(No Model.) 4 Sheets—Sheet 1.

J. W. OSBORNE.

METHOD OF AND MEANS FOR TRANSFERRING DESIGNS.

No. 282,111. Patented July 31, 1883.

Fig. 1.

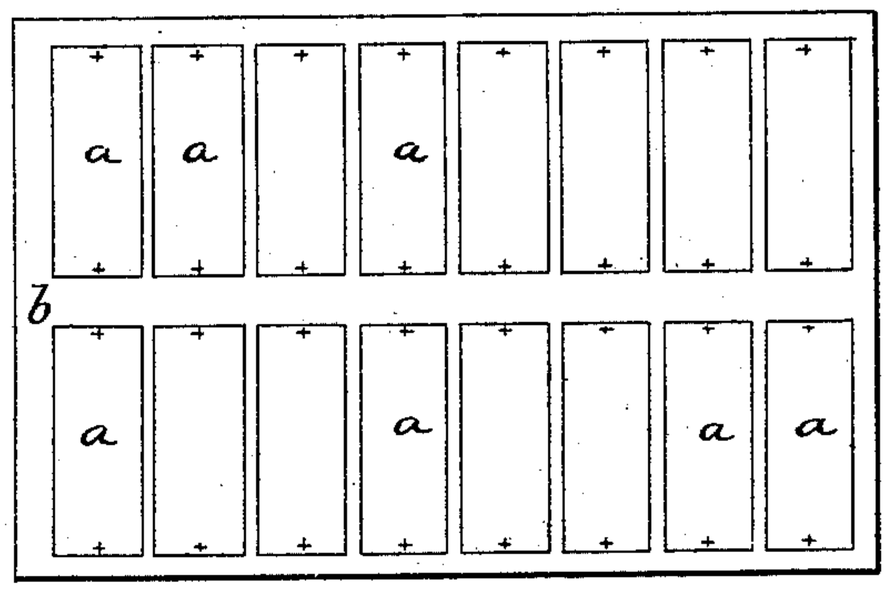


Fig. 2.

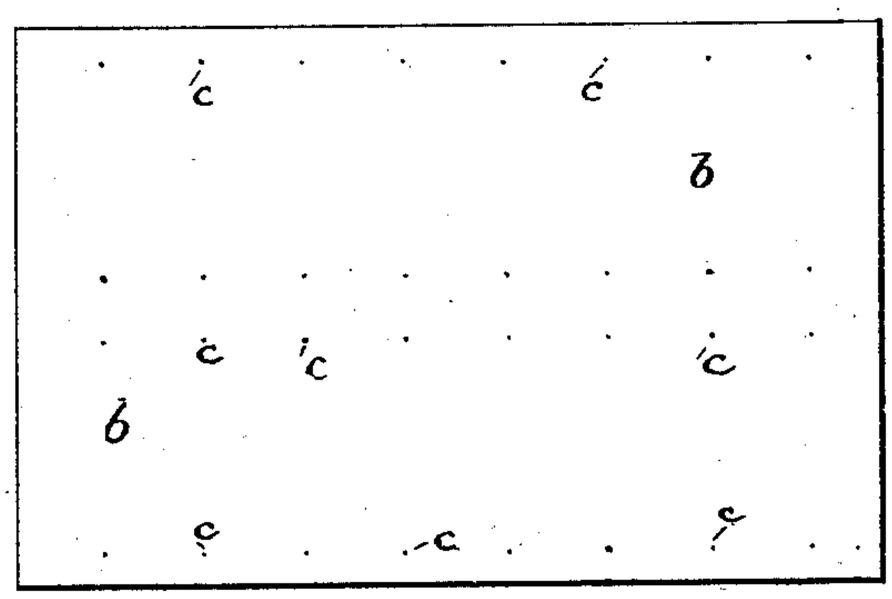


Fig. 3.

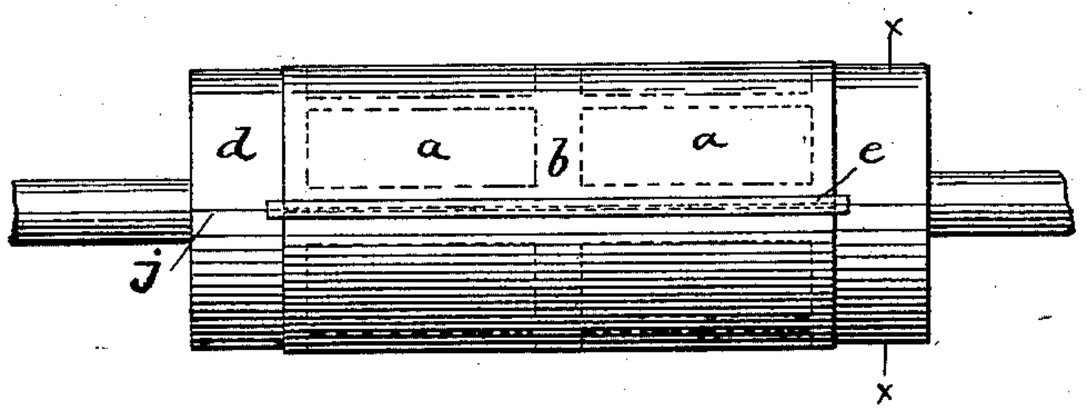
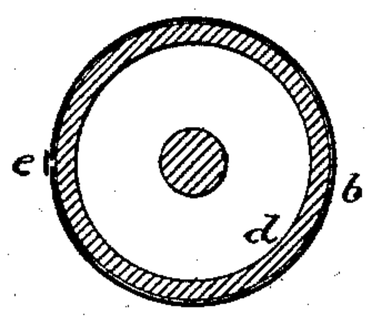


Fig. 4



Attest.

Sidney P. Hollingsworth

Newton Hyckoff.

Inventor.

J. W. Osborne.

By his atty.

Philip T. Dodge.

(No Model.) 4 Sheets—Sheet 2.

J. W. OSBORNE.

METHOD OF AND MEANS FOR TRANSFERRING DESIGNS.

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Fig. 5.

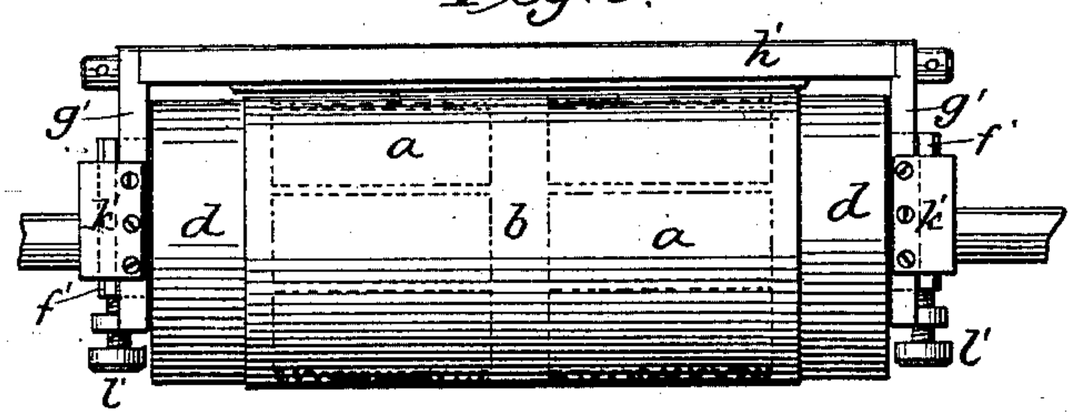


Fig. 6.

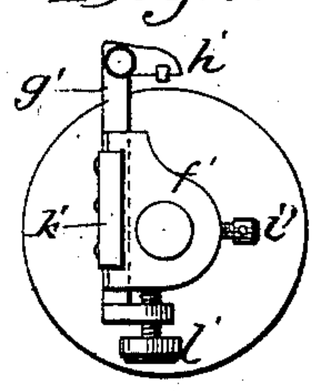


Fig. 15.

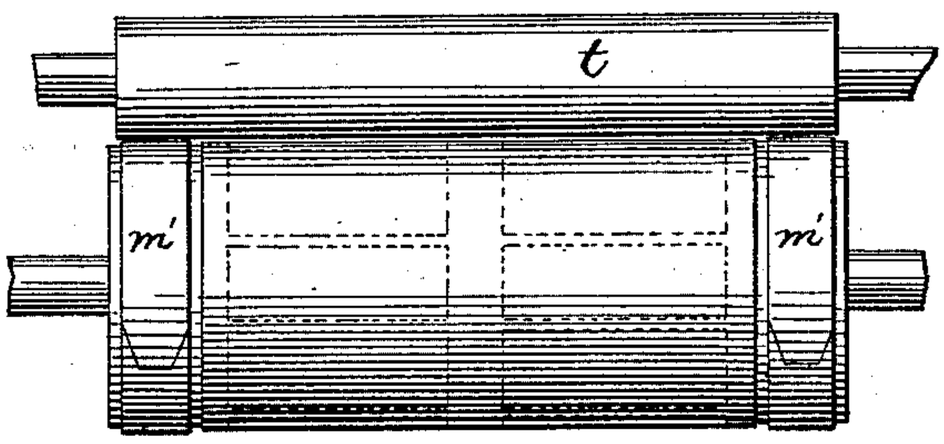


Fig. 9.

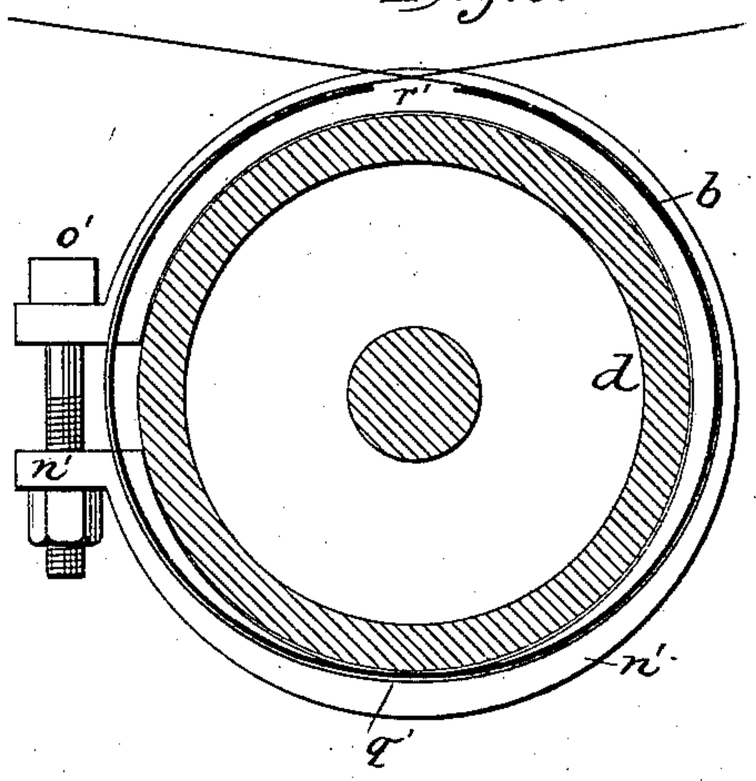


Fig. 7.

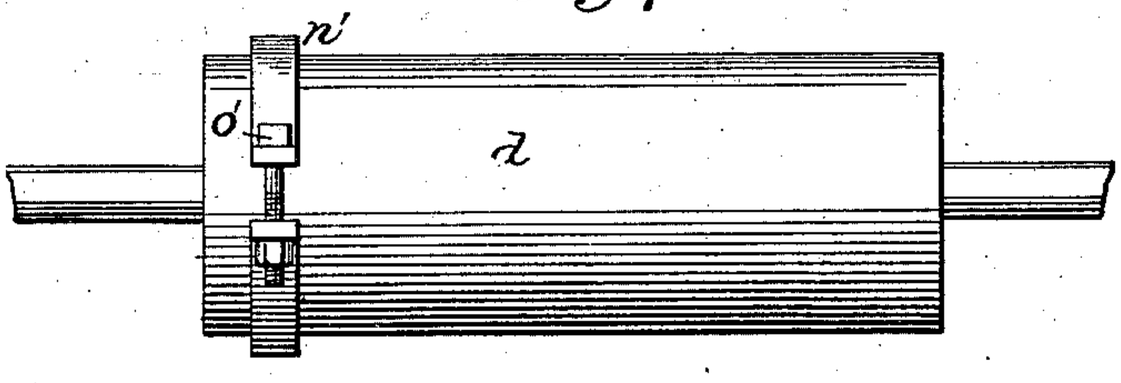
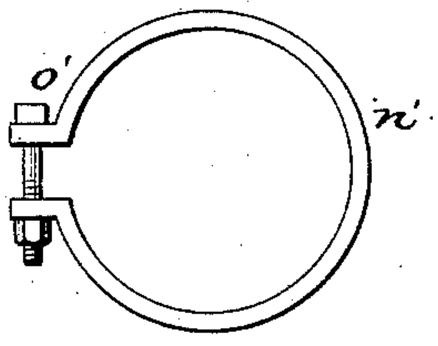


Fig. 8.



Attest

Sidney P. Hollingsworth

Newton Wyckoff.

Inventor.

J. W. Osborne

By his Atty.

Philip T. Dodge.

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J. W. OSBORNE.

METHOD OF AND MEANS FOR TRANSFERRING DESIGNS.

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Fig. 11.

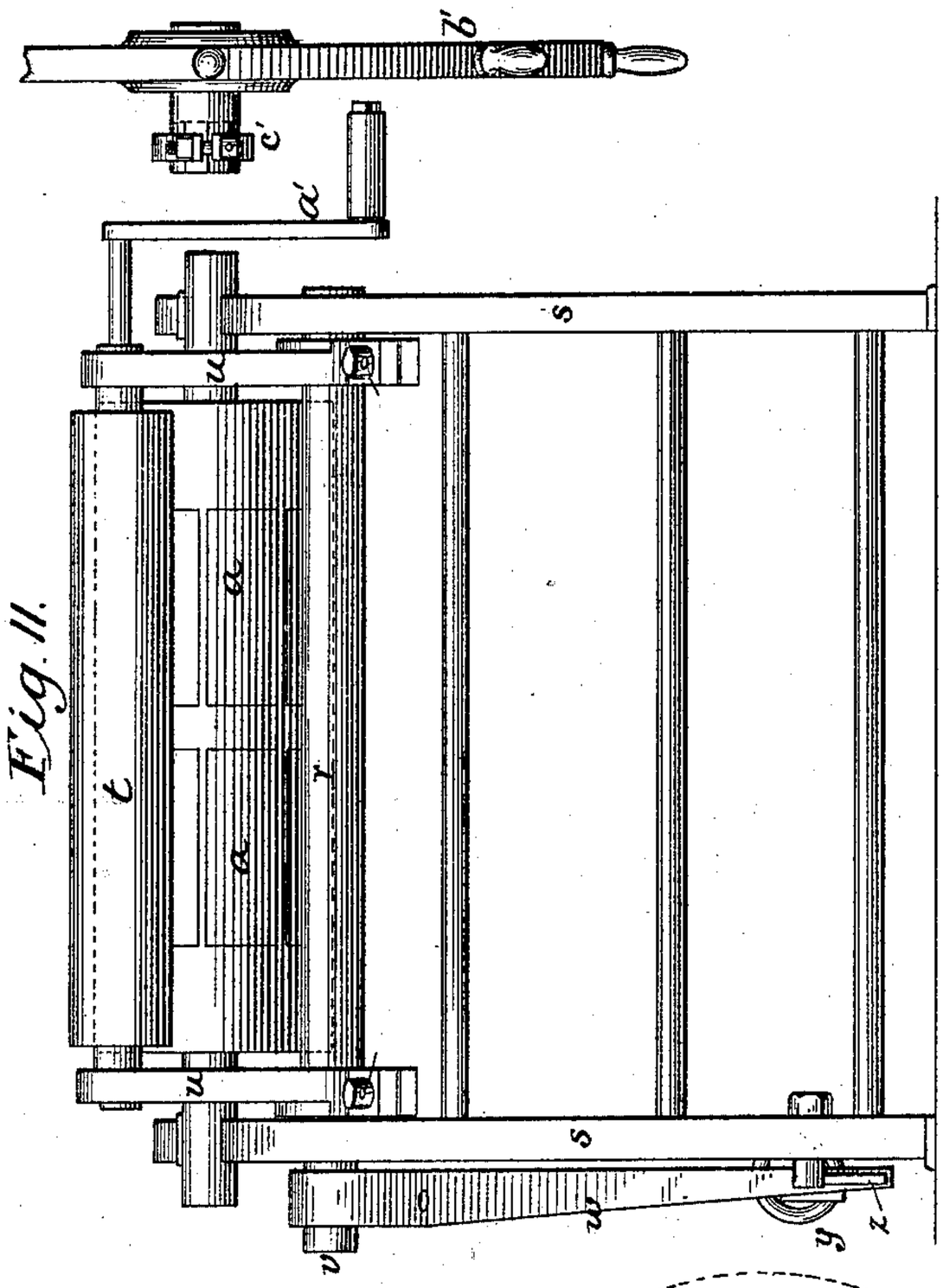

Fig. 12

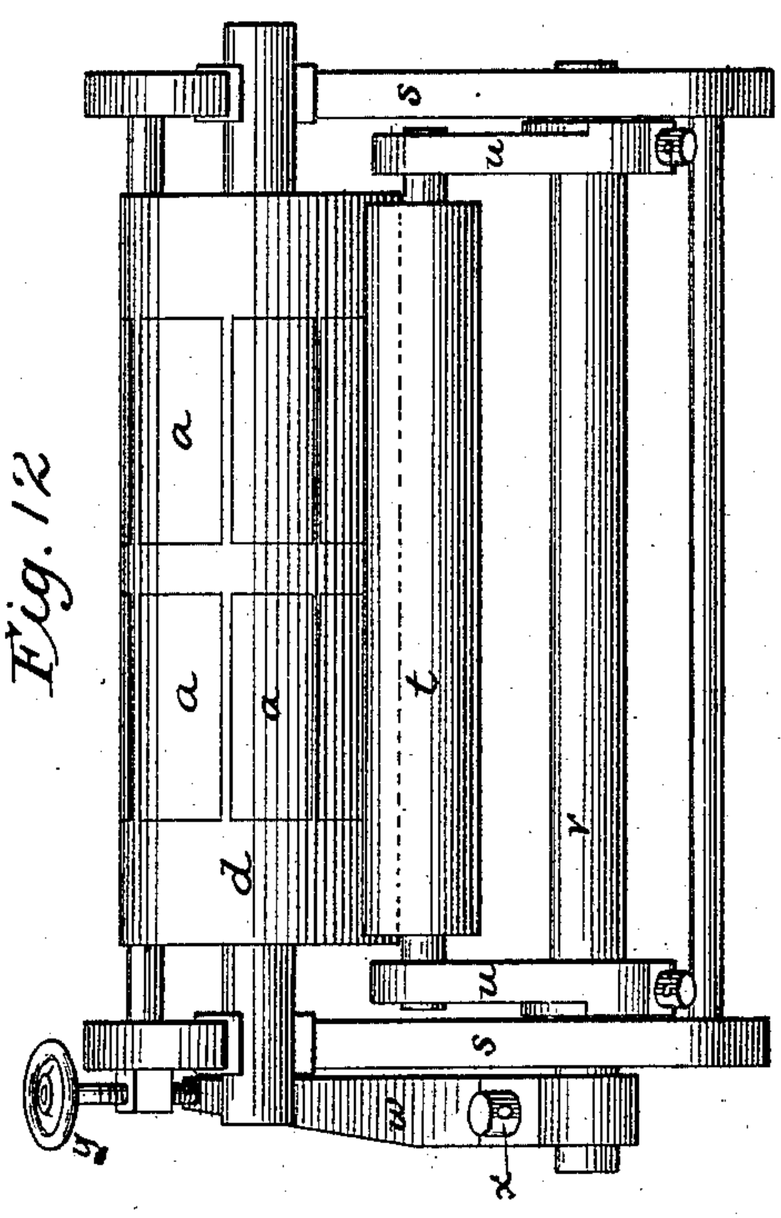

Fig. 10

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Sidney P. Hollingsworth

Newton Wyckoff.

Inventor.

J. W. Osborne.

By his Atty.

Philip T. Dodge.

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J. W. OSBORNE.

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Fig. 13.

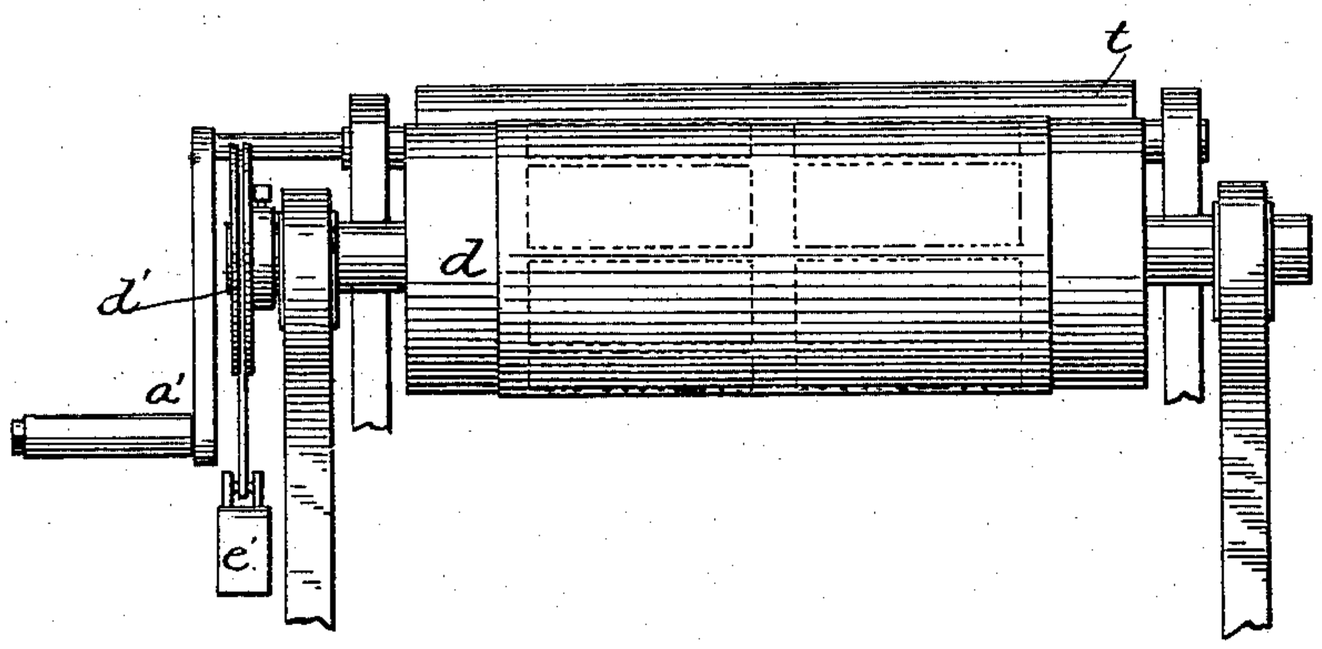
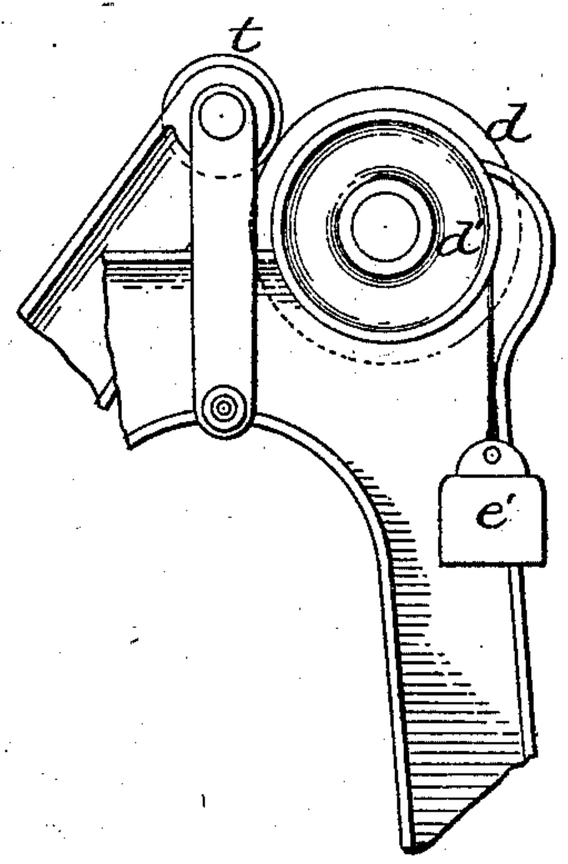


Fig. 14



Attest.

Sidney P. Hollingsworth

Newton Wyckoff.

Inventor.

John W. Osborne.

By his Attorney.

Philip T. Dodge.

UNITED STATES PATENT OFFICE.

JOHN W. OSBORNE, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO WILLIAM H. FORBES, OF BOSTON, MASSACHUSETTS.

METHOD OF AND MEANS FOR TRANSFERRING DESIGNS.

SPECIFICATION forming part of Letters Patent No. 282,111, dated July 31, 1883.

Application filed June 24, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. OSBORNE, of Washington, District of Columbia, have invented certain Improvements in Methods of and Apparatus for Transferring Designs, of which the following is a specification.

This invention has reference to the transferring of designs drawn or impressed on paper to solid curved surfaces for printing, ornamental, or other purposes. It is especially connected with the art of lithographic transferring, and with that of preparing cylindrical forms and rolls for calico and other printing.

The object of my invention is to effect the transfer of a design, in suitable ink, to a cylindrical or similarly-curved surface, so that every part of the design may occupy a definite and previously-determinable relation to a line, real or imaginary, upon the surface of said cylinder, parallel to its axis and to the circumference of a circle coincident with the cylindrical surface, and at right angles to the axis of the same. The object is, further, to accomplish this result with certainty and precision every time that such transfer is made.

In lithography, when a transfer is made to a flat stone or flat zinc plate, good results are obtainable without serious difficulty, and when such transfers are made to two or more printing-surfaces, each of which has afterward to print in its special color its independent design in register upon the same sheet, and which must therefore be relatively in correct position, the methods now practiced, with the exercise of judgment and care, will insure success. This is not the case, however, when the attempt is made to apply the same methods of transfer to solid zinc cylinders intended for printing, or to copper cylinders for the printing of textile fabrics. It is true that the design may be transferred to such surfaces—that is, it may be made to go over and attach itself thereto; but to make it do this thoroughly and precisely in the place where it is required is a matter of the greatest difficulty, which, as an accomplished practical fact, I have never seen or heard of from others, and which a wide practical experience justifies me in believing has never been done. When in the practice of lithography, which art involves transferring in its highest development, a design is carried by the application of pressure from the surface of paper to that of a flat stone, from which impressions are afterward to be printed, it is not necessary that the position of the design shall bear any exact relation to the edges of the printing-surface; nor is this necessary even when a number of designs are transferred each to its own stone, all to be afterward printed in register on the same sheet. The printer is in these cases indifferent as to the exact position of the general work, provided every part of it with respect to the other parts is correctly located, because in the press each stone admits of being moved in all directions before it is printed from, and the printer proceeds with this work only after the requisite adjustments have been made according to the necessity indicated by a greater or less number of trial impressions.

It will be seen, without lengthy explanation, that analogous adjustments are not feasible when the design is on a solid cylinder, that if, for example, the general direction of the length of the design is in a spiral direction around the cylinder, corresponding to a diagonal position on a flat stone, no feasible adjustment applied to the cylinder can make the direction of the design coincident with the cylinder's rotation.

In the process of transferring to a flat stone, the sheet bearing one or more designs, commonly denominated the "transfer-sheet," is properly damped and inverted on the stone as the latter lies in the press. The transfer-sheet is then backed with dry paper, the tympan closed over it, and the pressure, usually exerted by a narrow projecting edge of wood called a "scraper," is then brought down upon and across one end of the sheet, and from that position is caused successively to traverse its entire length. During this operation care is taken that the sheet is free to move upon the stone—that is, to stretch and yield under the dragging pressure to which it is subjected.

It will be readily seen that this treatment applied in the case of a transfer to a cylinder would rarely lead to successful results, so far as the accurate location of each part of the

work is concerned, and cannot be relied on. Everything would depend upon starting absolutely right—a difficulty which does not exist in flat transferring—because the slightest swerving of the sheet to the right or left, due to a bad start, or to an excess of pressure at one end of the cylinder, or to unequal damping, or to all these causes combined, would produce an irreparable imperfection. Moreover, it is often very desirable for printing and other purposes to cause a transfer design to encircle a cylinder in such manner that the design shall be continuous thereon, without beginning or end. The accomplishment of this by the ordinary methods—that is, by applying a dragging stretching pressure to one end of the damped transfer-sheet, so as to stick it fast, and then letting this same pressure traverse the whole, thereby causing the last work attached, which ends the sheet, to meet that which begins it—is possible only by accident. This is so because the number of factors effecting such a result are not only very numerous, but also of a most uncertain character.

The foregoing sketch makes reference only to the most obvious difficulties which attend the problem of transferring to cylindrical surfaces, and is presented to give a clear insight into the object and scope of the manipulations which follow.

As will be hereinafter explained, my method of transferring may be carried out by various appliances differing in construction, and is not dependent upon the specific apparatus hereinafter described, although its use is preferred.

When a transfer to a cylinder by the method I have invented is desired, the surface of the cylinder is turned off perfectly true and the length of its periphery made precisely equal to that of the work which is to go upon it, with the end margins added, if such there be. When a number of such transfers are required for chromatic printing or other purposes, all the cylinders employed are made identical in these respects. A sheet of paper of good quality is next prepared of an exactly true rectangular shape, the width being made sufficient to receive the work which is to be placed upon it, and the length such that when the sheet is damped to the extent requisite for successful transferring and then caused to encircle the cylinder its ends will meet edge to edge. With this degree of dampness practical transferrers are quite familiar. Upon this sheet the several pieces of transfer-paper, if there be more than one, with the designs, commonly denominated the "work," upon them, are disposed so that the spaces and margins are conveniently and rightly placed, and are made fast by touches of paste, as is done in the preparation of transfer-sheets for flat transferring; but the preparation of the transfer-sheet for the purpose which I have in view differs from that ordinarily practiced, in that the position of the work and every part of it is made to maintain its relation to the sharply-cut edges of the rectangular sheet to which the several pieces are attached with the same precision that the several parts maintain their relation to each other. To accomplish this with the extreme accuracy required, mechanical means other than the rule and compass are desirable, (although such tools can be made to answer the purpose with the expenditure of much time and labor,) and this is especially the case when, for chromatic printing, several transfers have to be made to different cylinders, impressions from which must subsequently register.

Referring to the accompanying drawings, Figure 1 is a face view of the transfer-sheet with the smaller sheets or design-impressions secured thereon. Fig. 2 is a face view of the templet. Fig. 3 is a face view of the printing-cylinder having the transfer-sheet disposed and secured thereon. Fig. 4 is a section on the line *x x*, Fig. 3. Figs. 5 and 6 are respectively a side and an end elevation of the cylinder, showing the transfer-sheet secured thereon by means of the radially-acting clamp. Fig. 7 is a side elevation of the printing-cylinder having the removable guide or ring thereon to secure the adjustment of the metallic plate. Fig. 8 is a view of said ring detached. Fig. 9 is a cross-section of the cylinder, showing the mode of applying the metallic plate thereto. Fig. 10 is an end elevation of the transfer-press. Fig. 11 is a front elevation of the same with the hand-wheel detached. Fig. 12 is a top plan view of the same. Figs. 13 and 14 are respectively a front and an end elevation of the transfer-press provided with the pulley and weight to overcome its inertia. Fig. 15 is a front elevation, illustrating the impression-cylinder and the printing-cylinder with the transfer-sheet and the removable bearers or supports for the impression-cylinder.

Fig. 1 illustrates a transfer-sheet, in which *a* represents the several small sheets or impressions or pieces of work, which are attached to the main sheet *b*, and which may be repetitions of the same design, or may differ from each other in size and in general outline. These may be made by the hand of an artist or draftsman, but in the great majority of cases will be impressions carefully printed with ink of the proper kind on paper prepared for the purpose, as usual, by giving it a starchy or gelatinous surface, which becomes adhesive when dampened. I shall refer hereinafter to these as "transfer-impressions."

There are various ways in which the sheet *b* may be accurately cut and marked; but I prefer, as one of the simplest, the use of the templet shown in Fig. 2. This consists of a sheet of thin metal made perfectly rectangular, and of such length in relation to the circumference of the cylinder with which it is associated that a sheet of dry paper cut to an

equal length with the plate will, when damped and expanded for transferring, have a length equal to the circumference of the cylinder. In other words, the length of the templet is to be such that it will produce a transfer-sheet which will, when damped, exactly encircle the cylinder. This length will be fixed by determining experimentally how much space is to be allowed in each case for the expansion of the paper. Through the templet needle-holes *c* are bored, at places accurately determined, to correspond with the position it is wished to give the "register-marks" on each impression. The register-marks on the pieces *a* are indicated (in an assumed position, for they may be anywhere) by the small crosses in Fig. 1. They are on the original printing-surface, and are printed with the rest of the design, so that their position in reference thereto is invariable.

The sheet of paper *b*, before being cut, is laid dry upon a flat surface. The templet is then placed upon it and carefully held down. The paper is then cut around the edge of the plate, and before either is moved the paper is pricked through the needle-holes *c*. The sheet is then ready, and the transfer-impressions are put in place and attached by passing two needles through the register-marks in each and through the corresponding pricked holes in the large sheet, and thus holding each of the pieces *a* until the spots of paste are applied. The transfer-sheet so prepared is next evenly damped in the manner well known to printers—namely, by placing it between sheets of damp paper. I prefer to carry this damping further than is necessary or desirable for good transferring, the effect and object of which are to cause the sheet to become longer than the circumference of the cylinder *d*. This cylinder has scratched upon its surface a very fine line precisely parallel with its axis, (preferably applied when the cylinder is in the lathe,) which, for convenience, I shall call a "meridional line," and which is shown at *j*, Fig. 3. The damped transfer-sheet is next caused to encircle the cylinder *d*, so that its two ends meet edge to edge and corner to corner, and join exactly over this line, the sides of the sheet being at the same time properly spaced from the ends of the cylinder. The ends of the sheet having been accurately brought together, as described, (which operation is much facilitated by the extra length of the paper,) a narrow strip of adhesive paper, *e*, is laid upon them, so as to quickly unite the two, as in Figs. 3 and 4. If the ends of this strip are permitted to extend beyond the sides of the sheet, they may be used to hold the line of junction over the meridional line by pasting them firmly to the surface of the cylinder, as shown in Fig. 3; or the line of junction may be held in place by any simple clamp acting radially—such, for example, as that represented in Figs. 5 and 6, to be hereinafter described. If the adjusting of the edges, as described, is quickly and dexterously done, the sheet will hang somewhat loosely upon the cylinder, and the latter, (the journals of which will be supported the while in suitable bearings—such, for example, as those represented in Figs. 10, 11, 12, to be hereinafter described) may be slowly revolved, so as to equalize the evaporation from the paper. As this proceeds the sheet contracts, and very soon the diminished size will cause it to embrace the cylinder tightly. Beyond this the contraction must not be allowed to go, and to check it further evaporation from the paper must be stopped, which can be done in several ways hereinafter described.

It will be seen that at this stage we have a transfer-sheet, as shown in Figs. 3 and 4, the two ends of which coincide with a true meridian and the two sides of which lie in planes of circles at right angles to the axis of the cylinder, all parts of the transfer-sheet being in contact with the face of the cylinder held by a gentle contractile force, and the work upon it occupying definite and previously-determined positions. It will also be seen that this same condition of things can be duplicated with precision upon any required number of similar cylinders at will.

The results attained by the manipulations which have just been detailed may also be obtained in kind, if not in quality, by certain equivalent modifications, which I will now describe, but which I do not recommend, as I believe them to be inferior to the method already set forth.

The rectangular sheet *b*, instead of being cut shorter than the circumference of the cylinder *d*, may be cut longer, so that when the paper is sufficiently damped and then put round the cylinder it will lap upon itself at the ends, which lap can then be pasted down and the contraction allowed to proceed as before; but to insure the correct size and position of the work, one end of the transfer-sheet having been made coincident with the scratched meridional line on the cylinder, the other lapping edge has to be made coincident with a pencil-line accurately drawn on the back of the sheet. The pencil-line in this case cannot be drawn when the templet is in position for cutting the paper, and the position of any line drawn by pencil or pen is much less certain than one scratched with a point; hence the method is not as reliable as that just described. In this second case, too, the two edges of the paper have to be separately adjusted up to the independent lines, whereas in the first described method both edges are brought to the same line and against each other, and when united can be finally adjusted in position and there held.

In the description above given I have stated that the transfer-sheet should be somewhat over-damped before it is applied to the cylinder, the object being to give time for uniting and adjusting the edges before any strain

comes upon them, and to facilitate the uniform contraction of the sheet as a whole after the true position of the line of junction has been fixed. The same ends may be reached by surrounding the cylinder with the transfer-sheet before it is damped or after partial damping, and holding it in an approximately correct position in any convenient way, as by very thin and feeble elastic rings, and then completing the damping and consequent expansion of the sheet without removing it from the cylinder. This can be done by surrounding it with damp paper or cloth, or by placing about the cylinder a vessel or box in which a damp atmosphere is maintained. When the paper has then expanded sufficiently to bring the end edges together on the meridional line, they are united as before, and the damping devices finally removed. There is in theory no objection to this modification, except, perhaps, the danger of the transfer-impressions attaching themselves prematurely; but in practice it will be found less convenient and simple, even though the danger named were completely guarded against.

I also adopt the following method of disposing the transfer-impressions correctly about the cylinder *d* with reference to the datum-lines on its face actually drawn or conceived to be drawn:

A sheet of thin metal is cut into a perfectly rectangular form, of width suitable for the transfer-impressions which are to be distributed upon it, and of length exactly equal to the circumference of the cylinder *d*. The metal used must be quite pliant, either by reason of its thinness or the softness of its composition—as, for instance, thin zinc, copper, or brass, or thicker sheets of the alloys containing lead or tin, &c. This sheet of metal is designed to take the place of the rectangular sheet of paper *b;* but as it can be used repeatedly on cylinders of the same size, and is not injured in the use, it is not requisite to provide a templet by which to cut it, and to indicate the position of the register-marks upon it. But other mechanical means and tools (well known to workers in metals) can be used to give such a sheet exact form and size and to determine the places with which the register-marks on the impression-sheets should coincide. These places may be simply marks scratched upon the surface of the metal; but I prefer to bore or prick them through, giving rise to a number of needle-holes similar to those used in the construction of the templet, already described, and shown in Fig. 2. It will be seen that this sheet of metal resembles in plan said templet very closely, save that its size is such that it exactly fills the cylinder when wrapped around it, and the drawing shown in Fig. 2 is an equally correct representation of the sheet now under consideration, the difference in length being totally inappreciable.

In carrying out this modification of my invention, I next prepare some adhesive material in a peculiar way—viz., by coating very thin paper on both sides with a hot solution consisting of glue or glycerine, which gelatinizes and stiffens when cold, but which will melt again when heated to a very moderate temperature—say, 120° Fahrenheit. This is best done by cutting thin paper into narrow strips, and, after dipping the same in the solution aforesaid, hanging them up to drain. I now place the sheet of metal on a flat table, and then, as before described, I perforate carefully the register-marks on the transfer-impressions with two fine needles and enter the same into the corresponding holes in the metallic sheet, whereby each transfer-sheet can be let fall precisely in its proper place, and can be held there by the needles till fastened. The fastening in this case is done by the adhesive paper, two or more small pieces of which, like wafers, are slipped under each transfer-impression at suitable places. By simply pressing heavily over these wafers quite sufficient adhesion is obtained to fasten the same to the paper and to the metal, and the adhesive material should therefore be placed where the absence of work upon the face of the transfer-impression admits of the application of the necessary pressure. The transfer-sheet so constructed is now ready for the cylinder, except that the transfer-impressions, if not made damp enough before they were laid down and attached, must have damp paper placed upon them to bring them to the right condition. The better way, however, is to lay out the metal sheet to receive the transfer-impressions damp, and to keep them in that condition with damp paper as they are laid down and attached until ready for transfer. A transfer-sheet of this description, if the metal used is very thin and pliable, may be laid about a cylinder in the way already described and recommended where paper alone is used—that is, one of the straight parallel edges may be laid exactly upon a meridian and the other edge brought up and united with it by pasting paper over both; but it will be seen that to make any change or correction in the adjustment of the sheet after close contact has taken place is difficult, and in most cases impossible, and that the necessity for any correction (which, it is true, would always be small, but at the same time very important) could only become apparent after the edges had met, because, unlike the paper transfer-sheet, the metal cannot be elongated, the edges then united, and the gradual contraction taken advantage of for adjustment and for the spontaneous and automatic localization of each part of the work and its final close embrace of the cylinder without irregular strain or slip.

The accurate setting of one edge of the transfer-sheet to the meridional line may be much facilitated by first laying a steel straight-edge very carefully on the same, and then by the

use of the clamp hereinafter described, and shown in Figs. 5 and 6, holding it fast. The edge of the transfer-sheet is now made to butt against the straight-edge, and when that is done the clamp is disengaged and again screwed down upon said edge, so as to hold the sheet fast while the other edge is brought round. The objection to this method in most cases is substantially the same as before—namely, that the slightest error in the position of the straight-edge is much exaggerated when the end of the sheet gets round, and, although it is sometimes very serviceable, (when the width of the sheet is very much greater than its length,) still I prefer to get the metallic transfer-sheet round the cylinder in a way which does not involve the accurate setting of one end on the meridional line by the eye, while it virtually accomplishes it in an equally efficient manner.

Fig. 7 shows in elevation and in place on the cylinder the device employed for this purpose, and Fig. 8 shows the same in plan unattached. This consists of a ring of soft metal, *n'*, such as lead or an alloy of lead and tin sufficiently soft to bend to the form of the cylinder (if cast fully large for the same) by the force exerted by the screw *o*. When the cylinder is in the lathe, this ring is put on and tightened up, and the face at *n'* is turned off radially down to the cylinder-surface, in the place where it is wished that one of the side edges of the transfer-sheet shall go. By the plane so determined the transfer-sheet is applied as follows, (see Fig. 9:) The metal sheet is bent round the cylinder approximately to the cylindrical form. Two or more belts, preferably of rubber, *q'*, are then made to encircle the sheet and cross over the opening between the approaching edges. The side of the sheet nearest to the soft-metal flange *n'* is then brought in contact with the same all round, and that part of the transfer-sheet which is diametrically opposed to the approaching edges at *r'* is next brought into contact with the face of the cylinder, (the position shown in Fig. 9,) and, without allowing it again to move from that position or the side edge to leave the soft-metal surface, the joining edges are closed by pulling on the rubber bands *q'*. In Fig. 9 the position of the transfer-sheet and of the rubber bands is shown just before closing the edges of the former. This operation, which is not difficult, renders quite certain the true position of the work upon the cylinder, and the edges at the line of junction may be united by pasting paper over them with a suitable cement, as before explained. It will be found, however, that it is impossible to bring the parallel metallic edges completely into actual contact, due to the fact that the thickness of the paper used for the transfer-impressions virtually increases the diameter of the cylinder which the metal has to cover. The exceedingly small space thus left is desirable, because, in whatever way pressure is afterward applied to the transfer-sheet, all danger of interference therewith by reason of the incompressibility of the metal sheet is removed, of which the workman could not feel certain if the edges of the sheet come into actual contact.

It is obvious that the method just described may be also used for the application of a transfer-sheet consisting wholly of paper, if the same be not too soft and yielding at its edge.

After the application of pressure, as herein set forth, and the perfect adhesion of the moist starchy surface of the transfer-impressions has been effected, the metallic sheet may be removed without disturbing the latter by dividing the strong paper connecting the edges and applying heat in any convenient way to the metal, beginning at one end of the sheet and proceeding on a meridional line progressively over the whole. The effect of the heat is to instantly liquefy the adhesive material holding the transfer-impressions to the sheet, when the elasticity of the latter lifts it at once and before any appreciable heat has been communicated to the paper under it. The heat in this operation is best applied from a gas-burner consisting of a perforated tube the whole length of the sheet.

It will be seen that waxy and resinous compounds might be used in place of the glue and glycerine to hold the transfer-impressions on the metallic sheet in the first instance, as far as the disengagement of said sheet is concerned; but such are unfavorable when the transfer-impressions have to be subsequently damped upon the back, which is commonly done.

The soft-metal guide can now be removed and the further treatment of the transfer-sheets on the cylinder proceeded with exactly as when the transfer-sheet consisted of paper alone.

Having secured the accurate application of the transfer-sheet to the cylinder by either modification of the process above described, the next step is to apply pressure to the surface in a manner which will not disturb what has been done, so as to cause the necessary adhesion and perform the function of the scraper pressure in the ordinary lithographic transfer-press. This I accomplish by applying local rolling-pressure successively over the whole surface in a transfer-press especially adapted and designed for the purpose. Such a press is shown in Figs. 10, 11, and 12. In these drawings the cylinder is shown in position resting on half-bearings in the side framing, *s*, where it is easily placed. The impression-cylinder *t*, covered with rubber blanket ground to a true surface, or with some equivalent therefor, is carried by the arms *u*, clamped to the heavy cross-shaft *v*, which also has bearings in the frame *s*.

It will be seen that the manner in which the impression-cylinder is connected with the shaft *v* admits of the very accurate adjustment of said cylinder with reference to the cylinder *d*, which bears the transfers, so as to make the surfaces of both exactly parallel.

The pressure exerted by the impression-cyl-

inder *t* is controlled and graduated through the intervention of the lever *w*, which is clamped on the cross-shaft *v*. This lever consists of a bar of steel, which embraces the shaft, but which can be released or tightened upon it at any time by means of the bolt *x*. The position of the lower end of the bar is governed by the hand-wheel and screw at *y* and by the stiff spring *z*. This spring is sufficiently strong to hold the lower extremity of the lever *w* at all times in contact with the end of the screw *y*. When, therefore, said screw is depressed by turning the hand-wheel forward, the force so exerted is communicated through the bar *w* and the shaft *v*, on which it is clamped, to the impression-cylinder *t*, which is thereby made to bear with greater force on the surface the cylinder *d*. If the screw at *y* be relaxed by turning it backward, the opposite effect will be produced, and the spring *z* will finally lift the impression-cylinder off the cylinder *d*, leaving the latter free to revolve independently of the impression-cylinder, which is frequently an important advantage. This construction facilitates a nice adjustment of the pressure applied by the impression-cylinder, and it also gives to that pressure an elastic character, the quality and range of which depend upon the length, thickness, and form of the steel bar *w*. When a cylinder such as *d* is to be placed in this press, it is lifted high enough to place its axles on the upper horizontal edges of the side framing, *s*, near its bearings, into which it is then rolled. But to do this it is necessary to get the impression-cylinder out of the way, which is accomplished by slacking the tap-bolt *x* and then bringing the impression-cylinder with its arms over till they hang downward from the shaft *v*. The construction of this press, and especially the provision for clamping and freeing the lever *w* on the shaft *v*, enables it to deal with transfer-bearing cylinders which vary considerably in diameter without affecting or interfering with the devices for applying any of the adjustments or making necessary any change of a substantial kind.

To apply local pressure successively to the surface of a cylinder in a transfer-press such as I have described, it is generally sufficient to attach a movable winch-handle, *a'*, to the axis of the impression-cylinder in any convenient way, (as by boring out one end of the latter and fixing it therein by a pin or feather,) and then causing the impression-cylinder to revolve in contact with the cylinder bearing the transfer. This it will drive without difficulty by reason of the frictional hold taken by the rubber blanket on its surface.

Gearing can of course be used to connect both cylinders, and in the case of very large and heavy form-cylinders, where much inertia and friction have to be overcome, its use may be desirable; but my experience convinces me that it can be discarded in most cases with positive advantage; and although it is more convenient, as a general rule, to apply the necessary force to the impression-cylinder, and by it to drive the other, still it is in certain cases advantageous to turn the latter directly, which is best done by means of the movable star-wheel *b'*, (shown in Figs. 10 and 11,) whereby a very steady motion may be obtained. To attach this the winch-handle *a'* must be removed and the clutch *c'* of the star-wheel tightened upon the end of the cylinder-shaft.

This transfer-press offers every opportunity for damping and redamping the transfer-impressions after the removal of the sheet on which they were distributed, either with the sponge or by passing damp sheets between the two cylinders, as well as for gradually increasing the pressure till all the ink has gone over solidly.

After the complete transfer of the ink has been accomplished by the method just detailed, the paper on which the work was printed or otherwise delineated is now to be soaked off, and the ink rolled up in the manner practiced by transferrers. After this the cylinder may be further treated in accordance with the nature of the work required of it, precisely as a transfer to a flat surface would be treated for similar purposes.

As the application and manipulations of the transfer-sheet upon the cylinder *d*, hereinbefore described, were accomplished while the latter was supported in its bearings in a transfer-press constructed substantially as set forth, the position of said cylinder is favorable for the immediate application of the pressure requisite to complete the work upon it. If the rectangular sheet consists of strong paper, which may be safely allowed to contract until it has seized the cylinder with considerable force, whereby the friction between the transfer-sheet as a whole and the surface of the cylinder is made very considerable, and a slip or shift or the onward creeping of the sheet as a result of advancing local pressure well guarded against, the workman may begin forthwith to turn the impression-cylinder slowly and to bring it down very gradually by setting forward the screw *y*, using much care and helping forward the cylinder *d* with his hand sufficiently to overcome its inertia; or a temporary removable pulley, *d'*, with cord and weight *e'*, attached to the shaft of the cylinder *d*, as shown in Figs. 13 and 14, may be used to accomplish the same result—that is to say, to so balance the inertia and friction of the cylinder *d* as to make the least possible demand upon the driving capacity of the impression-cylinder *t*, and reserve as its only function the application of a gradually-increasing pressure. These precautions are necessary, because, as will be seen, the impression-cylinder comes at the beginning in contact with the paper, and the driving force of the impression-cylinder *t*, which is a tangential force, is exerted thereupon and has to be resisted by the grasp which the transfer-sheet takes upon the surface of *d*; but the danger of slip or of a forward creep of the transfer-sheet is greatest at the start, and lessens rapidly as the pressure increases, and

it ceases altogether as soon as the starchy surface of the transfer-impressions has stuck fast to the cylinder, which takes place long before the ink goes over. It is therefore advisable at the start to make use of a clamp to hold the transfer-sheet behind the impression-cylinder, and thereby hinder in the first instance any movement of the paper. The construction of such a clamp is shown in Figs. 5 and 6. This consists of the two collars f'', upon which can be adjusted at pleasure the sliding bars g', which carry between them the clamping-bar h'.

The collars f' have set-screws i', by means of which they can be firmly fixed upon the cylinder-shaft in any desired position, but always so that the slides thereon (made to receive the bars g') are parallel. The sliding bars g' are provided with clasping-springs k', which bear strongly upon the outer surfaces of the collars when said bars are forced into place, and which, by the pressure they exert, give rise to friction sufficient to restrain the weight of the clamp above the face of the cylinder, while at the same time they do not prevent its instant removal when it is wanted out of the way. The clamping-bar h' has in its lower face an undercut groove, into which a strip of vulcanized rubber of suitable length is forced, but allowed to project, as shown in the figures.

When pressure is required along a meridional line on any part of the cylinder-face, so as to hold the transfer-sheet, the screws l', which butt against the collars f', are turned forward, thereby causing the bars g' to slide upon the ways made for them on the sides of the collars, and the rubber strip is, in consequence of their movement, pressed forcibly down upon the cylinder, the rubber giving a desirable elastic pressure.

With such a clamp the transfer-sheet can be held so as to prevent the possibility of a slip when pressure is first applied by the impression-cylinder; but when such a device is employed I prefer to apply the driving force directly to the cylinder by means of the star-wheel b', so that the pull on the paper may be from the clamp, and let the impression-cylinder be driven thereby. If necessary, the friction of the latter can be overcome by a weight in the manner shown in Figs. 13 and 14; but other precautions and manipulations may also be used to facilitate the first application of pressure to the transfer-sheet, which will greatly diminish the risk of the movement and the necessity for excessive care. These I now proceed to describe.

On the bare part of the cylinder d, (see Fig. 15,) outside the transfer-sheet and at each side of it, a long strip of thin paper of fine quality is tightly wound, filling the blank space upon the cylinder, and forming by repeated folds a thickness not less than that of the transfer-sheet, after which the end of each strip is fastened by a touch of paste. These strips must be of equal length. Such coils of paper m' form bearers, on which the impression-cylinder rests in the first instance, and by friction against which the impression-cylinder drives the cylinder which carries the transfer-sheet. The paper forming these bearers may be applied while the transfer-sheet is shrinking, if the workman is expert; but it is better to do so before the transfer-sheet is placed around the cylinder. When the transfer-sheet has contracted sufficiently and has clasped the cylinder tightly, the impression-cylinder is let down upon the bearers. These prevent it pressing upon the transfer-sheet at all, or let it do so very slightly. In the latter case, which is the condition of things aimed at, after a revolution or two of the larger cylinder, an equal amount of the strips of paper on both sides is torn off, whereby the bearers are made thinner, and the impression-cylinder is again made to traverse the surface with heavy pressure. Then another portion is torn from each bearer, and so on, rapidly dropping the impression-cylinder more and more upon the transfer-sheet, until the transferrer feels certain that the adhesive surface of the transfer-impression has attached itself firmly to the face of the cylinder. The bearers may then be entirely removed and the pressure continued without them on the transfer-impressions themselves, after removing the rectangular sheet above them, and after damping said transfer-impressions on the back by a sponge, or by the intervention of damped sheets passed between the cylinders, or by both methods, as practiced by transferrers.

It is evident that very thin metal bands or other pliant material can be used as well as paper to furnish the temporary bearers just described. These, as well as paper strips when they are used, should be wound up on the cylinder in such a direction that the frictional contact of the impression-cylinder shall tend to wind them up more tightly. Nor is it indispensable in reducing the thickness of the bearers that pieces should be torn off at intervals, for they may be simply allowed to unwind themselves from the start, in consequence of which the impression-cylinder will approach the cylinder d continuously, said approach amounting for each revolution of the latter to the thickness of the paper or metal band employed.

By such means and by the gradual increase of pressure, the ink is made to let go the paper and to go over solidly to the surface of the cylinder, after which the paper may be soaked off and the transferred work upon the cylinder rolled up, etched, or otherwise treated, according to the judgment and requirements of the workman.

In describing my method of bringing the ink upon the transfer-sheet into contact with the cylindrical surface by permitting the same to contract thereon, I have heretofore described the sheet in each instance as completely

encircling the cylinder. It should be understood, however, that the same method may be applied although the sheet may be of a length insufficient to encircle the cylinder, provided the ends of the sheet, previous to contraction, are secured against movement circumferentially upon the cylinder. They may be thus secured by means of a clamp or clamps such as hereinbefore described, or by any equivalent means.

Having thus described my invention, what I claim is—

1. In the art of transferring, the method of placing, adjusting, and holding a transfer-sheet upon a cylindrical surface, which consists in first making said sheet accurately rectangular, then placing and attaching upon the same the transfer impression or impressions with reference to two intersecting edges of the sheet, then expanding said sheet by damping, then placing the same upon the cylinder and causing its two opposing edges to meet throughout their length upon a line parallel to the axle of said cylinder and securing said edges together, and finally allowing said transfer-sheet to contract by evaporation of water used to damp it, whereby it clasps and holds the cylinder tightly, substantially as described.

2. In the art of producing printing forms on cylinders for printing in register, the method of transferring to such cylinders, which consists in first preparing a rectangular transfer-sheet bearing designs in transferable ink upon its surface, said designs being located with reference to two intersecting edges of the sheet, then covering the cylinder with said transfer-sheet, so that the opposite edges meet upon a line parallel to the axis of said cylinder, then securing said edges together and causing the transfer-sheet to tightly clasp the cylinder, and then transferring the design by suitable radial pressure applied successively to all parts of the sheet, substantially as described.

3. In the art of transferring, the method of accurately carrying over to a definite position on the surface of a cylinder a design or designs on paper in transferable ink, which consists in placing a sheet having two of its edges at right angles and bearing said design or designs, arranged with reference to said edges about and in contact with the cylindrical surface, and disposing it thereon with reference to a circle and a straight line on said surface, then holding the sheet fast against lateral movement, and finally applying pressure to the same to force the ink into intimate contact with the cylindrical surface, substantially as described.

4. In the art of transferring, the method of folding a transfer-sheet upon a cylinder preparatory to the application of pressure thereto, which consists in first expanding said sheet by moisture to a length greater than the circumference of the cylinder, then placing it about the same and uniting its meeting edges, and then contracting said sheet till it shrinks to the length of the circumference and clasps the cylinder tightly by causing the moisture it contains to evaporate, substantially as described.

5. In the art of transferring, the method of bringing the ink upon transfer-impressions into contact with a cylindrical surface preparatory to its transfer thereto, consisting in applying said impressions to a paper sheet, expanding said sheet by damping it, passing it around a cylinder, uniting its ends, and finally permitting said sheet to contract by evaporation of the water used to damp it until it closely embraces the cylinder, substantially as described.

6. In the art of transferring, the method of placing one or more transfer-impressions in correct position on a cylindrical surface, which consists in first making a sheet of pliant material accurately rectangular, then placing the transfer impression or impressions thereon and attaching them thereto with reference to two intersecting edges of said sheet, then bending said sheet around and in convenient proximity to the cylindrical surface and placing every part of one of its side edges so bent in a plane at right angles to the cylinder-surface, then bringing every part of the face of the sheet bearing the transfer-impression into contact with the surface of the cylinder, and maintaining at the same time the coincidence of the bent edge with the plane aforesaid, substantially as described.

7. In the art of transferring, the method of bringing the ink upon a transfer-sheet into contact with a cylindrical surface preparatory to its transfer thereto, consisting in expanding the sheet and securing its ends against circumferential movement upon said surface, and finally contracting the sheet until it closely embraces the surface, substantially as described.

8. A transfer-sheet consisting of a rectangular sheet of pliant material having needle-holes therein, and one or more transfer-impressions provided with register-marks and located upon and attached to the sheet, with said register-marks in coincidence with the needle-holes.

9. As a means of transferring designs to cylindrical surfaces, a cylinder combined with a transfer-sheet bearing the design and encircling the cylinder, with its two ends connected, substantially as described.

10. As a means of transferring designs to cylindrical surfaces, a transfer-sheet, *b*, bearing the design applied around the cylinder, and a strip, *e*, applied to unite and secure the ends of the sheet, substantially as shown.

11. As a means of applying designs in predeterminate positions to cylindrical surfaces, the combination, with the cylinder adapted to receive a transfer, of a removable ring around the same, and a transfer-sheet bearing the design, seated upon the surface of the cylinder and against the ring, as set forth.

12. The combination, substantially as de-

scribed, of a cylinder adapted to receive a transfer, a transfer-sheet bearing the design applied to said cylinder, and a clamping-bar with means for adjusting the same to a meridional line on said cylinder and applying a varying pressure, as set forth.

13. A clamp for holding a transfer-sheet upon a cylindrical surface, consisting of the collars, the sliding bars, and the pressure-bar, carrying the yielding strip, and controlled in its position by the pressure-screws.

14. In a transfer-press, the combination of the rock-shaft, the impression-cylinder, the cylinder-supporting arms attached to said rock-shaft, and an operating-lever combined with adjusting devices, and secured to the rock-shaft by means, substantially as described, adapted to permit said lever to be readily secured to or released from the shaft at will, whereby the attendant is permitted to throw the impression-cylinder away from an operative position.

15. In a transfer-press, the combination of the impression-cylinder, its sustaining-arms, the rock-shaft, the elastic lever on said shaft, and the adjusting-screw and spring operating in connection with the lever, as shown.

16. In combination with the impression-cylinder, its sustaining-arms, and the rock-shaft, the operating-lever secured to the rock-shaft by means, substantially as described, adapted to permit the adjustment and release of the lever at will, as described.

17. The method of applying a gradually-increasing pressure to a sheet disposed on a cylindrical surface, consisting in winding upon and around the ends of the same paper or equivalent ribbon to form bearers or supports for an impression-roll, and then gradually removing said paper, and thereby lowering the impression-roll toward the cylindrical surface.

18. In combination with a cylinder adapted to receive a transfer-impression, an impression-cylinder, and bearers or supports for the latter wound detachably upon the ends of the first-named cylinder.

19. In combination with an impression-cylinder and a cylinder adapted to receive a transfer-impression, pulleys and weights applied to the latter, substantially as and for the purpose described.

JOHN W. OSBORNE.

Witnesses:
PHILIP T. DODGE,
NEWTON WYCKOFF.