No. 637,560. Patented Nov. 21, 1899.

E. HETT.

METHOD OF PREPARING FORMS AND OF PRINTING.

(Application filed Nov. 1, 1899.)

(No Model.) 3 Sheets—Sheet 1.

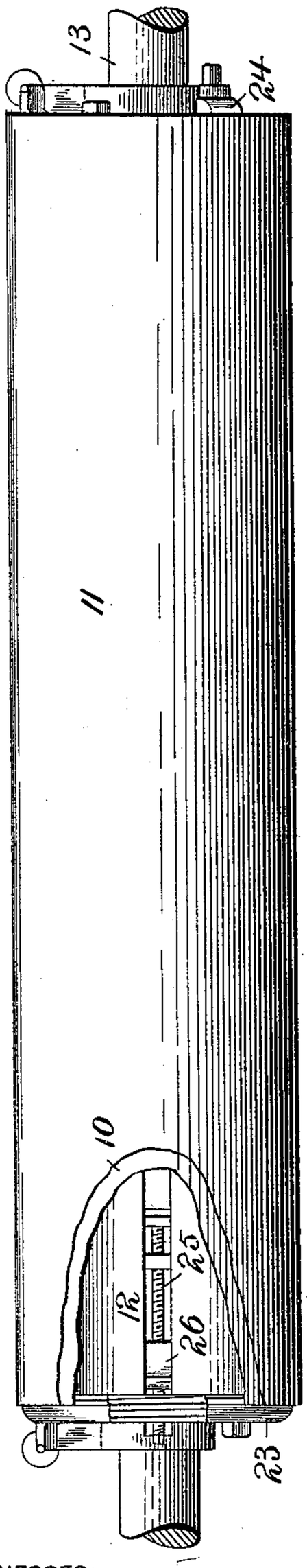

FIG. 1.

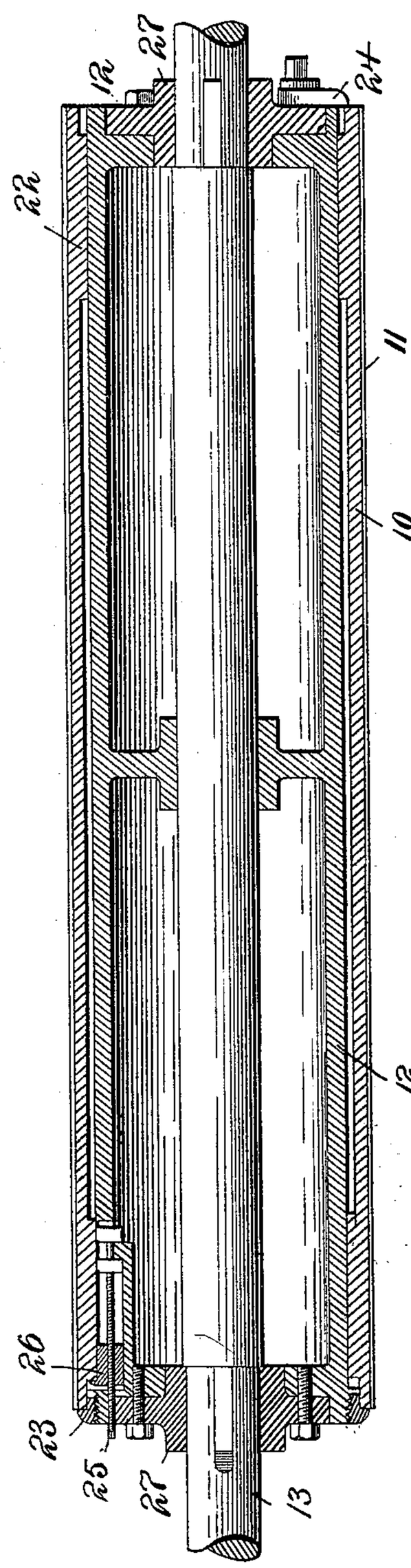

FIG. 2.

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(No Model.) 3 Sheets—Sheet 2.

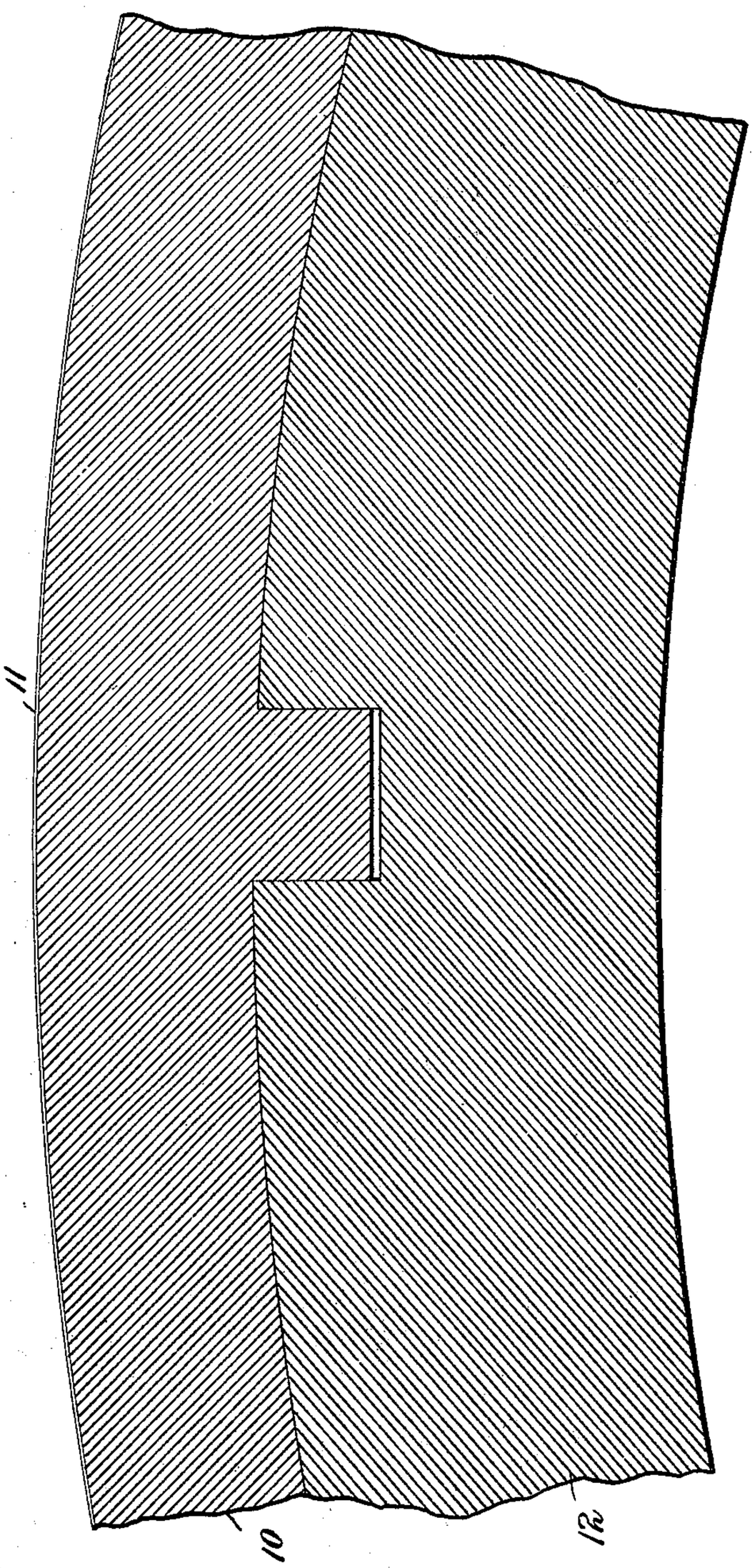

FIG. 3.

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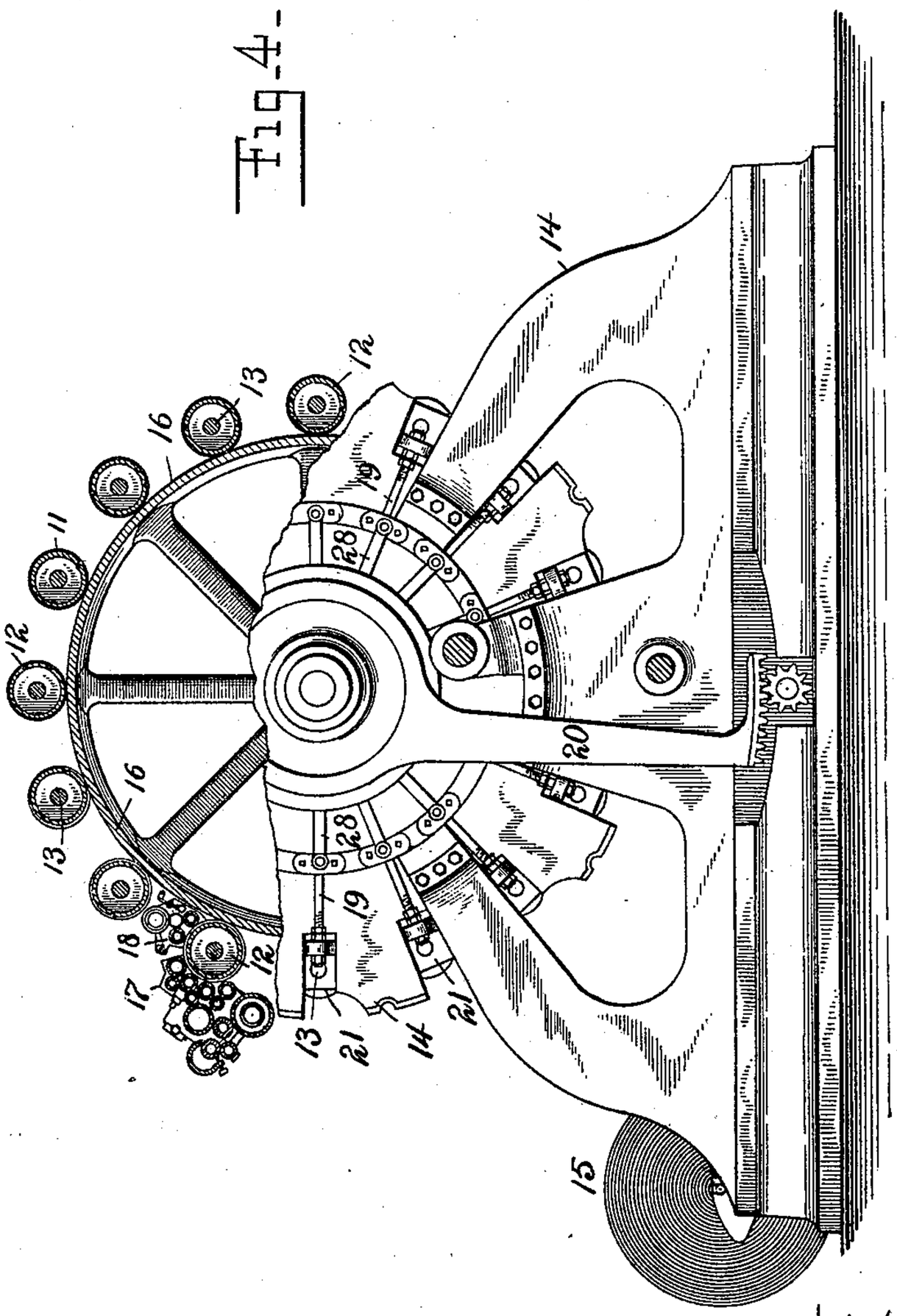
(Application filed Nov. 1, 1899.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

EDWARD HETT, OF NEW YORK, N. Y.

METHOD OF PREPARING FORMS AND OF PRINTING.

SPECIFICATION forming part of Letters Patent No. 637,560, dated November 21, 1899.

Application filed November 1, 1899. Serial No. 735,446. (No model.)

To all whom it may concern:

Be it known that I, EDWARD HETT, a citizen of the United States, residing at New York, (New Dorp, Staten Island,) in the county of Richmond and State of New York, have invented certain new and useful Improvements in Methods of Preparing Printing-Forms and of Printing; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to methods of preparing printing-forms and of printing, and especially planographic and lithographic printing.

It has for its object to improve the character and reduce the cost of printing, and especially planographic and lithographic printing, and to make possible and practical and economical and successful multicolor and lithographic printing, and particularly on the rotary-press principle.

It consists of the methods hereinafter claimed.

The accompanying drawings show apparatus for planographic and lithographic printing of the best form at present known to me adapted to carry out the method in view.

Figure 1 is a perspective view of the composite printing-form before the design has been transferred to it, certain parts being broken away at one end. It shows the printing-form as hollow and cylindrical and as applied to and in place upon an interior form cylinder or support. Fig. 2 is a longitudinal sectional view taken through the axis of the device shown in Fig. 1, with the shaft of the transfer or printing press in place in the form-support. Fig. 3 is an enlarged sectional view of a small portion of the printing-form in place upon a form-support. The section is taken at right angles to the axis of the form-support. Fig. 4 shows, diagrammatically, a multicolor planographic press in which a series of the printing-forms, each with its carrying-form support, is mounted.

The composite printing-form will be first described in the form in which it is specifically shown in the drawings. Referring to Fig. 3, the printing-form as there shown consists of a hollow base 10, preferably of copper, exteriorly cylindrical in shape and about one-quarter of an inch thick, and a separate removable outer coating adapted to be made into a printing-surface, preferably of electro-deposited zinc 11. The copper base 10 is a hollow tube that is cylindrical and of accurate shape and size and finish and polish on the outside and is slightly tapering on the inside. The outer surface of the copper shell has in its making been turned and polished with absolute accuracy as to shape and size, so as to present a true cylinder of the proper predetermined printing shape and diameter (when the printing-surface is upon it) to co-operate with the impression-surface in the printing operation, for it is through this base that the working shape and size of the printing-form are secured and permanently maintained. The coating or surface 11 may be of any suitable material and may be applied in any suitable way. The preferred material is zinc and is preferably applied by electrodeposition upon the outer surface of the copper base 10 after the latter has been accurately shaped and polished. The zinc surface is deposited in such a way as to adhere to the cylindrical copper base and to become substantially integral therewith, by which is meant that the surface and base are united together sufficiently to make one part move with the other and practically constitute one piece of metal and to constitute thereon a layer or coating, preferably in any given case of predetermined thickness, preserving the shape of the base and constituting thereon a printing-surface. This zinc layer or surface must be substantial enough to reliably constitute the desired printing-surface, and in any given case should be and preferably is of a predetermined thickness, so as faithfully to produce, when combined with a base of predetermined size, by its outer surface the accurately-shaped printing-surface required and of the exact size required, adapting the composite printing-form as a whole to properly coöperate with the other parts of the press in attaining register and printing accurately. Fig. 3 indicates such a surface layer 11. I have found that the thickness of deposit that is obtained under the conditions specifically set out hereinafter is admirably adapted to make the construction herein described suitable for planographic

printing. The copper shell 10 is preferably made to be slightly tapering or conical on the interior in order that it may absolutely and exactly fit the form-supporting cylinder 12 and may be supported substantially at every point by that form-support and yet may be readily removed from and replaced upon said support. In carrying out some of the features of my invention the printing-form is accurately adjusted and reliably held, both longitudinally and circumferentially, with relation to the other parts of the press.

Means for accurately adjusting, both longitudinally and circumferentially, and reliably holding the printing-form upon the form-support and the latter upon the shaft of the press, as well as the means for removing the printing-form from the form-support and the form-support from the shaft, are indicated in Figs. 1 and 2; but their details form no part of the present invention, being claimed in other pending applications. The printing-form is held in place circumferentially on the form-support by the spline 22 of the former taking into a longitudinal groove in the latter, and it is held in place longitudinally against the adjustable stop 23 by the clamps 24. To remove the printing-form from the form-cylinder, release the clamps 24 and then turn the threaded bolt 25, on which is a traveling finger 26, which takes against the printing-form, starting it off the form-cylinder. To remove the form-cylinder from the shaft, unkey one or both hubs 27 from the shaft, unscrew the other hub from the form-cylinder, and slip the latter off.

It will be observed that the printing-form shown in Figs. 1, 2, and 3 has a circumferentially-continuous curved outer surface for printing. It will also be observed that the printing-form is a hollow composite structure having a surface of suitable printing material and a hollow strengthening-base of a different material, the two being integrally united together. It will also be observed that this hollow composite printing-form is removable and replaceable on an interior form-support and that the form-support is removable and replaceable on the shaft 13 of the press. It will also be noted that in constructing the composite printing-form the copper shell or strengthening-base is constructed of a predetermined shape and dimensions that are fixed so as to permanently adapt the form to the coöperating parts of the press, and to that end the inner and outer surfaces of the copper base are with great care trued and turned and polished and cleansed, all with substantial accuracy, to the exact diameter that will adapt the printing-form as a whole, when finished, to the press and will reliably and permanently attain and maintain the proper support and the proper printing and register in the printing-press, and especially when a whole series of such printing-forms are mounted successively, as shown in Fig. 4, and print successively and in approximately instantaneous succession one color on top of another, as in a multicolor-press. It will also be noted that when a series of such printing-forms are combined in a press it will not be essential that all the forms be of the same predetermined size, as one form may be a multiple of another or of a series of designs of the same size circumferentially, or if a series of design groups of the same size circumferentially are arranged circumferentially on one form the circumference of another form might equal that fraction of the first form occupied by one design or a group of designs or any multiple of such fraction. All that is essential is that each form should be of a predetermined relative size, such that the design or designs carried by the form will print and register with the design or designs carried by the other forms. It will also be noted that when a base is thus once accurately shaped and sized such a thin removable coating or surface may be applied thereto as not to materially alter the predetermined shape and size of the base, in which case a printed form of substantially the same predetermined size and shape as the base is obtained, which will properly coöperate with the similar form or forms and print in register in a press. Preferably, however, a predetermined thickness of a removable coating or printing-surface is applied to the accurately shaped and sized base, thereby obtaining a printing-form of predetermined size and shape, the size of which, though different from that of the base, is determined by the size of the base. It will also be noted that while the thickness is preferably predetermined it need not be the same for all the forms to be used in coöperation in a press. For instance, where a series of bases are of different proportions, as above set forth, the thickness of the coatings should vary in the same proportions. It will also be noted that the thickness of coating on one coöperating series of printing-forms need not be the same as the thickness of coating on another series, even though the same bases be used in the different series, or even though the different series be used in the same press. When, however, the coating on one of a coöperating series of forms becomes worn or for any other reason needs to be replaced, if the old base or another of the same predetermined size is used in the said coöperating series the new coating must be of the same predetermined thickness as the old one. It will also be noted that where a coating of substantial thickness is applied to a base of predetermined size and shape its thickness in lineal measure need not be known, as the thickness may be determined in any suitable way, it being only essential to determine the relative thickness of the coatings to be applied to a series of bases having predetermined relative sizes, which, with their coatings, are to form a coöperating series of printing-forms adapted to print in register in a press. When a zinc coating is applied by electrodeposition, its thickness may

be and preferably is determined, either theoretically or experimentally, in the plating-bath by employing a standard of solution, of current, of time, and of character of manipulation in the bath all of which can be worked out or determined experimentally by the practical printer and may vary greatly, although the thickness of the coating may vary, as above set forth. I have found a half-hour's treatment in the zinc-bath, with a suitable solution and current, produces a satisfactory thickness of zinc surface on the smooth exterior of a copper tube and provides a satisfactory surface for the purposes of planographic printing. Although the thickness of this zinc exterior surface in lineal measure need not be known, for reasons above given, that preferably used by me has been found to approximate two one-thousandths of an inch, more or less. It is to be noted that a mere change of the color of a cylinder in the bath from copper color to zinc color is ordinarily not enough. Such a change of color occurs almost at once, and is quite complete in a minute or two under the conditions of solution and of current, of which I have found a full half-hour's treatment the best, as already stated. For the purposes of relief-printing (where the planographic surface, for example, after the design is transferred to it, is developed by deep etching into a relief-surface) the zinc surface should be thicker than is necessary for planographic printing. It is desirable also in case of cylindrical tubes that the deposit should be uniform in thickness, and to that end I have found it necessary in the case of cylindrical printing-tubes to keep the same in slow constant rotation underneath the surface of the bath and equably opposite the anodes. It is also to be noted that the character of the deposit is preferably such as will at once adapt the surface to receive a lithographic drawing or transfer and to be thereafter developed into a printing-surface for that design of the character desired. In this way a fresh and unused separate printing-surface can without difficulty be applied to the outer polished surface of a given basic copper tube time after time with such accuracy as to thickness, &c., that the resulting succession of composite printing-forms will reliably and accurately coöperate with the other forms of the same series and the other parts of the press and register with one another in the printing without remeasurements or readjustments or reconstruction. Thus if the entire printing-surface is removed from the copper base after a printing-job is finished without removing any of the copper base, (but instead preserving its original integrity in shape,) then a fresh printing-surface can be renewed on the same base, thereby producing a new printing-form of predetermined size adapted to coöperate with similar forms and print in register. While, as above set forth, the predetermined thickness of the coating and the predetermined size of the base may be varied as desired, I find in practice that it is more convenient and economical and also that better and more reliable results are obtained when the size and dimensions of the base are predetermined and fixed and the renewed coating or printing surface is of the same predetermined thickness as the one taken off. When this practice is followed, it will be noted that the removal and renewal of the printing-surface are accomplished without substantially affecting the shape or dimensions of the printing-form as they existed before such removal and renewal. I also find it preferable in practice to make the series of bases intended to coöperate in a press all of the same predetermined size and always apply to them or renew on them a coating of the same predetermined thickness, as by such practice a series of identical and interchangeable printing-forms are provided which can be applied to the same support or to different supports in the same press or in duplicate presses without discrimination or confusion or liability to error in the attainment of register. It will also be seen that when for a given press (multicolor or otherwise) a copper base has once been accurately and painstakingly shaped and sized and finished and adapted with a view to its exact adaptation to print and register in that press after receiving a separate printing-surface of a predetermined thickness then an indefinitely numerous succession of printing-forms may readily and economically be made therewith without any further adjustments or adaptations being required, and each with a fresh and unused printing-surface, and simply by removing from said base and integrally renewing thereon a separate removable printing-surface, as described, without substantially affecting the shape or dimensions of the form, and this can be done while employing such material for the different parts of the composite printing-form and such a shape of printing-form as to combine strength with lightness without sacrificing surface-printing character, whereby ease of handling off the press and absolute integrity of shape on and off the press are combined, and both with cheapness and convenience in the construction and preparation of the printing-forms.

My improvement renders multicolor-printing practicable, solving many of the most serious problems that have stood in the way of the practical attainment of that end.

Fig. 4 represents a multicolor planographic printing-press, showing combinations in which my improvements are of an especial value and advantage and have peculiar cooperations and results. 14 is the frame of the machine. 15 is the paper-roll. 16 is the impression-drum. 11 are the series of composite printing-forms arranged on the impression-face of the drum. 12 are the series of the form-supports; 13, the series of shafts carrying the form-supports; 17, the groups of inking-rollers, one group for each printing-

form; 18, the groups of dampening-rollers, one group for each printing-form; 19, the pressure-bars for removing the printing-forms into and out of contact with the impression-drum when operated to that end by the lever 20 through suitable knuckle-joint levers 28. The detail mechanisms of this printing-press form no part of the present invention, but are claimed in other pending applications. The shafts 13 are carried in sliding boxes 21, which are secured to the pressure-bars 19. When it is desired to remove the form-supports or printing-forms from the press, the nuts on the outer ends of the pressure-bars 19 are unscrewed and the sliding boxes are slid off the ends of the pressure-bars and out of their slideways in the frame of the machine, when the sliding boxes can be slipped off of the shaft 13, and the printing-form and the form-supports can be taken off of the shaft, or the printing-form alone can be slipped off. It will be observed that the printing-forms are arranged in series around the impression-face of the drum and are carried in proper position by a series of form-supports arranged around the impression-drum. It will also be observed that the accurately-maintained diameter of the printing-forms and their absolute uniformity of surface and their strong and reliable support by the form-support against bending or yielding at any point enable accurate and registering and rapid printing to be done with uniformity of pressure and perfection of work and with economy of manipulative preparation for the work. When the entire edition is printed, the printing-forms are removed from the press, the old design or ink thereof is washed off with turpentine or benzene in the usual way, and the printing-forms are washed with a suitable dilute acid or other agent, such as will remove the coating which had acted as the printing-surface and leave the base untouched, and therefore unaltered in shape or size or character of surface. I have found that this can be practically and economically accomplished in the case of a zinc surface upon a copper shell by the use of dilute nitric acid run quickly over the zinc surface with a sponge or brush and washed off with an abundance of water at once. Every trace of zinc can be thus removed in a few seconds from a large copper tube, as will be indicated by the color. I then quickly rub the copper surface with a little powdered pumice to clean it, and when it is perfectly bright and clean it is plunged into the zinc-bath under the same conditions as before to receive another planographic coating of zinc, which, as already described, may be and is preferably of the same predetermined thickness as before and does not substantially affect the shape or dimensions of the form. It is then mounted in the transfer-press and a new design is suitably transferred to it and it is etched and prepared for printing as before. The desired addition of the new design is printed from it in the same printing-press as before, and the zinc printing-surface is removed again by washing with suitable acid, as before, when a third fresh and unused zinc printing-surface is applied electrolytically under the same conditions as before, and so on. After the design or drawing has been transferred in the lithographic or in any suitable manner to the fresh planographic surface of the printing-form that surface may be developed into a printing-surface for that design of any desired character. For example, it may be developed by the ordinary light etching employed in lithography into a planographic-printing surface for that design, and I prefer so to develop it; but it may also and equally be developed by deep etching and by the suitable use of a routing-out machine into a relief-printing surface for the design. In the latter case dampening mechanisms are not required in the printing-press. The etching or routing should of course not be deep enough to cut into the copper base. In both cases and equally the parts of the original planographic surfaces that in the developed printing-surfaces do the actual printing lie all of them in the same plane—to wit, the plane of the original planographic surface when it receives the transfer prior to its development into a printing-surface.

I have shown in the drawings and described heretofore in connection with the drawings the invention in the best form in which it is at present known to me. Many changes and modifications, however, might be made without departing from the invention, as will be indicated by the omissions, as well by the inclusions, of the claims hereinafter made. I have specifically described herein the best methods and apparatus known to me for carrying out the invention; but for the purposes for many of the claims hereinafter made I do not wish to be limited to those specific details.

Among the advantages of the invention, especially when practiced in its preferred form, are these. The base of the printing-form, which gives accuracy and integrity of shape and size and gives body and stability and support to the outer and printing part or surface, may be made of material which would not be suitable for a printing-surface or adapted to receive a drawing or transfer in the lithographic manner or to be thereafter developed into a printing-surface of the character desired, but which may nevertheless be better for giving durability and permanence and for shape and size-giving and strength-giving purposes, and the outer or printing part or surface upon it, which must be made of material suitable and in a condition suitable for printing, may be thin, so that while answering fully the purpose of a planographic surface for receiving a transfer of a design and being developed into a printing-surface for that design of the character desired and for the printing of a full edition of one design it may then readily and

economically be wholly effaced or removed, as by acids, from the inner part or body or base and an entirely new and fresh outer part or surface of the material suitable for the printing may be applied to or renewed upon the base as at first, and this effacement and renewal of the outer surface of the composite printing-form may be repeated an indefinite number of times and for every new design, and meanwhile shape and size and register having been once attained are reliably and economically maintained. The advantage in such case of having the inner body-giving part or base of the printing-form made of different material from the outer part or printing is that by proper selection of effacing or removing agents, as of acids, the outer surface may be wholly and reliably taken off or removed (after each printing job is printed) without taking off any of the inner body-giving base, and thus uniform and reliably uniform working dimensions of the composite printing form or cylinder when it is ready for its printing work can be attained and maintained, a matter of moment and importance, especially in any effort to apply the rotary-press principle to planographic or relief printing work. Thus solid and substantial and unyielding printing-forms reliably maintaining their absolute integrity of predetermined shape and size, especially under the vicissitudes of removal and renewal of the printing-surface, the strains of handling out of the presses, and the pressure of use in the transfer and printing presses, may be attained with great economy of surface material and with a clean unused fresh planographic surface for each new design or job of printing, and these advantages, with other of the hollow composite printing form or tube, may be attained without sacrificing the solid unitary integral character of the hollow composite form or tube as a whole.

In that form of the invention in which a zinc printing-surface is applied by electro-deposition the zinc when properly so applied is thin, may be made continuous over the entire surface, is adherent to and integral with the copper and coherent throughout its own mass, is suitably absorbent, even and uniform, without corrugations or streaks, ruts or nodules, is pure and clean, and in a surface condition admirably adapted to the requirements of planographic transferring, and this at once and without the necessity of any sand-blasting process or other mechanical or chemical manipulations or preparations.

In that form of the invention in which the base is of one material, as of copper, and the printing-surface is of another material, as of zinc, there is the especial advantage that the printing-surface may be quickly and readily removed or effaced without removing any of the base by the selection of an acid which under the conditions of its application will attack the one and not the other. Another advantage is that the workman can by the difference in color readily know when the printing-surface is entirely removed. Other advantages have been stated heretofore.

In that form of the invention in which the printing-surface when secured is curved and circumferentially continuous special advantages reside. Every part of the surface may be utilized. The endless rolling contact characterizing the printing gives rapid and perfect results. The printing-forms may be used interchangeably, which is especially important in multicolor-presswork. A larger variety of designs can be printed. Register is more easily obtained.

In that form of the invention in which the peculiar printing-form is combined with an interior form-support certain special and peculiar advantages are obtained. Solidity and strength and reliability in the working parts, with lightness and cheapness and perfection of printing-surface and ease of manipulations of the same, are attained, and especially in the combinations involving a series of such form-supports and a series of such printing-forms are the full and final benefits and advantages found. The development of my planographic surfaces, having the design transferred to them into planographic-printing surfaces, contribute also toward a great advance in the art of planographic or lithographic printing.

By my invention the process of the simultaneous printing of many colors by as many different printing-forms in one and the same press is made possible and practical in the printing art and especially in the planographic art. The advantages of this printing in approximately instantaneous succession of many different colors—as, say, fifteen—in the planographic art and especially in lithographic are such as to make the change revolutionary in the art. The results which are secured in efficiency, capacity, and economy are greatly in advance of anything known in the art. A single press—such as is shown in the drawings, Fig. 4—will do the work and take the place of fifteen presses now in use in printing lithographs in fifteen colors—that is to say, this one press will print fifteen colors simultaneously, while this work would require fifteen presses of the present style, each one working separately and printing a separate color. Moreover, so much time is saved in the handling of the prints that it is estimated that such a press as is shown in Fig. 4 will print about four thousand seven hundred complete fifteen-color lithographs in the same time that it would require one of the present-style presses with the ordinary flat-stone and the reciprocating bed to print seven hundred copies in a single color. The capacity of the multicolor-press printing fifteen colors in approximately instantaneous succession will therefore be seen to be about one hundred times greater than that of the old presses in printing a fifteen-color job. In addition to this further economy is secured in the mat-

ter of space for the presses, in the matter of labor in handling the presses and the prints between printing, and in the matter of time in turning out the work. The present invention attains in the best way known to me the peculiarity of a curved lithographic-printing form having a circumferentially continuous or unbroken lithographic-printing surface, with the result of making rotary-press printing for multicolor lithographic work possible and practicable.

My improved apparatus set forth herein is not claimed in this application, but is made the subject of another application filed simultaneously herewith.

What I claim as new, and desire to secure by Letters Patent, is—

1. The improvement in the art of preparing printing-forms which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

2. The improvement in the art of preparing printing-forms which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, and making said second coating into a printing-surface.

3. The improvement in the art of preparing printing-forms which consists in taking a printing-form composed of a base and an exteriorly integrally applied removable coating made or adapted to be made into a printing-surface, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

4. The improvement in the art of preparing printing-forms which consists in taking a printing-form composed of a base and an exteriorly integrally applied removable coating made or adapted to be made into a printing-surface, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, and making said second coating into a printing-surface.

5. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate thin removable coating, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, and integrally applying to the base a second thin removable coating, adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, the size of the printing-form being substantially determined by the size of the base.

6. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate thin removable coating, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, and integrally applying to the base a second thin removable coating, adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, the size of the printing-form being substantially determined by the size of the base, and making said second coating into a printing-surface.

7. The improvement in the art of preparing printing-forms which consists in making a suitable base for the printing-form, integrally applying to said base by electrodeposition a separate removable zinc coating, making the said coating into a printing-surface, entirely removing the coating from the base, and integrally applying to the base by electrodeposition a second removable zinc coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

8. The improvement in the art of preparing printing-forms which consists in taking a printing-form composed of a base and an exteriorly integrally electrically deposited removable zinc coating made or adapted to be made into a printing-surface, entirely removing the coating from the base, and integrally applying to the base by electrodeposition a second removable zinc coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

9. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second removable coating, adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact reg-

ister and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form.

10. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second removable coating, adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact register and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form, and making said second coating into a printing-surface.

11. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, and integrally applying to the base a second removable coating of the same predetermined thickness adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact register and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form.

12. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, and integrally applying to the base a second removable coating of the same predetermined thickness adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact register and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form, and making said second coating into a printing-surface.

13. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, and integrally applying to the base a second removable coating of predetermined thickness adapted to be made into a printing-surface, the size of the printing-form being substantially determined by the size of the base and a fresh or unused surface being thus presented for each design.

14. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second removable coating of predetermined thickness adapted to be made into a printing-surface, the size of the printing-form being substantially determined by the size of the base and a fresh or unused surface being thus presented for each design, and making said second coating into a printing-surface.

15. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base by electrodeposition a separate removable zinc coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base by electrodeposition a second removable zinc coating of the same predetermined thickness.

16. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base by electrodeposition a separate removable zinc coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base, integrally applying to the base by electrodeposition a second removable zinc coating of the same predetermined thickness, and making said second coating into a printing-surface.

17. The improvement in the art of prepar-

ing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base by electrodeposition a separate removable zinc coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base by electrodeposition a second removable zinc coating of predetermined thickness adapted to be made into a printing-surface, the size of the printing-form being substantially determined by the size of the base and a fresh and unused surface being thus presented for each design.

18. The improvement in the art of preparing printing-forms which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base by electrodeposition a separate removable zinc coating of predetermined thickness, making the said coating into a printing-surface, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base by electrodeposition a second removable zinc coating of predetermined thickness adapted to be made into a printing-surface, the size of the printing-form being substantially determined by the size of the base and a fresh and unused surface being thus presented for each design, and making said second coating into a printing-surface.

19. The improvement in the art of printing which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

20. The improvement in the art of printing which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh unused surface being thus presented for each design, and making said second coating into a printing-surface.

21. The improvement in the art of printing which consists in taking a printing-form composed of a base and an exteriorly integrally applied removable coating, made or adapted to be made into a printing-surface, entirely removing the coating from the base, and integrally applying to the base a second removable coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, and making said second coating into a printing-surface.

22. The improvement in the art of printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate thin removable coating, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second thin removable coating, adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design, and the size of the printing-form being substantially determined by the size of the base.

23. The improvement in the art of printing which consists in making a suitable base for the printing-form, integrally applying to said base by electrodeposition a separate removable zinc coating, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base, and integrally applying to the base by electrodeposition a second removable zinc coating adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

24. The improvement in the art of printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second removable coating, adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact register and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form.

25. The improvement in the art of printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions, integrally applying to said base a separate removable coating of predetermined thickness, making the said coating into a printing-surface, printing the desired edition therefrom in the press, entirely removing the coating from the base without substantially affecting the shape or dimensions of the base and integrally applying to the base a second removable coating of the

same predetermined thickness, adapted to be made into a printing-surface, without substantially affecting the shape or dimensions of the printing-form, a fresh and unused surface being thus presented for each design, whereby the proper shape and size of printing-form for exact register and proper printing in a press having been once accurately attained are permanently maintained throughout subsequent printing operations of the form.

26. The improvement in the art of preparing planographic-printing forms which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable planographic coating, making the said coating into a planographic-printing surface, entirely removing the coating from the base, and integrally applying to the base a second removable planographic coating adapted to be made into a planographic-printing surface, a fresh and unused planographic surface being thus presented for each design.

27. The improvement in the art of printing which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable planographic coating, making the said coating into a planographic-printing surface, printing the desired edition therefrom in the press, entirely removing the coating from the base, and integrally applying to the base a second removable planographic coating adapted to be made into a planographic-printing surface, a fresh and unused planographic surface being thus presented for each design.

28. The improvement in the art of preparing planographic-printing forms which consists in making a suitable base for the printing-form, integrally applying to said base by electrodeposition a separate removable planographic coating, making the said coating into a planographic-printing surface, entirely removing the coating from the base, and integrally applying to the base a second removable planographic coating adapted to be made into a planographic-printing surface, a fresh and unused planographic surface being thus presented for each design.

29. The improvement in the art of preparing planographic-printing forms which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable planographic coating, suitably placing the picture or design on said coating and etching and preparing the coating for printing, entirely removing the coating from the base by washing with suitable acid, and integrally applying to the base a second removable planographic coating adapted to be made into a planographic-printing surface, a fresh and unused planographic surface being thus presented for each design.

30. The improvement in the art of preparing planographic-printing forms which consists in making a suitable base for the printing-form, integrally applying to said base a separate removable planographic coating of a different material from the base, making the said coating into a planographic-printing surface, entirely removing the coating from the base, and integrally applying to the base a second removable planographic coating of a different material from the base and adapted to be made into a planographic-printing surface, a fresh and unused planographic surface being thus presented for each design.

31. The improvement in the art of preparing planographic-printing forms which consists in making a suitable base for the printing-form, integrally applying to said base by electrodeposition a separate removable planographic coating of a different material from the base, suitably placing the picture or design on said coating and etching and preparing the coating for printing, entirely removing the coating from the base by washing with suitable acid, integrally applying to said base by electrodeposition a second removable planographic coating of a different material from the base and adapted to be made into a printing-surface, a fresh and unused surface being thus presented for each design.

32. The improvement in the art of printing, which consists in shaping the strengthening-bases of a series of printing-forms of predetermined shape and dimensions fixed so as to adapt the forms to the coöperating parts of the press, integrally applying to said bases separate removable planographic surfaces, suitably placing the designs for the several colors of the picture on said several surfaces in accurate and related register, and developing the several surfaces into printing-surfaces for the several designs of the character desired, printing the desired edition therefrom in accurate and related register, removing the printing-surfaces from the bases without substantially affecting the shapes or dimensions of the bases, integrally applying second removable planographic surfaces to said bases without substantially affecting the shapes or dimensions of the printing-forms, said planographic surfaces being adapted to be made with fresh and unused printing-surfaces for use in printing in accurate and related register.

33. The improvement in the art of planographic printing, which consists in shaping the strengthening-bases of a series of printing-forms of predetermined shape and dimensions fixed so as to permanently adapt the forms to the coöperating parts of the press, integrally applying to said bases separate removable planographic-printing surfaces, suitably placing the designs for the several colors of the picture on said several surfaces in accurate and related register, removing the printing-surfaces from the bases without substantially affecting the shapes or dimensions of the bases, integrally applying second removable printing-surfaces to said bases without substantially affecting the shapes or dimensions

of the printing-forms, suitably placing the designs for the several colors of another picture on said several second surfaces, and so on, whereby the proper shapes and sizes of the printing-forms for exact register and proper printing in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the forms and fresh and unused planographic-printing surfaces are presented by the printing-forms for each new picture or design to be printed, substantially as and for the purposes set forth.

34. The improvement in the art of printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the coöperating parts of the press, integrally applying to said base a separate removable planographic surface, suitably placing the picture or design on said surface and developing the surface into a printing-surface for the design of the character desired, printing the desired edition therefrom in the press, removing the printing-surface from the base without substantially affecting the shape or dimensions of the base, integrally applying a second removable planographic surface to said base without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the form and a fresh and unused planographic surface is presented by the printing-form for each new picture or design to be transferred and printed, substantially as and for the purposes set forth.

35. The improvement in the art of planographic printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the cooperating parts of the press, integrally applying to said base a separate removable planographic-printing surface, suitably placing the picture or design on said surface and etching and preparing the surface for printing, printing the desired edition therefrom in the press, removing the printing-surface from the base without substantially affecting the shape or dimensions of the base, integrally applying a second removable planographic surface to said base without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the form and a fresh and unused planographic-printing surface is presented by the printing-form for each new picture or design to be printed, substantially as and for the purposes set forth.

36. The improvement in the art of planographic printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the cooperating parts of the press, integrally applying to said base by electrodeposition a separate removable planographic-printing surface, suitably placing the picture or design on said surface and etching and preparing the surface for printing, printing the desired edition therefrom in the press, removing the printing-surface from the base without substantially affecting the shape or dimensions of the base, integrally applying by electrodeposition a second removable printing-surface to said base without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the form and a fresh and unused electrodeposited planographic-printing surface is presented by the printing-form for each new picture or design to be printed, substantially as and for the purposes set forth.

37. The improvement in the art of planographic printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the cooperating parts of the press, integrally applying to said base a separate removable planographic-printing surface, suitably placing the picture or design on said surface and etching and preparing the surface for printing, printing the desired edition therefrom in the press, removing the printing-surface from the base by washing with suitable acid without substantially affecting the shape or dimensions of the base, integrally applying a second removable printing-surface to said base without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the form and a fresh and unused planographic-printing surface is presented by the printing-form for each new picture or design to be printed, substantially as and for the purposes set forth.

38. The improvement in the art of planographic printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the

coöperating parts of the press, integrally applying to said base a separate removable planographic-printing surface of a different material from the base, suitably placing the picture or design on said surface and etching and preparing the surface for printing, printing the desired edition therefrom in the press, removing the printing-surface from the base without substantially affecting the shape or dimensions of the base, integrally applying a second removable printing-surface to said base of a different material from the base without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained through the subsequent printing operations of the form and a fresh and unused planographic-printing surface is presented by the printing-form for each new picture or design to be printed, substantially as and for the purposes set forth.

39. The improvement in the art of planographic printing which consists in shaping the strengthening-base of a printing-form of predetermined shape and dimensions fixed so as to permanently adapt the form to the coöperating parts of the press, integrally applying to said base by electrodeposition a separate removable planographic-printing surface of a different material from the base, suitably placing the picture or design on said surface and etching and preparing the surface for printing, printing the desired edition therefrom in the press, removing the printing-surface from the base by washing with suitable acids without substantially affecting the shape or dimensions of the base, integrally applying by electrodeposition a second removable printing-surface to said base and of a different material from the base, without substantially affecting the shape or dimensions of the printing-form, suitably placing another picture or design on said second surface, and so on, whereby the proper shape and size of printing-form for exact register and proper printing in the press having been once accurately attained are permanently maintained through the subsequent printing operations of the form and a fresh and unused planographic-printing surface is presented by the printing-form for each new picture or design to be printed, substantially as and for the purposes set forth.

40. The improvement in the art of printing, which consists in shaping the strengthening-bases of a series of printing-forms of predetermined shape and dimensions fixed so as to adapt the forms to the coöperating parts of the press, integrally applying to said bases separate removable planographic surfaces, suitably placing the designs for the several colors of the picture on said several surfaces in accurate and related register, and developing the several surfaces into printing-surfaces for the several designs of the character desired, printing the desired edition therefrom in accurate and related register and in approximately instantaneous succession, removing the printing-surfaces from the bases without substantially affecting the shapes or dimensions of the bases, integrally applying a second removable planographic surface to said bases without substantially affecting the shapes or dimensions of the printing-forms, suitably placing the designs for the several colors of another picture on said several second surfaces, and so on; whereby the proper shapes and sizes of the printing-forms for exact register and proper printing in approximately instantaneous succession in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the forms and fresh and unused planographic surfaces are presented by the printing-forms for each new picture or design to be transferred and printed, substantially as and for the purposes set forth.

41. The improvement in the art of planographic printing, which consists in shaping the strengthening-bases of a series of printing-forms of predetermined shape and dimensions fixed so as to permanently adapt the forms to the coöperating parts of the press, integrally applying to said bases separate removable planographic-printing surfaces, suitably placing the designs for the several colors of the picture on said several surfaces in accurate and related register, and etching and preparing the surfaces for printing, printing the desired edition therefrom in accurate and related register and in approximately instantaneous succession, removing the printing-surfaces from the bases without substantially affecting the shapes or dimensions of the bases, integrally applying a second removable printing-surface to said bases without substantially affecting the shapes or dimensions of the printing-forms, suitably placing the designs for the several colors of another picture on said several second surfaces, and so on, whereby the proper shapes and sizes of the printing-forms for exact register and proper printing in approximately instantaneous succession in the press having been once accurately attained are permanently maintained throughout the subsequent printing operations of the forms and fresh and unused planographic-printing surfaces are presented by the printing-forms for each new picture or design to be printed, substantially as and for the purposes set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

EDWARD HETT.

Witnesses:
FRANK D. BLACKISTONE,
NICHOLAS M. GOODLETT, Jr.