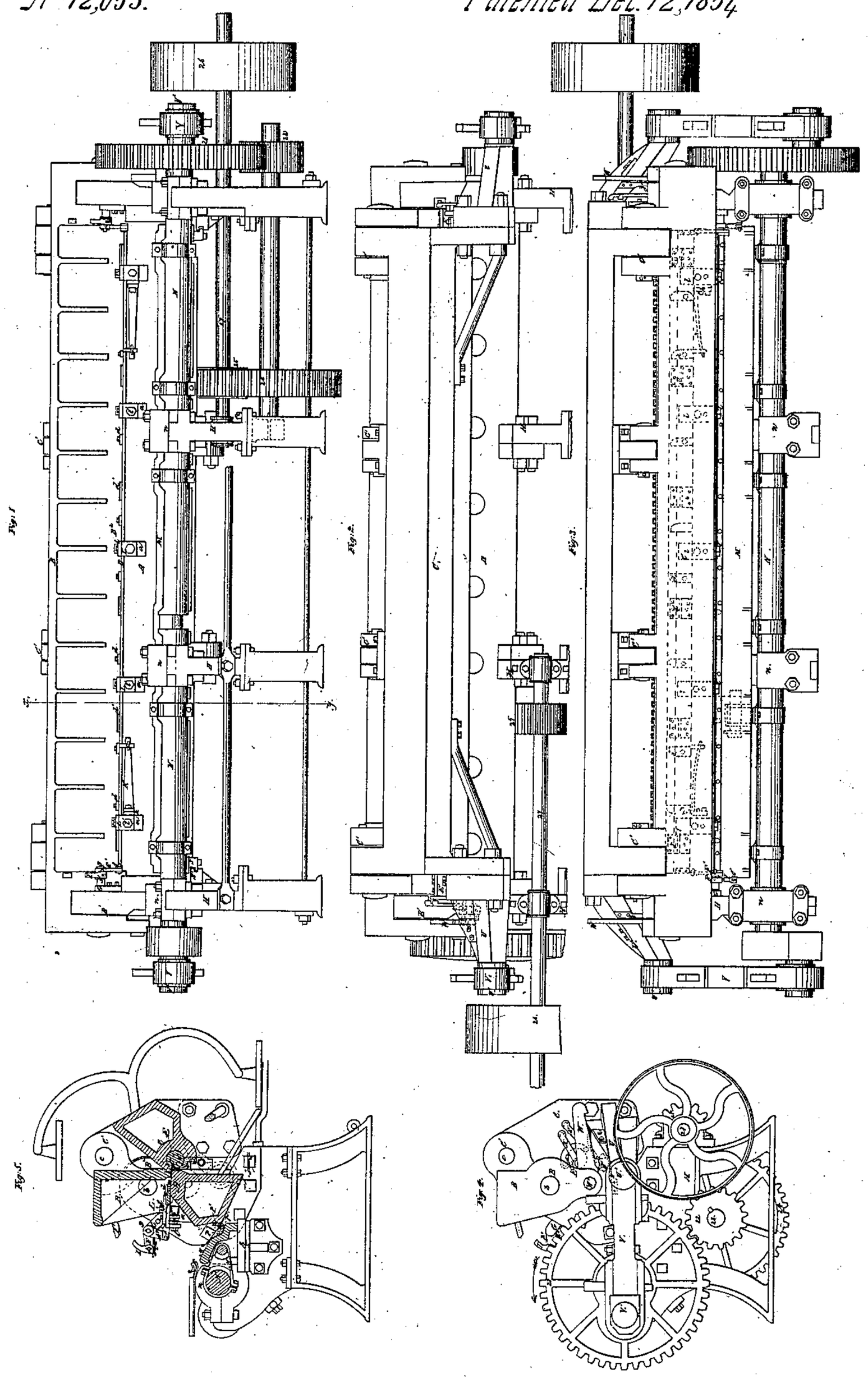
2 Sheets, Sheet 1.

W. W. Cumberland,

Edging Sheet-Metal.

No. 12,053. Patented Dec. 12, 1854.



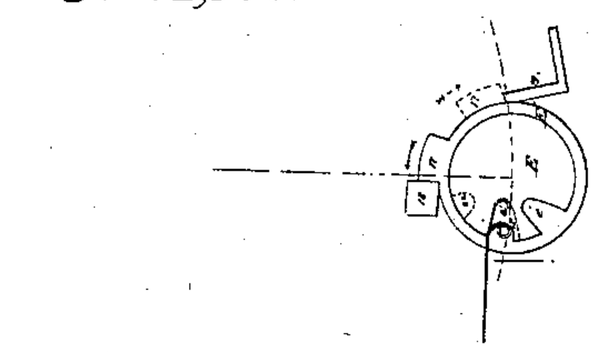
N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

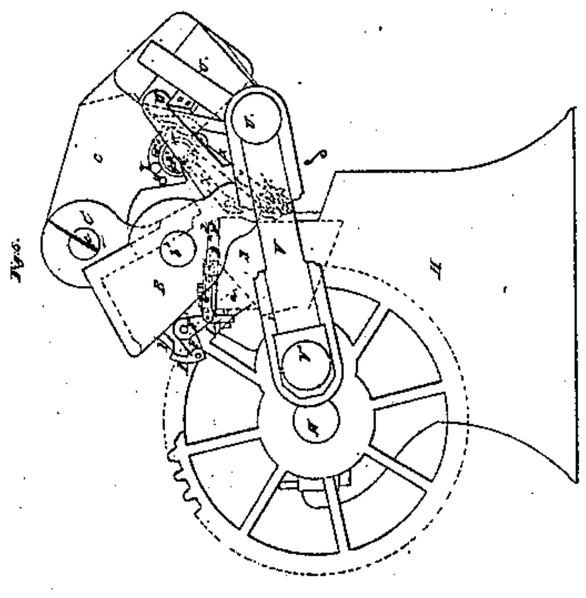
2 Sheets. Sheet 2.

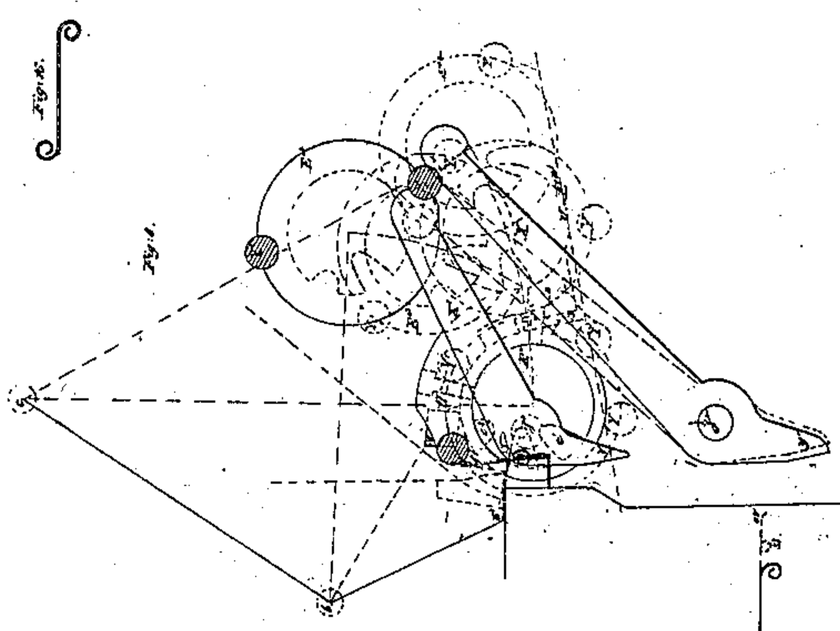
W. W. Cumberland.

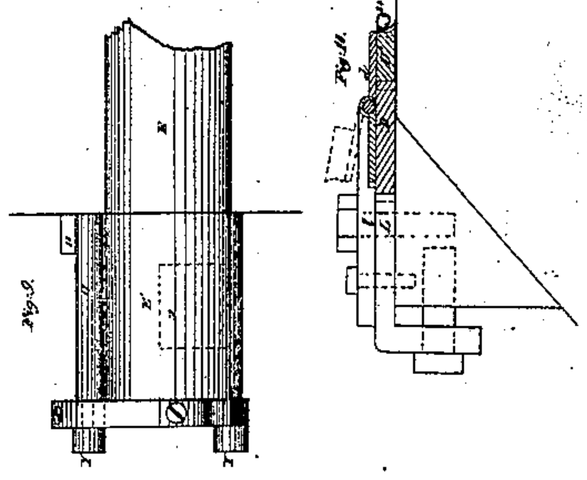
Edging Sheet-Metal.

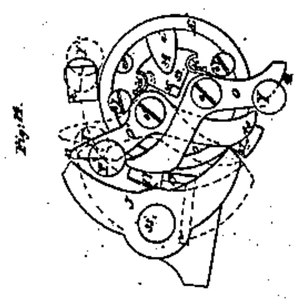
No. 12,053. Patented Dec. 12, 1854.

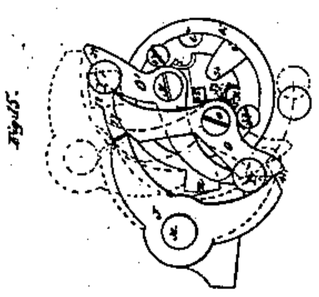


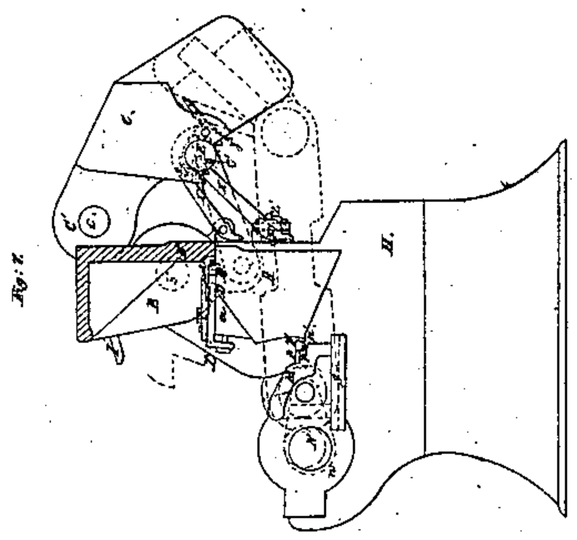


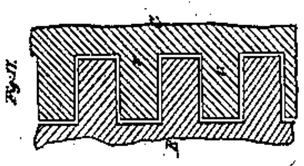


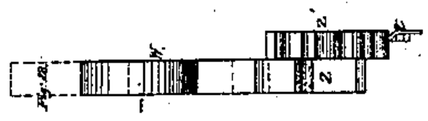


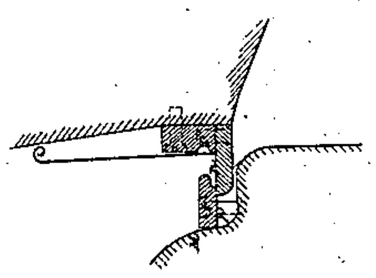


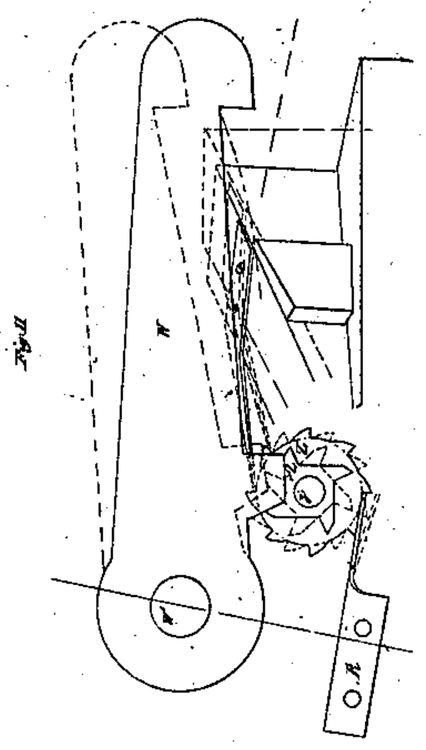












N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WM. W. CUMBERLAND, OF NEWARK, NEW JERSEY.

IMPROVEMENTS IN MACHINES FOR BENDING METAL.

Specification forming part of Letters Patent No. **12,053,** dated December 12, 1854.

To all whom it may concern:

Be it known that I, WILLIAM W. CUMBERLAND, of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Machinery for Bending Metal and other Material, and producing forms therein by pressure; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention has for its object the bending of the edges of sheet metal into various forms; but it is also applicable to the production of such forms as are capable of being produced by upsetting, stamping, or other operations performed by pressure.

It consists in a certain arrangement of bending or forming dies for producing the desired forms, of holding apparatus for holding the articles to be operated upon, and of apparatus for causing the articles to be presented properly to the dies, and in certain mechanism for giving the necessary movements to the said parts, whereby the process of bending or otherwise giving form to metal is facilitated and expedited and performed with a great saving of labor.

The accompanying drawings represent a machine for bending scrolls on the edges of the slats of a certain description of rolling-iron shutters, for forming the hinges or joints of the same. This machine fully illustrates my invention in every particular, as the only changes necessary to be made for bending or shaping metal requiring a different form will consist of mere modifications in the form and arrangement of the dies, and in some instances a slight change in the relative movements of some of the working parts.

Figure 1 is a front elevation of the machine. Fig. 2 is a back elevation. Fig. 3 is a plan. Fig. 4 is a right-hand end view. Fig. 5 is a transverse vertical section taken in the line *x y*, shown in Fig. 1, looking in the direction indicated by the arrow pointing to said line. Fig. 6 is a right-hand elevation showing the machine in a different position to Fig. 4. Fig. 7 is a transverse vertical section taken in the same plane as Fig. 5, but showing the machine in a different position to that figure. Fig. 8 is a diagram illustrative of the movements of what I term the "die-roll," which carries the bending-dies, as would be seen at the right-hand end of the machine. Fig. 8* is another diagram, illustrative of the manner in which the die-roll is held while the dies are in operation. Fig. 9 is a back view of part of the "die-roll," and its collar corresponding with Fig. 8. Fig. 10 is a transverse section of what I term the "backhold." Fig. 11 is a right-hand side view of the catch movement, which attaches what I term the "downhold" to the "die-piece" when it is necessary to raise the former. Fig. 12 is a front view of the above catch movement. Fig. 13 is a transverse section of the preparatory dies. Figs. 14 and 15 are left-hand end views of the die-roll, showing the mechanism which I sometimes employ for holding the die-roll in place while the bending-dies are in operation. Fig. 16 represents a transverse section of a finished slat which has been bent by the machine. Fig. 17 is an inverted plan of part of the face of the downhold and that part of the die-piece in front of the die-roll. Figs. 8 to 16, inclusive, are drawn by a scale of four times the size of Figs. 1 to 7, inclusive, for the purpose of showing the parts more clearly.

Similar letters of reference indicate corresponding parts in the several figures.

A is a strong bed of cast-iron having a plane top surface, and being firmly bolted to standards H H, to form a framing to support all the working parts of the machine.

B is what I term the "downhold," which consists of a strong casting which is straight longitudinally and has its transverse section of angular form, as shown in Fig. 5. It is hinged by strong hinge or knuckle joints B′ B′ to the upper parts of the end standards, H H, which are extended above the bed for the purpose. Its back part, B^2, has a plane face at the bottom, which extends the whole length of the bed A and is capable of fitting down flat upon a piece of sheet metal placed upon the plane surface of the top of the bed, which is horizontal longitudinally and nearly horizontal transversely. The face of the downhold B occupies a position just so far in rear of the pivots *b b* of the joints B′ B′ that a weight or downward force applied in rear of the pivots, or force applied in a backward direction above the pivots, would cause it to

bite or jam upon the piece of metal aforesaid, as will be hereinafter more fully explained.

To the upper part of the back of the downhold the die-piece C is hinged by hinge or knuckle joints C′ C′. The die-piece consists of a strong straight casting of nearly the same length as the bed, and has bolted to it at each end an arm, U, on which is a journal, U′, which is connected by a connecting-rod, V, with a crank, V′, at one end of the main shaft N, which works in bearings *n n* on the back parts of the standards. In the front part of the die-piece there is a recess or seat which extends along its whole length parallel with the pivots *c c* of the hinges *c′ c′*, and is of the form of about two-thirds of a cylinder of suitable size to contain the die-roll E, which contains the dies, so that it will hold the said die-roll and allow it to turn freely to a suitable extent and always leave about one-third of its periphery exposed. This recess must be at such distance from the line of the axis of the pivots *c c* that the axis of the die-roll will vibrate in an arc which would strike the bed A a little below the top surface. The bending of the slat or plate is performed by the vibratory movement on the center *c c* which is given to the die-piece C by the cranks and connecting-rods before referred to. This vibrating movement brings the dies into operation on and causes them to bend a portion of the slat or plate which overhangs the back of the bed, while another portion of the slat or plate is held firmly between the downhold and the bed. The slat shown requires to be submitted to the operation of two dies besides the preparatory dies, which will be hereinafter explained, to make either of the two scrolls or bends represented on opposite edges, and in order to effect this it is necessary that the die-piece make two vibrations while the slat is upon the bed, and that the die-roll E, which contains both the dies, be turned on its axis between the successive operations of the two dies, in order to bring first one die and then the other into operation.

The die-roll E consists of a steel cylinder fitted truly to the recess or seat in the front of the die-piece, and is of a length greater than the die-piece, so as to protrude from each end thereof. It is held up in its seat in the die-piece, to prevent too great wear on the front edges of the latter, by bearing-pieces *e*, which are bolted to the die-piece C, as shown in Fig. 5. The protruding ends of the die-piece are each furnished with a collar, E′, (shown in Figs. 2, 8, and 9,) which is fitted and secured firmly to it to prevent the withdrawal of the die-roll endwise from the die-piece.

The bending-dies consist of recesses *e′ e²*, of a proper transverse sectional form, extending along the whole length of the die-roll. The die *e′*, which comes first into operation, is much deeper than the die *e²*, which finishes the bend, and both have concave bottoms, but the shallow die *e′* is wider at the bottom than the deep die *c′*. Every revolution of the main shaft N and crank V′ V′ transmits motion to the die-piece, and causes the axis of the die-roll to describe an arc from the center *c*. During one revolution the die-piece receives a motion back and forth in the said arc to the full extent allowed by the crank, as is shown in Fig. 7, and does not transmit any motion to the downhold, which remains in the meantime held down on the bed by the weight of the die-piece; but during the succeeding revolution the die-piece is caused to raise the downhold by means of two strong catches, W W, which are hung on pins W′ W′, one at each end of the downhold. These catches have hooks at their ends of such form that if they are not raised by some means they will catch the arms U U of the die-piece, as shown in Fig. 6, by the time the latter has moved about half-way backward, and thus connect the downhold with the die-piece in such a manner that the latter cannot move farther without the former, and hence the center of motion is changed from the line forming the axis of the pivots *b b*, and the remainder of the backward movement allowed to the die-piece by the cranks is more of an upward movement, while the downhold receives such a movement as to raise its face from the bed. Every second backward movement of the die-piece raises the downhold, and this always after the operation of the finishing-die *e²* in order to allow of the discharge of one slat from and the placing of another slat upon the bed. When the die-piece moves forward, after having raised the downhold, the latter descends upon the bed, but being nearly balanced does not press with any considerable force upon the slat until the bending commences. The catches W W are each raised up, in order that they may not catch the arms U U during the first backward movement of the die-piece, by means of one of two lifter-wheels, Z Z, which are capable of revolving freely on studs *z z*, which are secured to the bed near its two ends, and stand parallel with the axes of *b b* and *c c*. These wheels are represented with four teeth or lifters, but may have any other number; and they are each secured to a ratchet-wheel, Z′, the number of whose teeth must be equal to twice the number of the lifters. Every time the die-piece moves forward the ratchet-wheels are turned one tooth by means of click-pieces *z′ z′*, attached one to each arm U; but they are held stationary during the backward movement by means of spring-pawls *t*, attached to the framing of the machine, as shown in Fig. 11. Each movement of the ratchets only turns the lifter-wheels half a tooth, and hence one movement leaves the lifter-wheel with the top of one of its lifters under the catch and the catch raised, as shown in red outline in Fig. 11, and the succeeding movement leaves it with the back of the next lifter under the catch, and the catch depressed, as shown in black outline in the same figure. In the two

positions described the catches are alternately left at the termination of the forward movements of the die-piece, being left in the former position after the operation of e', the first of the two dies in the die-roll, and in the latter position after the operation of e^2, the finishing-die. When the catches are in the former position, the arms U U escape them during their backward movement, and the downhold is not moved; but when they are in the latter position the arms catch them and raise the downhold.

The contrivance employed for turning the die-roll E on its axis to change the position of the dies e' e^2 and bring the one and the other into the operative position consists of the two catches X X′, shown in Figs. 4, 6, 7, and 8, which are pivoted to the bed near one end, and two studs, Y Y′, which are attached to the end of the die-roll. The two catches are placed one above the other, the lower one, X, having for its pivot one of the studs z z, which serve as the axes of the lifter-wheels, and the upper one, X′, being attached to the bed by a pin, z^2, which is parallel with z. These catches stand out in a backward direction from the bed, and are hooked at their ends to catch hold of the studs Y Y′, and below their pivots z z^2 they have tail-pieces y' y', which are caused by the weight of the catches when their hooks are free to bear against one of the standards, and thus hold up the hooks to the proper height. The studs are secured firmly to the end of the die-roll E, or to the collar E′, which is secured firmly to, and may be considered part, of the die-roll E, and thus occupy positions almost diametrically opposite each other. The die-roll is only allowed to turn far enough to change the positions of the dies to bring either one into its operative position, its motion being controlled by a projecting piece, 17, which is secured to the collar, and which is arrested at the desired point either by the stop 18, which consists of a bolt screwed into the end of the die-piece so as to leave only the head outside, or else by the stop 19, which consists of an angular-formed piece of metal bolted on the top of the arm U, according to which direction the roll is moving. The stop 18 is shown in Figs. 6 and 8, and the stop 19 is shown in dotted outlines in both of those figures. In the latter figure the dotted line U, upon which the stop is placed, represents the top of the arm U.

The operation of turning the die-roll on its axis to change the position of the dies is illustrated in Fig. 8. In this figure the roll is represented in black outline, and indicated by E* in the position it occupies after the operation of either die, the positions of the two dies after the operation of the first die, e', being shown in red outline, and their positions after the die e^2 has finished the bend shown in black dotted outline. The studs Y Y′ are represented in red outlines to correspond with the former position of the dies, and in black outline to correspond with the latter position. Suppose the dies and studs to be in the former position and the backward movement of the die-piece to take place, the die-roll moves in an arc described from c with the dies stationary in relation to its axis until it arrives at the position represented in red dotted outlines, and indicated by E*′, when the stud Y′, being in proper position, is caught by the hook of the catch X and its further movement in the arc is arrested. The continued motion of the die-roll in the arc beforementioned, after the stud Y′ has been caught by the hook, will bring it to the position represented in red lines, and indicated by E*², having caused it to turn on its axis far enough to bring the finishing-die e^2 into such a position that on its return it will finish the bend already partly formed by the die e'. After returning and finishing the bend, the die-piece carries back the die-roll, and during this backward movement the die-roll describes a curvilineal angle, formed of two arcs described, one from c and the other from b, as hereinbefore explained, and when it arrives at the position represented in black dotted outline and indicated by E*³ the stud Y is caught by the hook of the catch X. The continued movement of the die-piece after the stud Y has been caught by the catch X will carry the die-roll to the position represented in black outline and indicated by E*⁴, and the catch X will be moved to the position represented in red outline. The dies are now in such a position that on their return the die e' will perform its operation on a new slat, which would have been placed on the bed since the last backward movement commenced.

The studs are represented in Fig. 8 in the different positions in outlines corresponding with the outlines of the die-roll. The arrangement of the studs and catches is such that each catch leaves the studs in such a position that the stud which is operated upon by the other catch will be caught at the proper time. When the die e' is in its operative position, the projecting piece 17 is in contact with the stop 19, as shown in red outline in Fig. 8, and when the die e^2 is in its operative position the said piece 17 is in contact with the stop 18, as shown in black dotted outlines in the same figure. The dies are so arranged in the roll that the operation of either die in bending the slat will tend to turn the die-roll in such a way as to force the piece 17 against that stop with which it is contact, and thus keep the die-roll and die stationary in the die-piece. This arrangement of the dies is illustrated in Fig. 8*, where the die-roll is represented in transverse section in the position it occupies at the termination of the operation of each die. The two dies are represented in the operative position, the die e' in red and the die e^2 in black outline. The slat is also partly represented in colors to correspond with the dies—viz., in red outline as having been submitted to the operation of the first die, e', and

in black outline as having the scroll finished by the die e^2. The stops are represented in black, and the piece 17 is represented in red and black, corresponding with the positions of the dies represented in the same colors. The arc described by the axis of the die-roll is represented in red color and continued through the dies to show the direction of the motion of the dies. The mouths of the two dies arrive at the same position; but the bottom of the die e' is entirely above the arc described by the axis of the roll, while the said arc passes nearly through the center of the bottom of e^2. That point in the scroll where the greatest resistance is offered to the bending operation of each die is below the center of the bottom of the die, and is indicated by *s*. It will be seen that the point *s* in the scroll which is partially formed by the die e' is above the arc, and therefore the greatest resistance is offered, when this die is in operation, above the line of motion of the axis of the die-roll, and tends to cause the die-roll to turn in the direction of the red arrow and force the piece 17 against the stop 19; but the point *s* in the scroll which is finished is below the arc, and therefore the greatest resistance is below the line of motion of the axis and tends to cause the die-roll to turn in the direction of the black arrow and force the piece 17 against the stop 18.

On that part of the top surface of the bed in front of the part B^2 of the downhold is placed what I term the "backhold," whose principal part consists of a long flat metal plate, D, which rests partly upon the top face of the bed A, and partly upon a number of pieces, *a a*, which project forward from the front inclined part, A^2, of the bed, and whose upper surfaces form portions of the same plane as the top surface of the bed. The plate D is of nearly the whole length of the top surface of the bed. The plate D is of such width as will give it a good bearing thereon. This plate has another plate, D', of the same thickness, hinged to it at its back edge by hinges *d' d'* in such a way as to be capable of being thrown back above it, as represented in red outline in Fig. 10, or thrown down in front of it to lay on the bed, as shown in the same figure in bold black outline. When in the latter position, the plate D' is kept down on the bed by buttons *d d*, pivoted to the plate D, and represented in dotted lines in Fig. 3. The plate D is attached to two springs, which consist each of a stiff iron bar, K, (see Fig. 1 and also dotted outlines in Fig. 3,) which has one end bent nearly at a right angle, and bolted by two bolts passing through slots to one side of one of the projections *a a*, with a stout piece of india-rubber, *k*, between it and the said piece *a*. The plate is attached near the extremity of the bar K, which constitutes a spring of great strength and of greater durability than a steel spring, and serves to hold it in a given position, but allows it to move from such position when necessary and returns it to the said position when opposite influences cease. It is confined to the bed by means of a number of metal cap-pieces, *l l*, which are bolted to an equal number of plates, L L, which are bolted to the top of the projections *a a* on the bed. These plates L L are of a thickness a very little greater than the plate D, so as to allow the latter to slide freely under the cap-pieces *l l*, but not to allow it to move vertically; and their front parts are bent downward at right angles to the top parts to enable them to be adjusted backward or forward by screws *l' l'* screwing into the front of the projections *a a*. The back ends of the plates L L all range in line to form stops for the plate D to abut against when necessary. The back stop-plates, D D', are intended to regulate the position of the slat by placing the said slat or piece with its front edge against the back edge of either of the said plates—that is to say, against the plate D when the plate D' is turned up, and against the plate D' when it is down upon the bed. The slat or other article is placed on the bed when the downhold is raised, and at that time the plate D is in the position in which it is held by the springs K K, as shown in black dotted lines in Fig. 10, and when the downhold descends upon the slat the latter is driven by the action of the former forward against the plate D, which is driven forward by the slat. The first pressure of the downhold after its descent on the slat is merely due to its own weight and the effect of the weight of the die-piece, yet this is sufficient to grasp the slat with considerable tightness. When the die-piece moves forward, and the die comes in contact with the slat, its tendency is to drive it forward on the bed; but this forward motion is opposed by the resistance caused by the weight of the downhold and by the resistance of the springs K K, attached to the plate D, which causes the die-piece to assume the character of a lever of the first order, whose fulcrum is that point in the scroll or bending part of the slat where the greatest resistance to the bending is offered, and the power applied at U by the cranks V' V' and connecting-rods V V is transmitted to *c*, the point of connection with the downhold. The power applied to the down-hold at *c* tends to make the face slide forward on the bed, and carry with it the slat until it arrives at such a position as to jam or bite the slat so firmly that further movement on the bed is impossible, and the slat, being thus held firmly, is bent or rolled up by the continued forward movement of the die-piece, whose fulcrum, after the downhold becomes stationary, is changed to the pivots *c c*, and it is changed from a lever of the first to a lever of the second order.

The operation of the downhold is illustrated in Fig. 8 by the lines *c b* and *b* b^3, which represent a lever of the first order as constituted by the downhold. The point *b* represents the axis of the pivots *b b*, by which the downhold is attached to the bed and is the fulcrum. The point *c* represents the axis of the pivots *c c* by

which the die-piece is attached, and is where the power is applied, and the point b^3 represents a point in the face which bears upon the slat. It will be understood that power applied at *c* in a backward direction will tend to throw the point b^3 forward and make it bear with a very great force upon the slat. It is intended that the face of the downhold shall be caused to bite or jam upon the slat by the power applied at *c*, but that it shall not be made to do so by merely pushing forward the slat between it and the bed. The plate D must be attached to the springs K K, or the said springs be attached to the bed, in such a way that it (the plate) is capable of adjustment back or forth, and its position, when it is free and only held by the springs, must be such that, after the slat has been placed in front of and in contact with it, the forward movement given to the slat by the tightening of the downhold upon it will leave so much of the slat overhanging the back edge of the bed as is necessary to form the scroll. The stops L L are adjusted to such a position that slats of uniform width, when they are exactly of the necessary thickness, will, when moved forward on the bed by the combined operations of the downhold and the die-piece, as described, just cause the plate D to come into contact with them. These stops would be unnecessary but for the slight variations in the thickness of the plate-iron from which the slats are made, which is quite unavoidable. The slighest variations in the thickness of the slats would cause them to move to different positions on the bed; a thicker slat would have a tendency to move farther forward, and a thinner one not so far. The stops are set so that the thinnest slats would cause the plate D to be driven forward so as to touch the stops, as shown in Fig. 10 in bold black outline, then those of the greater thickness will cause it to be driven hard up and be arrested by them. The slats will then always be arrested at the same spot and leave the same quantity of metal overhanging the bed. The face of the downhold, if the plate D is arrested by the stops before the downhold has tightened sufficiently to arrest them, will generally move a little farther forward upon and tighten itself on the slat. It is necessary that the downhold always tightens on the slat, as, in addition to holding it, it is required to strengthen or flatten the part which comes under it.

In bending the first edge of the slat the single plate D only is necessary to be used to regulate the position of the slat; but in bending the second edge the plate D′ must be turned down upon the bed in order to throw the slat far enough back to present the proper quantity of metal beyond the bed to form the scroll. The width of the plate D′ must be sufficient to compensate for the width of slat that is lost in making the first scroll, and throw the back edge of the slat to the proper point for the turning of the second scroll. The back edge of the plate D′ is made of proper concave form to serve as a suitable bearing for the first scroll and prevent its shape being injured during the forming of the second scroll.

It will be seen on reference to Figs. 5 and 7 that the back part of the face of the downhold overhangs the back part of the face of the bed. It will also be seen in the same figures that the part *r* of the die-piece above the opening where the dies are presented stands out some distance in front of the die. The overhanging part of the downhold and the part *r* of the die-piece are both necessary to form a bearing for the upper side of the slat while either of the dies is operating, as the tendency of the slat is to bend upward. It is desirable that as the die finishes its operation the die-roll should be allowed to come as near as is practicable up to the bed, and in order to allow this and at the same time give the proper bearing to the upper side of the slat the overhanging part of the downhold and the part *r* of the die-piece are made with a series of projections and recesses, as represented in Fig. 17, which represents a portion of the under side of the faces of the downhold and the part *r* of the die-piece. The projections on the one part enter the recesses on the other, and thus both work into each other. This is also imperfectly shown in the plan view, Fig. 3, and also in the transverse section, Fig. 5, where the section is taken through a projection of the die-piece and a recess on the downhold. The face of the downhold and the face of the part *r* of the die-piece should all stand about in line transversely with the top edge of either die that may be in an operative position; but the front of *r* may have the corner rounded off, to prevent it catching against any part of the edge of the slat that may not have been properly prepared by the preparatory dies.

The backhold-plates D and D′ serve another purpose besides that of regulating the position of the slat, and holding it up toward the die during the bending operation—viz., that of throwing the slat from the machine after either scroll is finished. For this purpose the plate D is connected by a short connecting-rod, *f*, at each end with one, F′, of two arms, F F′, which form the equivalent of a bell-crank lever whose fulcrum is a pin, *g*, secured to a small standard, G, which is bolted to the upper part, H′, of one of the standards H. The arm F has movable piece, I, pivoted to its end by a pivot, *f*′. This is best shown in Fig. 5. This piece is held in the position shown in Fig. 5 by a spring, *i*, which is attached to the under side of the arm F, and presses on a tangential face which extends forward from that part of I below the pivot *f*′, and thus throws a shoulder at the back of the piece I down upon the top of the arm F. The point of the piece I stands in such position when the plate D is left free to the action of the springs K K that it is struck every time the downhold is raised to

release a slat by one of two pieces I′ I′, which project from the front of the downhold near the ends thereof. The pieces I′ I′, striking on the ends of the points of the pieces I I, and passing over them, cause the arms F F to be sharply thrown downward, and the ends of the arms F′ F′ to be thrown sharply forward, overcoming the resistance of the springs K K, and pushing before them the plate D, as shown in Fig. 6 in dotted outline, and causing it to push back the slat so far that it overbalances and falls over the back of the bed to a shelf, 20, placed behind the machine to receive it. The ends of the pieces I′ I′ and the points of the pieces I I are so formed that after the former have struck the latter, and moved the levers a short distance, they pass behind them and leave the plate D free to the action of the springs K K, which throw it suddenly forward to the position in which it is ready for the adjustment of the next slat when placed on the bed. When the downhold moves to seize the next slat, the points of the pieces I I move forward as the pieces I′ I′ pass them, but are returned again to the position shown in Fig. 5 by the springs *i i*.

The preparatory dies, already named, are for giving the edges of the slat a slight bend to prepare it for the action of the dies in the die-roll, as without the edge being slightly turned the operation of the latter dies would be very imperfect if they were in any degree operative. The preparatory dies consist of a male die, P, and a female die, P′, of which the latter is bolted to the lower part of the front of the bed and occupies a position not far behind the main shaft, and the latter is attached to what I term the "preparatory die-piece" M, which is a strong piece of cast-iron whose transverse sectional form is represented in Fig. 5, and which is straight longitudinally and of the same length as the face of the downhold. The preparatory die-piece has grooved pieces S S attached one to each end to work on horizontal slides S′ S′, which are bolted to the inside of the end standards, H H, and it receives a reciprocating motion by means of eccentrics N′ N′ on the main shaft, said eccentrics being connected with it by means of strap-connections N^2 N^2. The forms of the preparatory dies are best shown in Fig. 13. The female die, which extends the whole length of the bed, has a straight concave groove extending from end to end. The male die is of the same length as the female die, and is of the reverse form. It is bolted to the top of a suitable shelf on the piece M. While the slat is being operated upon by the preparatory dies it is placed edgewise, or in an upright position, as represented in Fig. 13 in red color, upon a number of guide-stops, *p*, which are secured by screw-bolts at regular intervals to the bottom of the female preparatory die. These guide-stops consist each of a narrow metal plate of such length as to project horizontally far enough in front of the female die to extend quite across the space which is left between the male and female dies when the former is drawn to its most forward position. A recess, *p′*, is made in the preparatory die-piece M for each of the guide-stops *p* to enter when the dies approach each other. The guide-stops may be adjusted higher or lower to bend the slat nearer to or farther from its edge by inserting packing between them and the bottom of the female die, and decreasing or increasing the packing as may be necessary. The main shaft of the machine carries a spur-wheel, 21, which receives rotary motion from a smaller spur-wheel, 22, on an intermediate shaft, 23, which rests in bearings under the standards, and carries another spur-wheel, 24, through which it receives rotary motion from a wheel, 25, on the driving-shaft 27. The driving-shaft carries a driving-pulley, 26, which receives the motion through a belt from any prime mover.

The construction of the several parts of the machine and their operations having been now explained, I will proceed to describe the process of bending a slat in the machine. The machine requires but one attendant, who stands in front of it; but in order to prevent any interruption to the operation a shelf above the machine may from time to time be supplied with slats, and the bent slats be removed by an assistant from another shelf on which the machine throws them when finished. The slats are intended to be bent in a cold state, and are supplied and removed at the back of the machine, so as to leave the front clear and give the attendant the necessary room. In commencing the operation, the front plate, D′, of the backhold is turned back over the plate D, and the plate D having been properly adjusted the machine may be set in operation. The direction of the revolution of the main shaft is indicated in Fig. 4 by an arrow. The attendant, after taking a few slats from the shelf above the machine and placing them on another shelf in front to be handy, takes one slat in his hands and places it edgewise upon the guide-stops *p p*, as shown in Fig. 13, to submit it to the operation of the preparatory dies, and the first time the die-piece M is carried back by the revolution of the eccentrics on the main shaft the edge of the slat is bent about as much as indicated at 32 in Fig. 10. The attendant then takes the slat, lays it on the top of the backhold with the bent edge against the downhold, and the bend turned downward, and as soon as the downhold is raised from the bed by the swinging forward of the die-piece, as hereinbefore described, during the next revolution of the main shaft he pushes the slat over the backhold onto the bed and brings it in contact with the front edge of the plate D. The first time the die-piece moves forward after the slat is upon the bed the deep die *e′* is presented in its operative position. Immediately after the die-piece has moved forward far enough to allow the

downhold to descend upon the slat the die e' arrives far enough forward to receive the edge of the slat. The die at first pushes forward the slat; but the resistance which the die encounters from the slat soon causes the die-piece to act upon the downhold, as hereinbefore described, and make it press so hard upon the slat as to prevent any further forward motion. After the slat becomes fixed between the downhold and bed, the edge of the slat is rolled up till it receives the scroll form 33. (Shown in Fig. 10.) The next revolution of the main shaft causes the die-piece to swing back again; but the catch W does not raise the downhold, and as the die-piece recedes the die is turned by the action of the catch X′ on the stud Y′, and the shallow die e^2 is brought to its operative position. When the die-piece returns forward, the die e^2, operating in the same manner as the die e', previously described, finishes the scroll already partly formed by the die e', leaving it in the form represented at 34 in Fig. 10. The next revolution of the main shaft causes the die-piece to swing back again, and this time the catch W raises the downhold from the slat and causes the upper part of the downhold to be thrown back so as to make the pieces I′ I′ strike the pieces I, attached to the levers F, and thus throw forward the backhold plate D, as before described, and expel the bent slat from the bed. While the downhold is raised from the piece a new slat is introduced by the attendant in the manner before described, to be submitted to the same operation as that which has just been expelled. The opposite edge of the slat requires to be submitted to the same operations as those described; but in practice when a large number of slats have to be bent it is better to bend one edge of each of them before commencing to bend the second edge, as much time would be lost in adjusting the plate D′ for every slat singly. After every slat has one edge bent, the plate D′ is turned down upon the bed and secured in its place by the buttons *d d*, and the operation of bending the other edges is but the repetition of that of bending the first edges.

It may be supposed from the foregoing description that four revolutions of the main shaft are necessary to complete the bending of one edge of the slat; but every second revolution turns out a slat, as two slats are operated upon at the same time, one being submitted to the preparatory bending operation, while the other is under the downhold. The operations of the dies e' e^2 afford ample time for the slat to be submitted twice, if necessary, to the operations of the preparatory dies. Two operations of the latter dies are sometimes necessary when the slats are not very straight.

Slight variations in the thickness of the metal employed in this machine require no adjustment of any of the parts of the machine further than the adjustment of the backhold, as hereinbefore described, as, in consequence of the attachment of the bending-die to the downhold, the relative positions of the face of the downhold and that die which is in the operative position are at all times the same, and the face of the downhold and the acting part or interior of the die always impinges upon the same side of the slat.

In order to adapt this machine for giving form to different articles by upsetting, all that is necessary is to arrange the backhold so as to present a proper quantity of material beyond the bed and downhold, and use a die or dies of such form as may be necessary to produce the form described. In other operations than those of bending the preparatory dies will usually be superfluous.

In order to adapt the machine for bending articles of different form to those described, different dies must be used of the necessary form. In some cases the bend may be performed, or the desired form produced, by one die and one movement of the die-piece, and in such case the die may be fixed in the die-piece C, and the downhold will require to be raised every time the die-piece swings back. This may be effected by removing the lifter-wheel Z, which raises the catch W, and thus leaving the catch always operative. In other cases more than two dies and a corresponding number of movements of the die-piece may be necessary to perform the bend or produce the desired form, and in those cases the proportion between the number of lifters on the lifter-wheel Z and the number of teeth on the ratchet Z′ must be such as will cause the catch to fall after the proper number of movements of the die-piece, and thus enable the downhold to be raised.

When the machine is used for giving form to any articles by upsetting, the metal will usually require to be heated, and this may also be necessary for some bending operations.

In some cases, in forming metal or other material, the faces of the bed and downhold may produce a part of the form, and will then, of course, require to be of the reverse shape to that of the form to be produced.

The method hereinbefore described of arranging the dies in the roll, whereby each one is secured in its operative position by the tendency of the resistance of the slat to force the projecting piece 17 against the stop 18 or 19, is only effective in bending or otherwise producing certain forms, and will not be effective in bending and producing other forms. In bending articles whose form renders that arrangement of the dies ineffective I employ the mechanism for turning and holding the die-roll which is represented in Figs. 14 and 15, and supposed to be attached to the left-hand end of the machine. In those figures the die-roll, instead of having the studs Y Y′ attached firmly to it, as before described, has similar

studs attached to two levers, O O′, whose fulcra are screws *o o′*, by which they are attached to the end of the die-roll. Each of these levers is exactly the reverse of the other in form. The stud Y is attached to the lever O, and stud Y′ to the lever O′. The collar E′ has a similar projection, 17, to that before described, and similar stops, 18 19, are attached to the die-piece. The collar is also furnished with a projection, 32, of a similar nature to 17, but shorter, and placed near the end. Similar catches, X X′, are employed to act upon the studs. The levers O O′ are both acted upon by a spring, 33, composed of a small block of india-rubber, which is confined in front of the levers between a piece of metal, 34, which is driven in the end of the die *e′*, a screw-bolt, 35, screwed into the axis of the die-roll, and two smaller pieces of steel, 36 36, bolted to the levers. The spring 33 acts upon the levers through the pieces 36 36, and its effect is to hold back both of the studs Y Y′ a little in rear of the position of the fixed studs Y Y′, before described. In front of the levers are two pins, 37 37, screwed into the end of the die-roll in such positions that when the studs are pulled forward in opposition to the action of the spring 33 the levers are stopped by the said pins in positions corresponding with the positions of the previously-described fixed studs Y Y′. In rear of the levers O O′ is a double pawl, J, of arc form. This pawl is capable of vibrating on a pivot, 38, which is secured to the die-piece, and is equidistant from the points of the pawl. The pawl is so arranged and its fingers are of such length that the point of the lower finger is capable of falling in close behind the projecting piece 32, as shown in Fig. 14, when the die *e′* is in the operative position, and the projecting piece 17 is in contact with the stop 19, thus preventing the possibility of the turning of the die-roll on its axis, and that the point of the upper finger is capable of falling in close behind the projection 17 when the die e^2 is in the operative position and the projecting piece 17 is in contact with the stop 18, as shown in Fig. 15, thus again preventing the possibility of the turning of the die-roll. When one end of the pawl is in operation, the other end is always thrown back. The levers O O′ are for the purpose of controlling the operation of the pawl J, holding it with either tooth in operation, and throwing one tooth in and the other tooth out of operation, as desired. In Fig. 14 the lever O′ is represented in black outline in that position relatively to the roll in which it is held by the spring 33, and the spring holds the upper point, 39, of the lever in contact with or nearly in contact with the upper point of the pawl, so as to prevent the lower point of the pawl falling out from behind the projection 32, where it is occupied in holding the die *e′* in its operative position. The lower part of the said lever is in the meantime nearly or quite in contact with the lower point of the pawl. Now, suppose the catch X′ to come into operation on the stud Y′, the stud will be moved forward by the catch, and so much of the first part of the motion as is necessary to bring the stud Y′ and the lever O′ to the position in which they are shown in red outline in the same figure will be employed by the lower end, 40, of the lever in throwing back the lower end of the pawl to the position shown in red, which is far enough back for the projecting piece 32 to pass it. The upper point, 39, of the lever in the meantime recedes to allow the pawl to move. When the lever O′ and pawl J arrive at the position shown in red, and the die-roll is released from the pawl, the lever O′ comes in contact with its stop-pin 37 and the continued movement of the stud Y′ by the catch X′ turns the die-roll to bring the stud to the position shown in red and indicated by Y′* in Fig. 14, by which time it brings the die e^2 to the operative position, as shown in Fig. 15, and brings the projecting piece 17 into contact with the stop 18. During the first part of the above-described movement of the die-roll the pawl J hangs loose, and afterward the ends of the lever O form resting places for the two points of the pawl until the projection 17 comes in contact with the upper point. As soon as the upper point is supported by the projection 17, the incline 41 on the lower end of the lever O comes in contact with the lower point. During the continued movement of the die-roll beyond this point the incline 41 would force the lower point of the pawl farther back but that it cannot move back without the upper point moves forward. The forward movement of the upper end is prevented by the projection 17, and so the resistance of the pawl to the movements of the lever O causes the lower half of the spring 33 to be compressed until the projection 17 passes the upper point of the pawl, when the resistance of the pawl being removed from the lower end of the lever allows the spring 33 to expand and drive back the lower end of the lever and lower point of the pawl until the upper point of the pawl falls to the bottom of the projecting piece 17, as shown in black in Fig. 15, which projecting piece, being in contact with the stop 18, is thus firmly secured by the pawl. The upper point of the pawl is kept in place as long as the die-roll remains stationary with the die e^2 in its operative position by the lower end of the lever O, which keeps back the lower point of the pawl in the same manner, as it has been hereinbefore described, that the upper point was kept back by the lever O′ when the die *e′* was in the operative position. The return movement of the die-roll to bring the die *e′* again in the operative position reverses the action of the pawl just described to make its lower point fall behind the projection 17. During this latter movement the action of the levers O and O′ are exactly reversed.

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

1. The arrangement and connection in any

manner, substantially as herein described, of the parts A, B, and C, termed, respectively, the "bed," the "downhold," and the "die-piece," and employed the two former for holding the slat or piece of metal to be operated upon and the latter for holding the die or dies, whereby the resistance of the slat or piece operated upon to the bending or forming operation causes it to transmit the power necessary to produce the pressure for holding it, as herein fully set forth.

2. Furnishing the downhold or movable holding part B with a catch, W, which is so formed and arranged that it may be brought to a suitable position to catch on the die-piece or on an arm attached thereto when the die-piece has moved back to a certain distance after the die has done its work, and thereby attach the downhold to the die-piece, so that the former is raised by the movement of the latter, and thus caused to liberate the slat or other article which it has held in place.

3. Controlling the operation of the catch W so that it shall only catch the die-piece during every second return movement, or after it has made as many movements as may be necessary to produce the required form on the slat or other article, by means of the lifter-wheel Z, ratchet Z′, and click-piece z', all arranged and operating as herein described.

4. Constructing the back part of the face of the downhold with a series of projections and recesses and the front r of the die-piece above the die with similar projections and recesses fitting to the projections and recesses on the downhold, as described, for the purpose of affording support to the upper side of the slat or piece on the side opposite the bend during the bending operation, and allowing the die to work up as close as is necessary to the edge of the bed and downhold.

5. The employment of two or more dies, e' e^2, of different depth or of different form, arranged in or upon a tool, E, which has such movements on its axis, as described, as to bring the said dies successively into operation upon the slat or other article, whereby a form requiring two or more distinct operations of the die to produce it is produced on the slat or article without releasing it.

6. Attaching the backhold-plate D, which regulates the position of the slats on the bed, to the bed by springs K K, of any suitable description, for the purpose of allowing it to yield to the movement which the slat is caused to receive upon the bed by the tightening of the downhold, and for allowing the movement which is given to it for the purpose of throwing out the slat.

7. Furnishing the backhold-plate D with a flap-piece, D′, hinged to it so as to be thrown down on the bed at pleasure, for the purpose of regulating the position of the slat when the second scroll is to be formed, and compensating for the reduced width of the slat caused by the bending of the first scroll, as herein fully described.

8. Giving to the backhold-plates D and D′ the necessary movement to expel the slat or piece after the scroll or other form is produced on either edge thereof, and suddenly leaving it free to be returned by the action of the springs K K to the proper position to adjust a new slat or piece upon the bed by connecting it with a lever, F F′, which is furnished with a springing piece, I, which is operated upon, as described, by pieces I′ I′, attached to the downhold every time the latter moves to liberate a slat or piece.

9. The arrangement of the dies relatively to the arc described by the axis of the die-roll, as herein described and represented in Fig. 8*, whereby the resistance of the metal to the bending or forming operations of the two dies is made to act in such a direction as to cause the die to have a tendency to turn on its axis in the proper direction to bring the projecting piece 17 into contact with the stop 18 or 19, as may be required.

10. The method herein described of turning the die-roll E back and forth to change the positions of the dies e' e^2 by means of catches X X, which are attached to the bed, and stand in such positions that when the die-piece swings back they catch on studs Y Y′, attached to the die-roll at a distance from its axis.

11. Attaching the studs Y Y′ to a pair of levers, O O′, which are attached to the die-roll, and are so formed and arranged and controlled by a spring, 33, that when the studs are caught by catches X X′, which turn the die-roll on its axis, the levers are caused to act upon a double pawl, J, which is so arranged as to fall behind either of two projecting pieces, 17 32, on the die-roll, for the purpose of holding it against one of two fixed stops, 18 19, and to move the said pawl so as to release one of the projecting pieces and fall behind the other, and thus release the die-roll from the position in which one die is operative, and secure it after it has been moved to the position in which the other die is operative, as herein fully described.

12. The arrangement of the preparatory dies P P′ relatively to the bed, the downhold, and the die-piece which carries the bending-dies, as described, whereby the attendant is enabled to conduct the operations of the preparatory dies upon one slat and the bending-dies upon another slat at the same time.

WM. W. CUMBERLAND.

Witnesses:
O. D. MUNN,
J. W. COOMBS.