

No. 608,706.

Patented Aug. 9, 1898.

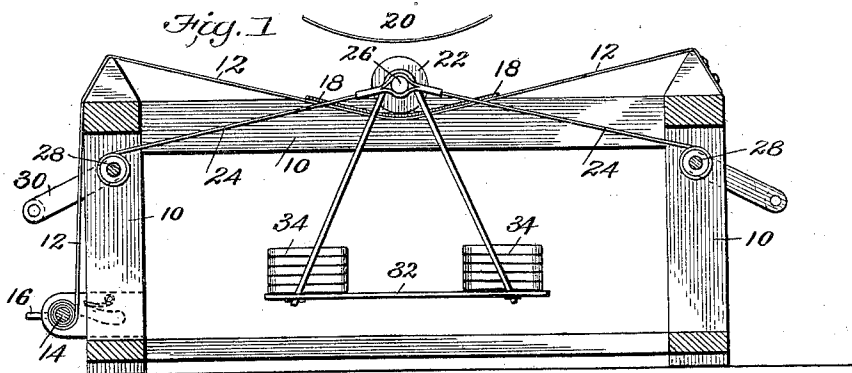
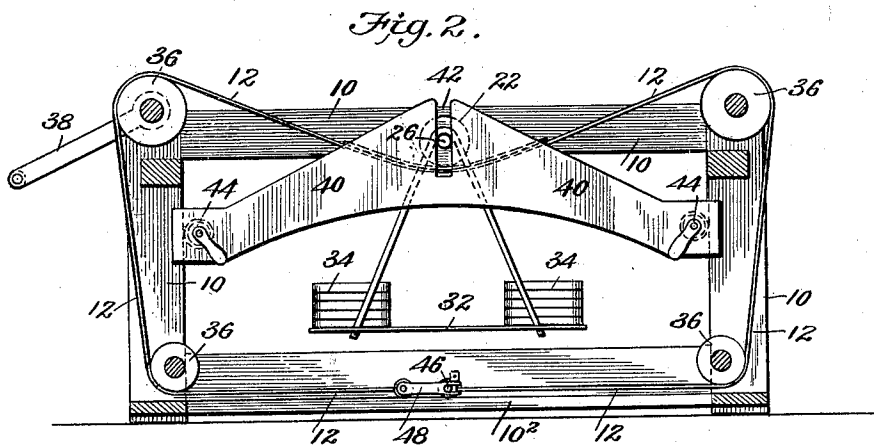
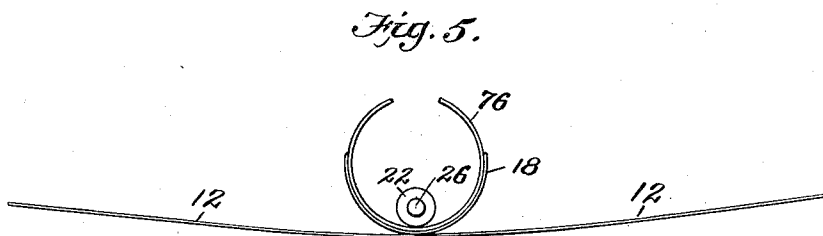
J. W. OSBORNE.

APPARATUS FOR BENDING FORM PLATES FOR PRINTING.

(Application filed Mar. 19, 1897.)

(No Model.)

3 Sheets—Sheet 1.



WITNESSES:
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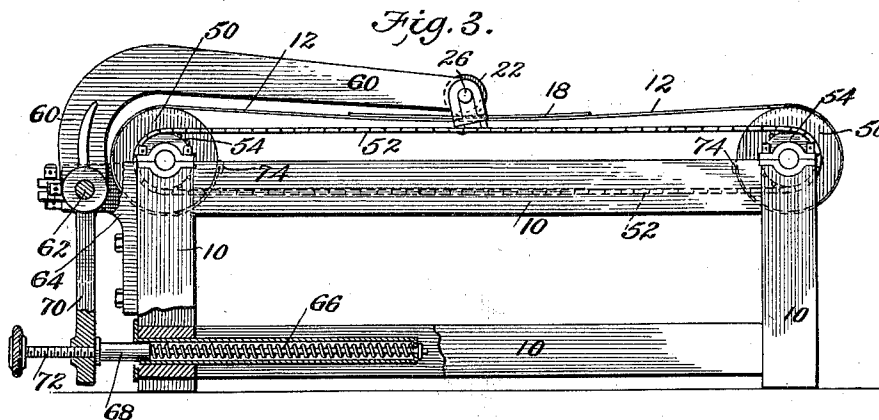
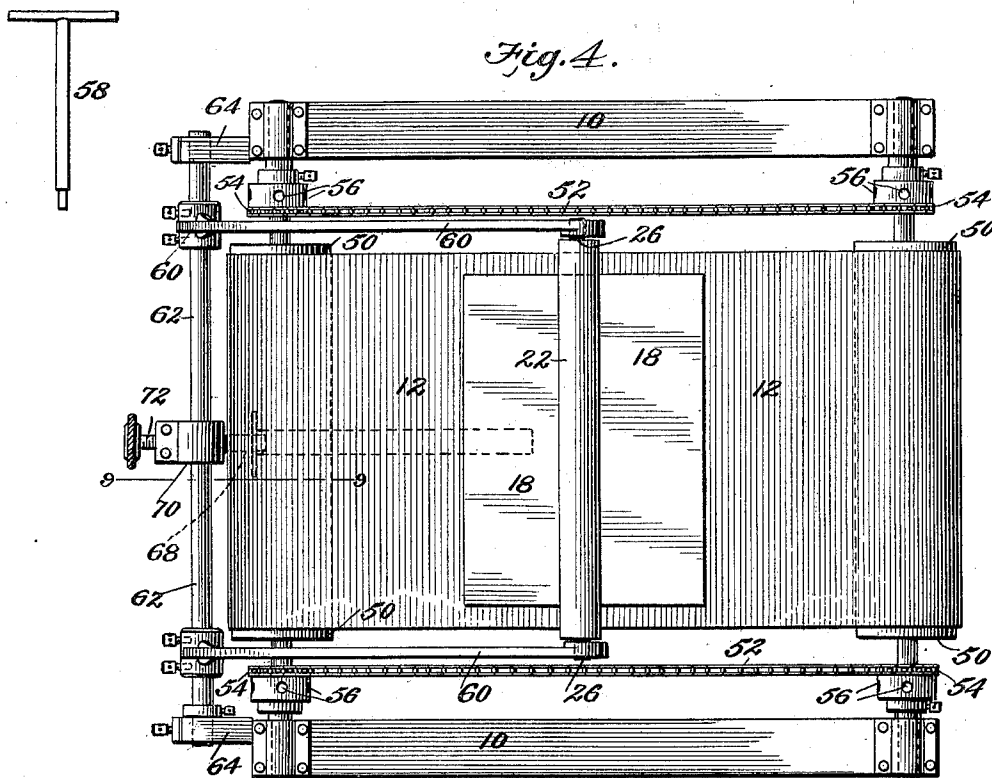
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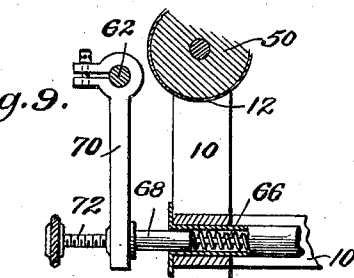
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3 Sheets—Sheet 2.



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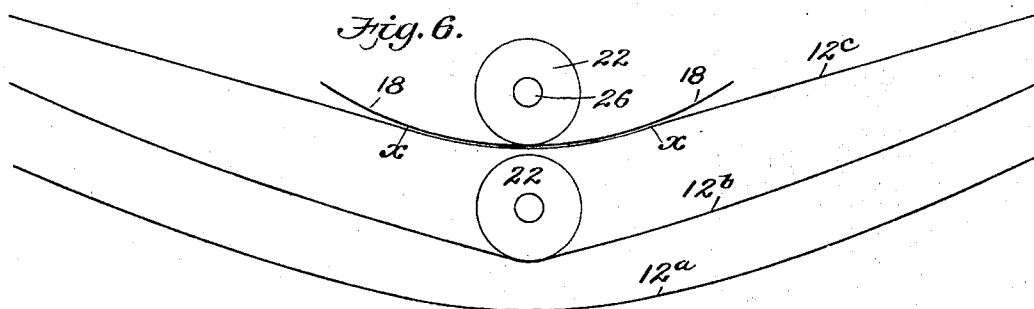
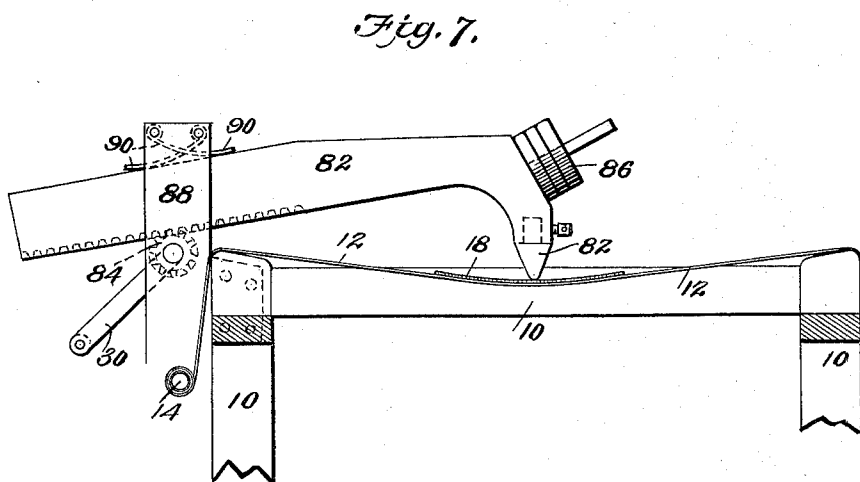
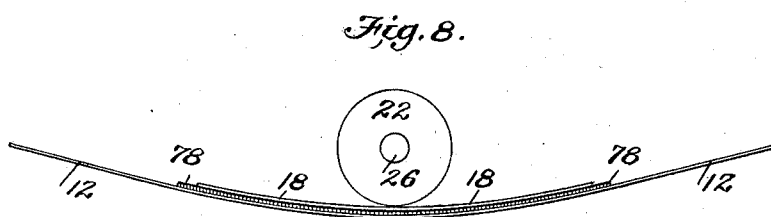
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(No Model.)

3 Sheets—Sheet 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR BENDING FORM-PLATES FOR PRINTING.

SPECIFICATION forming part of Letters Patent No. 608,706, dated August 9, 1898.

Application filed March 19, 1897. Serial No. 628,332. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. OSBORNE, a subject of the Queen of Great Britain, and a resident of San José, in the county of Santa Clara and State of California, have invented a new Apparatus for Bending Form-Plates for Printing Purposes, of which the following is a specification.

The object of this invention is to bend a metallic plate bearing a printable design in such a way as to make it conform to the curved surface on which it is to rest in the printing-machine.

My invention is designed more especially for zinc plates etched into relief and is very serviceable in the making ready of multicolor-presses provided with one or more cylindrical form-cylinders.

In the method usually practiced for the bending of form-plates to cylinder-curves several difficulties are met with. When the plates consist of electrotype-shells backed with soft metal or when they are cast in stereotype-metal, these difficulties are less than when zinc is the material employed, and especially when that metal is etched or cut away unequally in accordance with the design thereon. Zinc is a rigid and harsh metal, apt to yield unequally and suddenly. It is used for printing purposes of considerable thickness—that is, of one-eighth inch, or thereabout—and the form-plates made of it have often many square feet of surface. Such a plate when covered with fine and delicate work unequally distributed and etched into high relief is bent with much difficulty into the true cylindrical curve necessary. Ordinarily for this purpose it is laid upon the form-support in the press that is destined to carry it, and after being roughly forced into approximate coincidence by hand it is held there and rolled down from the face by the impression-cylinder itself. It is difficult by this process to get the plate to coincide with the support throughout its entire surface, because the flexure imparted must always be less in degree than that required, a very heavy pressure being necessary to accomplish even that approximation, so that pressure so applied has to be supplemented by tangential strains in opposite directions applied to the ends of the plate by devices adapted therefor. These

difficulties are in great part caused by a peculiar short-lived elasticity characteristic of zinc-plate and also by the great variation in its thickness according to the nature of the design upon the different parts of it, in consequence of which the metal yields to a lesser force at one place than at another and is liable to kink if carelessly handled or sufficient time be not given for the formation of the desired curve. I reduce to a minimum these and other difficulties by applying the depressing or flexing force to the back of the form-plate in such a way as to traverse the same while the face is constantly sustained and the plate carried by a support possessed of flexibility and some elasticity, (largely under control,) so that the same may bend with the plate and offer resistance that enables it to hinder any sudden or local yielding to the depressing or flexing force, which is made to act against successive parts of the back on lines parallel to the axis of the curve, said web also reacting elastically against the depressor employed.

In the drawings which are part of this specification, Figure 1 shows in elevation (part of the frame removed) a plate-bending machine with distended web and depressing-cylinder. Fig. 2 is a similar machine provided with an endless web. Fig. 3 represents in elevation from the side a machine possessed of special devices for facilitating the perfect bending of form-plates of widely-differing curvatures. Fig. 4 shows the same in plan. Fig. 5 is an elevation from the side of an interposed shell between the depressing-cylinder and the plate. Fig. 6 illustrates the action of the depressing-cylinder. Fig. 7 shows the action of a depressing force applied without a cylinder. Fig. 8 is a partial sectional view of a catenary web with a form-plate and interposed elastic sheet. Fig. 9 is a broken detail of mechanism from Fig. 3.

In Fig. 1 my invention is shown in its simplest form. It consists of a strong frame 10, (one side of the same being removed in the drawings,) over which a web 12 is distended, one end being fast to the frame and the other to a reel at 14, which can be locked by the pawl 16, whereby the strain put upon the web is determined and maintained. This web should be horizontal and tightly stretched at first. It should be made of heavy sail-

cloth, or of cotton belting, or of rubber belting, or of thin sheet metal, or of any flexible material strong enough to carry the plates for which the machine is intended and to withstand the strain, as hereinafter described.

The plate 18 to be bent—for example, to the cylindrical curve shown at 20—is placed face down about the middle of the web, and across it is laid the depressing or flexing cylinder 22. The weight of this cylinder is usually enough to cause the web to sag appreciably, and if while exerting that downward force it is made to traverse the back of the zinc the same will be gradually bent to an even and continuous curve. This reciprocation is accomplished by means of four cords or belts 24, (two only being shown in Fig. 1,) which grasp the projecting ends of the axis 26 of the flexing-cylinder 22, extending in pairs from the two reels on the shafts 28, which are turned by the winch-handles 30. By using these alternately the cylinder 22 rolls in either direction and can easily be made to traverse the whole plate. When a certain amount of curvature has been obtained, it can be increased slowly by continuing the reciprocation, or more rapidly by either of two changes—namely, by increasing the weight of the depressing-cylinder or by increasing the sag of the flexible web. The latter is done by releasing and unwinding more or less the reel 14, the effect of which is to give rise to a change in the position of those parts of the web that support the plate, practically increasing the concavity into which the plate may be said to subside under the influence of the depressing force from above. That force may also be increased by suspending by rods the tray 32 from the cylinder ends and loading it with the weights 34 until the plate is sufficiently bent.

In Fig. 2 a modification is shown of importance. In this case the web 12 is endless, and it runs over rollers 36. It hangs in the usual catenary curve between the upper two, and the form-plate when laid upon it is made to travel under the depressing-cylinder 22 by moving backward and forward the winch-handle 38, the cylinder being held stationary by the side pieces 40, provided with the long slot 42 and the clamping-screws 44. The ends of the web in this case are united below by means of a clamping-bar 46, and this bar when rolled upon itself carries the ends with it and shortens the whole web. The short clamping-lever 48, with an antifricition-roller at its end, rests and rolls on the frame-piece 10², which holds the clamp in an obvious way.

In Figs. 3 and 4 a very convenient arrangement of parts is shown in side elevation and plan. In this bending-machine the web is lapped about two large rollers 50 and made fast thereto, covering about three-quarters of their surface. The rollers are connected by the chains 52, in gear with the sprocket-wheels 54 on the large-roller axes. These wheels are

held by set-screws and are made wide enough to admit of a number of holes 56, which fit the shank of a movable key, (marked 58,) whereby the two rollers may be partially rotated to and fro at the same time. When a change in the sag of the web is desirable, all that is necessary is to free two of the sprocket-wheels on the same roller-axle and then unroll or roll up, as the case may be, the web on one of the large rollers, or on both should it be necessary. Whatever adjustment of this sort may be made, when the sprockets are again screwed fast the sag of the web will remain constant and the two rollers 50 will move in the same direction and to the same extent, according as the lever 58 makes them oscillate, and the plate 18 upon the web will also travel to and fro under the depressing-cylinder 22, which is held in the bearings at the ends of the arms 60. These arms are fixed upon the short stiff shaft 62, which lies in bearings in the brackets 64. In this machine the requisite increase of pressure exerted by the cylinder 22 upon the back of a plate, irrespective of its position at the time—that is, whether on a slack or tight web—is effected by a long powerful spring 66, compressed at all times. (See the sectional part of Fig. 3.) The shouldered rod which passes through this spring has a projecting end 68, which is forced out continually toward the position shown, and the storage of force so obtained is used to virtually increase the weight of the depressing-cylinder in whatever position it may be. This is done by clamping the adjustable arm 70 fast on the shaft 62, its screw 72 being in contact with the rod 68. Then in proportion as said screw is advanced the reaction through the adjustable arm 70 and the stiff shaft 62 tends to press down the arms 60 and the cylinder 22, which they carry, whereby the traversing pressure on the back of the plate 18 is increased until the screw 72 is exhausted, after which the latter may be retracted, the rod 68 let go forward, another grip on the shaft 62 may be taken, and the rod be again forced back by 72. This machine possesses many advantages. When in use, the web, fast to each of the large rollers 50 at 74, is usually strained tight at first. Upon this the zinc form-plate, etched into relief for printing, is laid face down under the depressing-cylinder 22, which may be lifted entirely off the web, if that is desirable, with the help of the adjustable arm 70, clamped horizontally to act as a hand-lever. The depressing-cylinder in Figs. 3 and 4 is easily taken from its bearings in the side arms 60, as shown in the drawings, such provision being made to admit of cylinders of different diameters being employed, for upon their size depends, in part at least, the diameter of the curve to which the plate can be bent and the rapidity with which the bending may be accomplished, as also the evenness and regularity of the curved surface after treatment in the machine. Except in certain cases to

be specified presently a depressing-cylinder is always of a very much smaller radius than that of the bent plate.

In Fig. 6 three related diagrams are shown in juxtaposition which illustrate the process of bending. The line marked 12^a represents the flexible web hanging in the catenary curve which it would take naturally when slack to the extent shown. In 12^b the same web is shown loaded by the depressing-cylinder 22, in which case the web forms two catenary curves, each of a little less than half the length of the first and much flatter, each running tangentially into the other through the short circular segment that coincides with that part of 22 in contact with the web. When in the case of the web 12^c the zinc plate 18 is interposed and drawn many times to and fro under a depressing-cylinder of the same weight as the preceding, then the plate will bend and take a curved form like that shown, and into this the two short catenary curves formed by the web will run tangentially, as they did into the curve of the depressing-cylinder; but the included segment of the plate will be a much larger one than in the former case, and a point will be reached at last beyond which the plate will not bend, due to its rigid resistance to the depressing force and to the general support given it by the strained web underneath. Starting with a flat plate, it may be said that as it bends and the radius of the curve gets smaller the distance between the lines of separation from the web, from x to x in Fig. 6, (the plate being long enough to show such lines,) becomes shorter, till at last the depressing-cylinder cannot overcome the stiffness of the included piece and that of the web also, and the result is a state of equilibrium depending on the relation of several factors. If, for instance, after such equalization the web be lengthened, or the weight of the cylinder increased, or its diameter decreased, and if the rolling to and fro be then continued, it will be found that the flexure of the plate will begin again at once and continue in any one of the three cases till a similar state of equilibrium is again established. It follows, in consequence, that the convexity of the curvature given the plate or of any cross-strip of it (inasmuch as it may be locally rolled) is perfectly under control, and as all the factors affecting it can be increased or decreased in the manner shown by small increments at a time the increase in the flexure of a plate may be made as gradual as the workman thinks necessary to avoid false bends or kinks, which are well guarded against, besides, by reason of the perfect and uniform support furnished by the strained web. In practice it is best not to continue the traversing of a plate till the curve resulting from a certain set of conditions is fully reached, because toward the end of any such bending the progress made is very slow. It is better to stop well short of such a point

and then by continuing to roll those places that are still too flat (usually the ends of the plate) to secure for the whole a uniform curvature. In giving to a plate the requisite form a templet may be used, cut to the proper sweep, or preferably to a circle of diameter a little less than that of the form-cylinder, so that when the plate is taken from the bending-machine and placed upon its support in the press its ends shall spring tightly against the latter and every part of its back, being bent to a slightly-quicker curve than that of the form-support in the press, shall clasp and hug the same when the plate is pressed or drawn down upon it. All that the impression-cylinder has then to do is to cause a slight flattening of the plate's curvature by the application of a single depressing pressure that is always central between supporting ends and not applied to the extremities of a curve rocking on a convex surface under it, as takes place ordinarily when the rolling down is done in the press.

I avail myself of the foregoing principle by the use of a shell 78, encircling the depressing-cylinder, to give finally to the back of the plate that identity with the form-support in the press that it ought to have. This shell is made with a gap large enough to let the small depressing-cylinder pass through it, to the end that it may be easily put in position for the completion of the work without removing the depressing-cylinder. The shell for this purpose is of the desired diameter, its face representing, in fact, the face of the form-support. When the shell rests upon the plate and is heavily pressed against it, resting on a tightly-strained web, the plate can then by the reaction of the web against the face of the plate be rolled into perfect contact with the shell—that is, the elasticity which the zinc possesses will yield, and a perfect coincidence of the surfaces in contact will be the result, as in Fig. 5. When the shell is used to accomplish the final bending of the plate, the packing on the impression-cylinder is thereby saved from injury, and fine isolated details (when present) upon the form-plate likewise. To secure the latter object with greater certainty, a sheet of soft rubber or felt 78 may be interposed between the face of the plate and the web, as in Fig. 8. The crushing force on the face of delicate relief-work is very much reduced by this device, because the rubber extends to the bottom of the blanks etched from the front of the plate, and as it cannot escape laterally the pressure necessary to bend the plate is in large part borne by such blanks. This advantage is also gained, but in a much lesser degree, when the bending-machine is provided with a soft flexible web of some thickness.

It will be seen that in this specification, while I speak of my invention as a "catenary" plate-bending machine, using that term as conveniently descriptive, the bending act

may be theoretically regarded as effected by the gradual pressing of a cylindrical projection over the plate into a cylindrical though more or less yielding seat in the pliant web beneath it and that it is this yieldingness that insures (in part at least) a sufficient time or interval for the zinc to bend in, and therefore takes from the imperative character of the operation, which in that regard contrasts with other plate-bending methods. The success which attends this process is largely due to the abundance of time that is inevitably allowed for the molecular changes in the metal to take place. All metals require time for a change of form, but in the case of zinc the necessity is much greater than in that of most others in common use, a fact that is possibly due to its very low tensile strength and want of ductility at ordinary temperatures. However that may be, the plate is hindered by the manner of its treatment from suddenly giving way to the bending force, the increments of which decrease spontaneously in effectiveness, while the several factors remain constant, and more and more time is required for the completion of the work. It will be seen that this method of fitting the form-plates for the particular press in which they are to print is so gradual and so thoroughly under control and so open to scrutiny that great accuracy may be easily and surely attained, and also that an error in the nature of overbending, if it should occur, can always be definitely corrected by the substitution of a larger depressing-cylinder and flatter web without subjecting the plate in doing so to sudden or local strains of any kind, and although I have described the application of pressure in my bending-machine as made with the help of a depressing-cylinder it is not the only way in which the desired end can be reached, as will be seen by an examination of Fig. 7, in which 80 represents a depressor of hard wood similar to the scraper used in lithographic hand-presses, attached to the arm 82, which, with its rack meshing into the pinion indicated at 84, can be made to reciprocate over the plate and impart thereto a sliding instead of a rolling pressure adjustable as to force by movable weights at 86. The arm 82 passes through the flat jaws 88, which act as guides therefor, and the indicated springs at 90 hold it down on the pinion 84.

In this specification the expression "length of the plate," &c., is meant to define that one of its dimensions which is parallel to the length of the web at the time of bending and which subsequently at the time of printing is parallel to the direction of the run of the press.

Having thus described my invention and the best methods known to me for carrying out the same, I wish it understood that I do not confine myself to the specific means shown and described herein, for it is evident that other devices might be employed for the working out of my bending method and apparatus

therefor without departing from the principle underlying the same.

What I claim is—

1. In a form-plate-bending machine, a web of flexible material supported at the ends and adapted to carry a form-plate face down, in combination with a depressor crossing the web and adapted to lie upon and successively depress lines across the back of the interposed plate; substantially as described.

2. In a form-plate-bending machine, a web of flexible material supported by adjustable straining apparatus at the ends and adapted to receive and carry the plate face down; in combination with a depressor crossing the web and adapted to lie upon and successively depress the metal along lines of contact at the back of the interposed plate; substantially as described.

3. In a form-plate-bending machine, a web of flexible material supported at the ends to receive and carry the plate face down; in combination with a depressor of adjustable weight crossing the web and adapted to lie upon and successively depress the interposed plate along the shifting line of contact; substantially as described.

4. In a catenary plate-bending machine, a rotary depressing-cylinder, to flex the plate from the back or smooth side, with means for increasing the weight of said cylinder; in combination with an adjustable catenary web held in apposition to the depressing-cylinder and adapted to support and press the plate continuously against the same; substantially as described.

5. In a form-plate-bending machine, a web of flexible material supported only at the ends so as to be capable of flexure in numerous curving lines, in combination with a depressing-cylinder crossing said web, so as to rest on the back of a plate supported by said web, and means for rolling the cylinder back and forth in the direction of the length of the web, whereby the plate may be gradually curved, substantially as described.

6. In a catenary plate-bending machine, a rotary depressing-cylinder of adjustable weight adapted to force and flex the plate from the back; in combination with a hollow shell of larger diameter encircling the depressing-cylinder and in contact with its lower surface; and an adjustable catenary web held in apposition to the depressing-cylinder and adapted to support the plate continuously and elastically against the same and the interposed shell; substantially as described.

7. In a catenary plate-bending machine, a pair of parallel rollers in the same horizontal plane running in bearings and separated from each other by a distance in excess of the length of the plate to be bent; in combination with a web of flexible material passing over the rollers and sagging between them to a curve which is flatter than that to which the plate is to be bent, a depressing-cylinder of diameter less than that of the curve the plate is to

receive, and with means for rolling the depressing-cylinder to and fro over the plate; substantially as described.

8. In a catenary plate-bending machine, a pair of parallel rollers running in bearings in the same horizontal plane and separated from each other by a distance exceeding the length of the plate to be bent; in combination with a web of flexible material passing over and around each roller and fastened thereto; with means for rotating the rollers simultaneously and each equally in the same direction to and fro; and with a depressing-cylinder placed appositely and rotating upon an axis across the web and having an upward and downward movement; whereby the depressing-cylinder can follow the web and plate at all times; substantially as described.

9. In a catenary plate-bending machine, a pair of parallel rollers of a diameter equal to about the length of the largest plate to be bent, running in bearings in the same horizontal plane and separated from each other by a distance exceeding the length of the plate; in combination with a web of flexible material passing over and around each roller and fastened thereto; with means for clamping each roller relatively to the other in any angular position, thereby adjusting the sag of the web between them; with chain or other gearing for rotating the rollers simultaneously and each equally in the same direction to and fro, and with a depressing-cylinder appositely placed above and across the web and adapted to traverse the back of the plate lying thereon; substantially as described.

10. In a catenary plate-bending machine, a pair of parallel rollers of a diameter equal to

about the length of the largest plate to be bent, running in bearings in the same horizontal plane and separated from each other by a distance exceeding the length of the plate; in combination with a web of flexible material passing over and around each roller and fastened thereto; with means for clamping each roller relatively to the other in any angular position, thereby adjusting the sag of the belt between them; with chain or other gearing for rotating the rollers simultaneously and each equally in the same direction to and fro; with a depressing-cylinder appositely placed above and across the web, to traverse the back of the reciprocating plate; and with a compressed spring to operate said cylinder downward; substantially as described.

11. Means for gradually curving printing-plates consisting of a suspended flexible yielding support for the face of such form-plate, and a relatively-movable yielding presser by which lines of pressure may be applied to the back of such form-plate, substantially as described.

12. Means for gradually curving printing-plates consisting of a yielding support suspended at its ends, on which the plate may rest, and a yielding presser traveling back and forth over the plate, whereby the plate and support may yield in movable lines under the presser, in combination substantially as described.

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Witnesses:

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