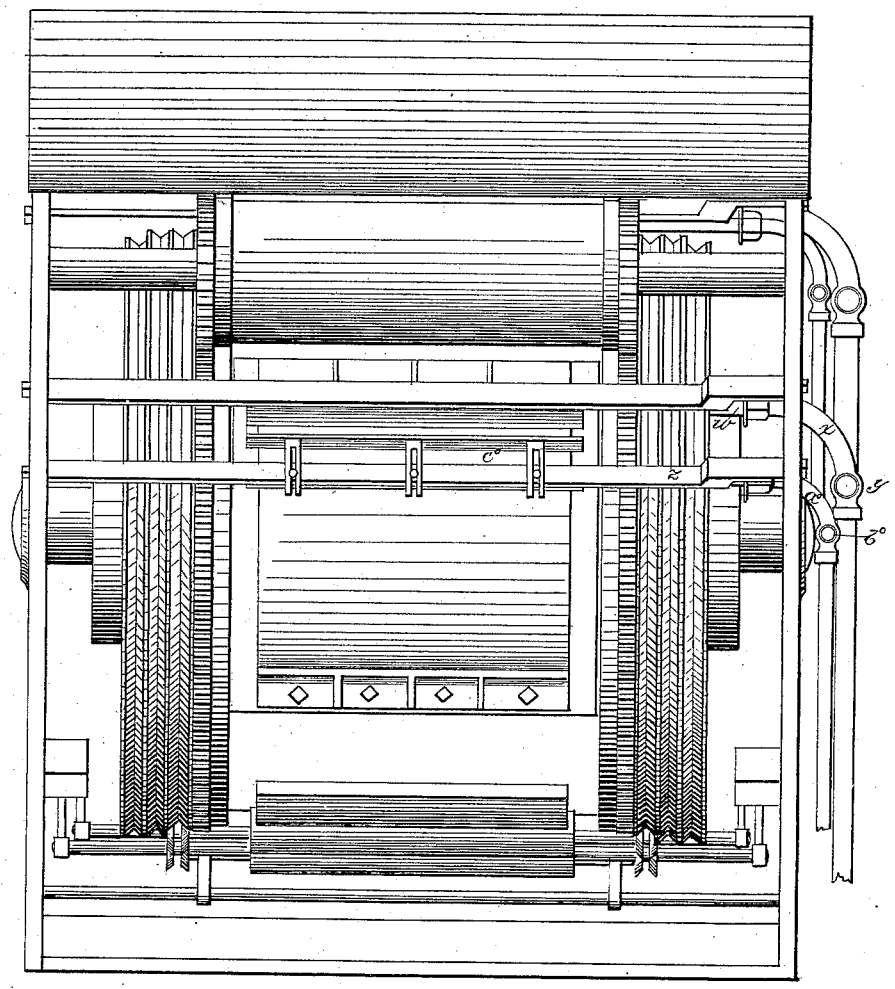
ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 6.



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(No Model.) 7 Sheets—Sheet 6.

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ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

No. 305,169. Patented Sept. 16, 1884.

Fig. 7.

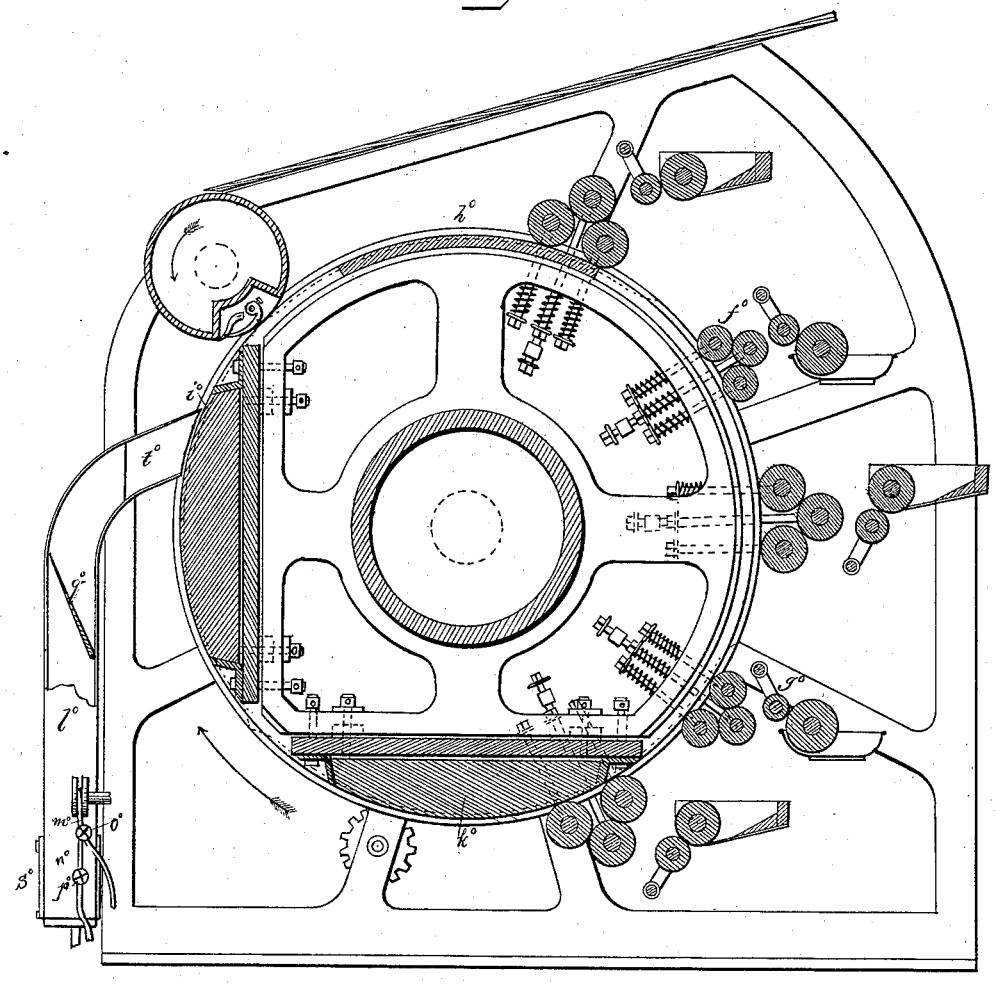

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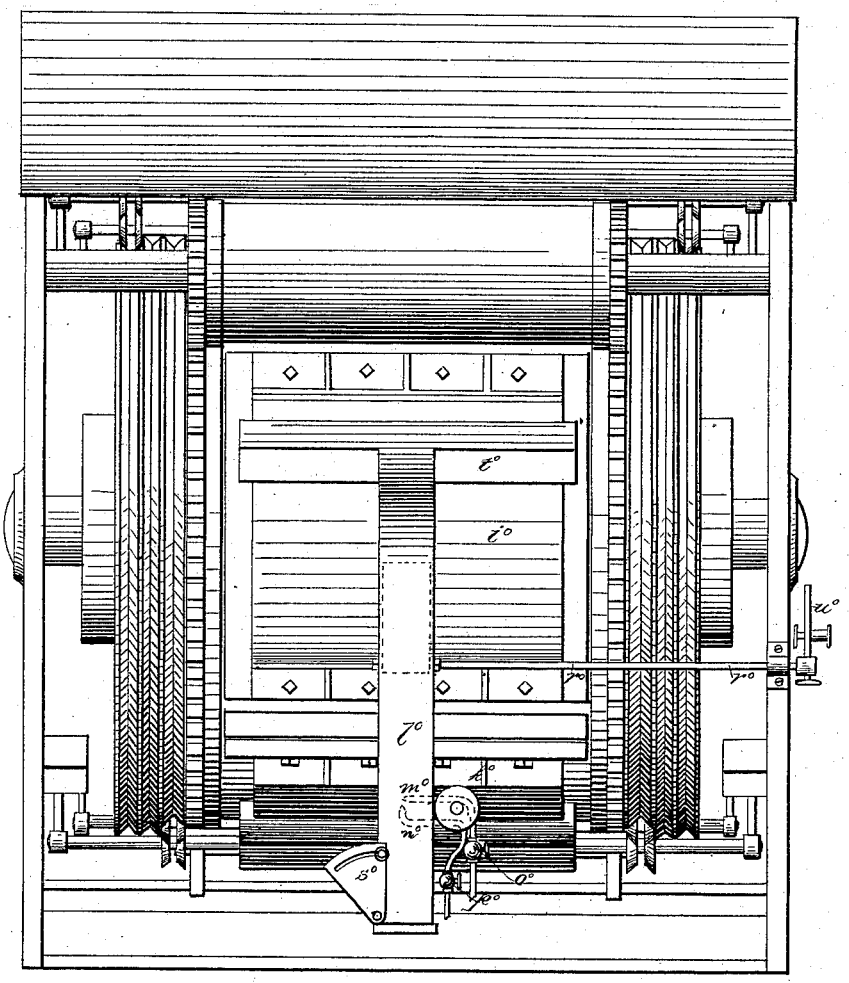
Fig 8



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UNITED STATES PATENT OFFICE.

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ART OF AND MECHANISM FOR CHROMOGRAPHIC PRINTING.

SPECIFICATION forming part of Letters Patent No. 305,169, dated September 16, 1884.

Application filed June 11, 1881. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM H. FORBES, of Boston, county of Suffolk, and State of Massachusetts, and JOHN W. OSBORNE, of Washington, District of Columbia, have invented a new and useful Improvement in the Art of and Mechanism for Chromographic Printing, of which the following is a specification.

Our invention relates to the mechanisms for printing two or more designs in different colors, and in register one with another, upon a single sheet of paper, whereby a chromographic picture or delineation is produced, and to an improvement in the art of chromography which consists in printing in rapid succession, and combining for the production of a single design, two or more impressions from surfaces prepared for printing in the lithographic manner, or of two or more such impressions combined with one or more printed in the typographic manner, or of one such combined with one or more typographic impressions, when the latter or any one of them is printed first.

In the art of color-printing, impressions from different relief-plates or engraved wood blocks have been combined by printing the same with colored inks, one upon the other, in a continuous series upon the same sheet. To produce successful results in this way, it is necessary that the ink from one relief-plate should be dried before another design is printed upon it, and accordingly presses have been constructed in which the several relief-surfaces having being adjusted as for typographic printing, the sheet of paper, after being fed to the press, is presented to each form inked with its appropriate color in succession, and finally discharged from the press bearing the complete chromographic design. This procedure is possible because the sheet upon which one impression is printed is capable of taking an additional quantity of ink from each following typographic printing-surface, and the latter cannot be injuriously affected thereby, because only those parts of the freshly-printed design which are meant to receive additional color come in contact with the raised surface furnishing it; but if we now try to substitute the lithographic for the typographic manner of printing the case is different. It is then necessary to dry the ink on one impression very thoroughly (several days being usually required for this purpose) before proceeding to the next following impression. If this were not done, the fresh ink upon the sheet printed from one stone would offset where it overlapped upon the non-printing parts of the stone which followed in order, producing there a greasy smear, which would continue to become worse and worse, as the printing proceeded. The reason of this is the fact that in printing lithographically the sheet comes in contact with all parts of the printing-surface, and if consecutive printing be attempted in that manner the clean parts of the second and following stones, after the damping-water upon them has been dissipated by the previous rolling in of ink, will, in that very sensitive condition, (characteristic of stone, zinc, and collographic plates,) immediately lay hold of the fresh ink upon the printed paper and take a part of it exactly as it would take ink from a fresh inking-roller. As this would be obviously destructive of the work upon a stone or similar surface, the printing of chromo-lithographs in continuous sequence or in rapid succession without drying has been regarded by practical men as a problem offering insurmountable difficulties. In our invention these difficulties are overcome by damping the stone or its equivalent a second time. The first damping precedes the inking in the usual way, to prevent the clean parts of the stone taking ink from the inking-rollers. The second damping precedes the printing, to prevent those same parts taking ink from the sheet which has been previously printed.

Our invention is applicable in all forms of lithographic presses.

Figure 1 shows in section the relative position of the damping apparatus to the essential parts of a reciprocating lithographic machine, and to a lithographic stone adjusted for printing, the framing, connecting, and driving mechanisms being all omitted. Fig. 2 shows the same, save that a different kind of damping apparatus is employed to accomplish the second damping. Fig. 3 shows in section the

way in which the second damping is accomplished by rollers in a chromatic press containing three stones. Fig. 4 is an end elevation of the same, in front of the impression-cylinder, the cross-framing and the delivery-board being removed. Fig. 5 is a sectional view similar to Fig. 3, in which a different method of damping is employed throughout, and one typographic is combined with two lithographic printing-surfaces. Fig. 6 is an end elevation of the same. Figs. 7 and 8 illustrate still another way of accomplishing the final damping in a chromatic press with a different sequence of forms. Figs. 9 and 10 show in section and on a small scale other arrangements of different kinds of printing-surfaces upon the form-cylinder of a chromatic press.

In Figs. 1 and 2, *a* represents in both the usual damping mechanism, and *b* the water-fountain belonging thereto. *c* is the impression-cylinder, and *d d d d d* are the inking-rollers, of a reciprocating lithographic press as usually constructed. The stone *e*, having been damped by *a*, passes forward under the stop-cylinder to the position shown in the drawings. In so doing it receives ink from the rollers *d d d d d*, after which it travels back, in the direction indicated by the arrow, toward the impression-cylinder, which carries the sheet to be printed, said sheet having already on its surface one or more fresh impressions. In making this journey it takes more ink from the rollers *d d d d d*, and is then (in Fig. 1) damped by the damping-roller *f*. This roller (which can be duplicated, if desired) is constructed of absorbent material, is more or less weighted by the rider *g*, and is supplied with water by the carrying-roller *h* from the fountain *i*. It takes the place usually occupied by the first inking-roller, and is driven by a side rack, as all the other rollers are driven. Receiving in this way water from *f*, the stone *e* is thoroughly protected from any offset from freshly-printed sheets fed to the cylinder *c*, and such sheets will receive a clean impression and pass over the stone without injury to the same.

The water-fountain *i* and the carrying-roller *h*, as shown in Fig. 1, may be dispensed with, if desired, by so adjusting the feed of water from the fountain *b* as to furnish sufficient for the roller *f*, which it takes up from the stone when the latter is going forward, and gives to it again on its return journey. Moreover, the quantity of water required for the second damping is very small, and therefore one roller for this purpose will generally be found sufficient, if it be maintained in good working order, and with a surface-speed precisely the same as that of the stone or its equivalent. The effect of this damping-roller upon the freshly-inked work is not of course favorable for the production of the maximum of brilliancy in the impressions; but our experience leads to the conclusion that the injury caused by the second damping is very slight, and is far outweighed by the other advantages gained. It should be remembered also that the first impression in the series requires no second damping, the press for printing the same having an inking-roller in the position occupied by *f*, and that most of the delicate details and shades in a very large class of work may be printed at that time, leaving the flat and broader tints for the following printings. It will be seen, however, that the roller *f* will necessarily take up rather more ink from the printing-surface than damping-rollers generally do, and transfer that in the well-known way to the metallic riding-roller *g*. To obviate the trouble caused by having to clean the rider *g* oftener than usual, we also place upon it a second rider or ink-lifting roller, *k*, Fig. 1, which runs freely on *g*, and is constructed with a surface of flannel, or other substance having a very strong affinity for printing-ink when wet, which will absorb most of that which slowly accumulates on *g*. The absorbent material upon *k* thus keeps the rider *g* clean, and can itself be washed or renewed at long intervals; or the riding-roller *g* can have its power of taking up ink and its capacity to retain a large quantity of it increased by drawing on it a covering of flannel or similar material, which, when saturated, can be replaced without loss of time. The second damping may also be accomplished by precipitating an atomized spray of water upon the printing-surface before it passes under the impression-cylinder, and the way in which lithographic damping in general may be performed by such means is fully set forth in an application for a United States Patent filed by us on the 20th day of April, 1881, to which the Patent Office has given the number 31,287; or it may be effected by the condensation of water in the way described by one of us, and for which an application for a United States Patent was also filed on the 2d day of May, 1881, to which the Patent Office applied the number 32,287. By either of these last-named methods the stone *e*, or other surface to be printed from in the lithographic manner, may be damped after inking and before taking the impression, so as to protect the clean parts of said surface from offset of the fresh ink on the sheet to be printed without the contact of any solid body, and as a consequence without the disturbance of the ink or any other inconvenience due to the use of a damping-roller.

Fig. 2 shows the position of the damping apparatus when the method by condensation is used for the final damping, in which *l* is the cross-section of a tube closed at one end and crossing the printing-surface without touching it, the position of which corresponds exactly to that of the damping-roller *f*, above described. Into this tube, by suitable connections leading from apparatus, which need not be more fully described in this specification, as that has been already done in the application referred to, a current of the vapor of water, or of air saturated with the vapor of water at a temperature above that of the surface

to be damped, is conducted. This current issues from many perforations in the tube. (Indicated in the drawings.) It enters the dependent chamber forming the lower part of the exit-tube, which is open at the bottom all across the stone, and from it flows down upon the latter. By automatic connections with the moving parts of the press the current passing into the exit-tube is caused to flow when the edge of the stone nearest the impression-cylinder (moving as indicated by the arrow) reaches the tube, and is cut off when the other edge leaves it. During this interval the cold of the printing-surface has caused the precipitation of an even film of water all over it in the form of dew, whereby it is most effectually and uniformly damped. This method of damping is well adapted for the successful prosecution of our invention, because of the small space required for the damping apparatus and the perfect control which the workman has over the very small quantities of water required.

Using presses of the kind described for the improvement we have invented, it is necessary to make the printing of each color a separate operation, although each may follow that preceding it without loss of time, and two or more such presses may be used simultaneously by letting a second press take the sheets as fast as they are furnished by the first; but our invention is equally applicable to chromatic presses in which all the printing-surfaces are adjusted in one and the same machine, and from which the impressions are printed in continuous sequence.

Figs. 3 and 4 show in section and elevation a chromatic press resembling in its essential features that for which a United States Patent was granted to Thomas B. Dooley, dated December 14, 1880, and numbered 235,606. In this press, as shown, provision is made for combining three impressions only, that number being sufficient to illustrate the application of our invention; but there is no limit to the number of printing-surfaces which may be used except the inconveniences arising from the increased size which the machine must have. The form-cylinder of this press, which in Dooley's invention receives typographic relief-plates, is modified to receive and hold three lithographic stones. Each stone is provided with a set of damping and inking rollers, (marked *m* and *n*, respectively,) with the riders, carrying-rollers, and water and ink fountains belonging thereto. As the form-cylinder *o* revolves, each stone in turn comes first under its damping-rollers, and immediately after under its inking-rollers, each set dropping upon it for the requisite interval, and then rising out of the way of all the other stones. As they are inked they come up one after the other under the impression-cylinder *p*. The first stone in the series is printed without a second or final damping; but just before the next in order reaches the impression-cylinder, the damping-roller *q* falls upon it and the sheet (which still remains upon the impression-cylinder) is printed with the second color without danger of offset. So, also, with the third stone, after which the printed chromo-lithograph is thrown over the delivery-board, and another sheet is taken by the grippers. The arrangement in this press for the final damping is essentially the same as that already described and shown in Fig. 1. *q* is the damping-roller, *r* its rider, and *s* the water-fountain. In this figure no independent ink-lifting roller is shown, (as *k* in Fig. 1;) but the metallic riding-roller *r* is made to perform its own proper function of distributing the water on *q* and weighting the same, and also that of absorbing and retaining a large quantity of ink by reason of the very great affinity which the flannel covering drawn over it (indicated in the figure) possesses for that substance even when wet. In this way the roller *q* is kept clean; but the same result could be accomplished as in Fig. 1 by a special ink-lifting roller corresponding to *k*, with the advantage that such a roller, running freely upon *r*, is easily removed when saturated, and a fresh one substituted for it. In modifying this press for chromo-lithographic printing, it would apparently have been a simplification (inasmuch as it would have reduced the number of parts) to let one set of damping-rollers do the damping for all the stones; but those conversant with the lithographic art will perceive that if the stone nearest such damping-rollers received enough of water and no more, (an indispensable condition of things for good lithographic printing,) then those farther off would certainly receive too little, due to the rapid loss of water by evaporation which results from the passage of the printing-surface through the air; and, also, that, as the amount of water suitable for printing-surfaces with different amounts of work upon them varies very much, its quantity should be adjustable for each, which could not be done if only one set of damping-rollers was used. Excess of water in lithographic printing is exceedingly injurious, chiefly because of its action on the ink. All that is used (less that due to evaporation) is taken up on the inking-rollers and incorporated with the ink by the distribution, deadening and shortening the same and changing its nature very seriously. When only enough water is used for damping, most of it is dissipated by evaporation.

In Figs. 5 and 6 a similar chromatic press is shown in section and front elevation, in which the damping of the forms before inking (those which print in the lithographic manner) is accomplished by condensation, and the second or final damping is done in like manner.

In our invention it is not necessary that all the colors which together form the design should be printed from stone, zinc, or collographic plates. Two or more of the impressions may be printed from stone or zinc and one or more from relief-plates; or the series may be begun with one or more relief-plate

printings and ended with one or more from stone or its equivalent; but in every case the final damping of all surfaces which print in the lithographic manner is necessary when the sheet on which the impression is taken has been already printed upon in any manner, and in whatever order the printing-surfaces upon the form-cylinder follow each other the cams or analogous devices which govern the damping mechanism (the construction and arrangement of which are well understood) are so adjusted as to bring about the final damping at the proper time and where it is required to prevent an offset.

In Fig. 5, *t* represents a stone, the first in the series. *u* is also a stone giving the second impression; but *v* is a relief-form, and the resulting design will therefore be made up of two lithographic and one typographic impression combined together. The apparatus for final damping by condensation takes the place of the roller *q* in Figs. 3 and 4. The exit-tube for saturated air is represented at *w*, the tube *x* leading to it from the saturating apparatus, and the cock *y* (moved automatically by a suitable cam) determines the periods of emission and the necessary interruptions in the flow of the vaporous atmosphere. In damping printing-surfaces by this method it is sometimes expedient, especially in hot weather, to cool the same—an operation which may be accomplished by directing a current of air against it which has been mechanically compressed and cooled, and the exit-tube for which is represented at *z*. This tube is perforated with a close row of fine holes opening over the stone, and is supplied with the compressed air by the tube a°, leading from a reservoir in which the compression and cooling has taken place. The cock b° is opened and closed automatically, as is the case with the cock *y*. The compressed air issuing from the exit-tube *z* absorbs much heat in expanding, and lowers the temperature of the stone in consequence, thereby facilitating the condensation of moisture upon its surface from the aqueous vapor issuing from *w*. Between the two exit-tubes a shield or screen, c°, is placed, the function of which is to prevent the disturbance of the saturated air from *w* by the air issuing under pressure from *z*. All these devices are fully described and explained in the application hereinbefore cited.

In Fig. 5 apparatus precisely similar is employed (lettered d° and e°) for damping the stones *t* and *u*, respectively, before inking. In the arrangement of printing-forms shown in Fig. 5 the final damping would only be required on the second stone, *u*.

It may be explained incidentally that in using the method of damping by condensation shown in Fig. 2 the necessity for cooling the stone by compressed air does not exist, and no exit-tube for condensed air is shown in that figure, because any accession of heat which the stone acquires due to the condensation of watery vapor issuing from *b* is immediately removed, and the stone cooled by the wet damping-rollers at *a*, to the action of which it is twice subjected before the next condensation takes place.

In Figs. 7 and 8 the general damping required before inking is effected by the rollers f° and g° in the usual manner; but the final damping of the surfaces which print lithographically is accomplished by a cloud of atomized water projected against those surfaces before they pass the impression-cylinder. In this case the relief-form h° is the first in the series. It is followed by the stones i° and k°, both of which have to be damped after inking. Within the lower part of the perpendicular trunk l° an atomized spray is generated. This may be done in many ways; but as shown the drawings it is produced in a well-known manner at the junction of the tubes m° and n°, which terminate in small orifices, one conveying water and the other air or steam under pressure. By the proper adjustment of the cocks o° and p° a cloud of atomized water is thrown up, which fills the trunk at all times as far as the valve q°. This valve is hinged at its lower part, and can be opened or closed by the rod r°, Fig. 8. When opened, the induced current of air entering at the adjustable valve s° carries the cloud of atomized water into the horizontal trunk t°, through the open side of which it reaches the stone and accomplishes the damping. The timing of the discharges upon the printing-surface depends upon the movements of the valve q°, and the amount of water which reaches said surface is controlled by the extent to which the valve q° is opened. The adjustable lever u° on the rod r° (to which the rod from the eccentric or cam is attached) admits, by obvious use of its set-screws, of altering the angular movements of the valve q°, and also of opening it always from the closed position, so that said valve performs the double function of timing the damping and determining its amount. These results can be obtained in other ways, which will be found fully set forth in the application hereinbefore cited.

Fig. 9 illustrates the relative positions of the printing-surfaces upon a form-cylinder when the lithographic stone is both preceded and followed by a relief-form, the final damping being requisite only before the second printing.

Fig. 10 illustrates in like manner the disposition of the printing-surfaces when a typographic form is preceded and followed by a lithographic stone, the final damping being necessary only before the third and last printing.

In Figs. 3 to 10, inclusive, the position of the form-cylinder in the chromatic press represented is uniformly that it would have after the completion of the first impression in the series, and its rotation is always in the direction of the arrow.

In the foregoing, several cases have been

described in which lithographic and typographic impressions are combined to produce the finished chromograph. It is obvious that these are not the only feasible arrangements, and that the possible changes in the order and relative proportion of the two kinds of printing in a finished chromograph become very numerous when the number of printing-surfaces is increased; but to describe all such cases specifically is unnecessary, one rule being always applicable—viz., that whenever in a series of colored impressions the printing from a lithographic or equivalent surface has been preceded by one or more impressions of any kind, said surface will be protected and its printing rendered possible by a second or final damping.

In the production of a chromo-lithograph much the larger part of the time required is consumed in drying the sheets after each printing—an operation which requires space and the expenditure of much labor. Our invention obviates this delay and expense, and permits of the combination of lithographic and typographic printing in the same press without any restrictions; and although the construction of the heavier parts of chromatic presses must undergo some modification when lithographic stones take the place of type-forms, still, when flexible zinc plates are used on which to make the printable drawings and transfers, even this change is unnecessary, and the same may be said if collographic plates are employed, when such productions are on a flexible base; but in the drawings forming part of this specification the surfaces printing in the lithographic manner have been uniformly represented as stones, to distinguish them from the relief-surfaces printing in the typographic manner upon the same press.

In this specification, and in the claims, black is regarded as a color whenever reference is made to color.

We do not herein claim the press illustrated save as hereinafter set forth, the same being the invention of one of these applicants, and being claimed in an application filed February 5, 1881, to which the Patent Office has given the number 25,480.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. That improvement in the art of printing in the lithographic manner which consists in first damping the printing-surface, then inking it, then interposing a protective substance between the inked surface on the sheet which bears the fresh ink of a previous printing and the non-printing parts of the form, and finally printing from said form or printing-surface, substantially as stated.

2. That improvement in the art of printing in the lithographic manner which consists in first damping the printing-surface, then inking it, then damping it again, and finally printing from the same on a surface which bears the fresh ink of a previous printing, substantially as described.

3. That improvement in the art of chromographic printing which consists in printing in the lithographic manner the first impression of a series on a suitable sheet, then damping, inking, and damping again the surface prepared for printing in the lithographic manner which is to furnish the second impression of the series, then printing from that surface upon the sheet bearing the first impression and before the ink upon the same has dried, substantially as set forth.

4. That improvement in the art of chromographic printing which consists in printing a series of two or more impressions in a lithographic manner, the surfaces being protected from offset substantially as stated, and one or more impressions in a typographic manner, all upon a single sheet and before the ink of any of the impressions has dried, substantially as described.

5. The combination, with the impression mechanism of a printing-press adapted to print from a plurality of forms in the lithographic manner, of a damping apparatus which operates on the printing-surface in advance of the inking-rolls, the inking apparatus, and a damping apparatus succeeding the inking-rolls, arranged as described, so that both sets of damping apparatus shall be brought into operation on the printing-surface each time said surface passes the damping and inking apparatus, substantially as stated.

6. A printing-machine provided with two or more forms or surfaces adapted for printing in the lithographic manner, means, substantially as described, for protecting one or more of said forms from offset, and one or more forms or surfaces adapted for printing in the typographic manner, substantially as set forth.

7. The combination, in a printing-machine, of two or more surfaces prepared for printing in the lithographic manner, and mechanism, substantially as described, for damping, inking, and again damping said printing-surfaces, substantially as stated.

8. The combination, with the damping-rollers of a lithographic press, of the metallic riding-roller, and of an ink-lifting roller, as *k*, substantially as shown and set forth.

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L. C. YOUNG.

Correction in Letters Patent No. 305,169.

It is hereby certified that in Letters Patent No. 305,169, granted September 16, 1884, upon the application of William H. Forbes, of Boston, Massachusetts, and John W. Osborne, of Washington, D. C., for an improvement in the "Art of and Mechanism for Chromographic Printing," an error appears in line 30, page 1, of the printed specification requiring the following correction, viz: after the words "it is" the word *not* should be inserted; and that the Letters Patent should be read with this correction therein to make it conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 9th day of December, A. D. 1884.

[SEAL.]

M. L. JOSLYN,
Acting Secretary of the Interior.

Countersigned:

BENJ. BUTTERWORTH,
Commissioner of Patents.