(No Model.) 4 Sheets—Sheet 1.

# C. D. PRUDEN.

## SHEET METAL MOLDING MACHINE.

No. 489,498. Patented Jan. 10, 1893.

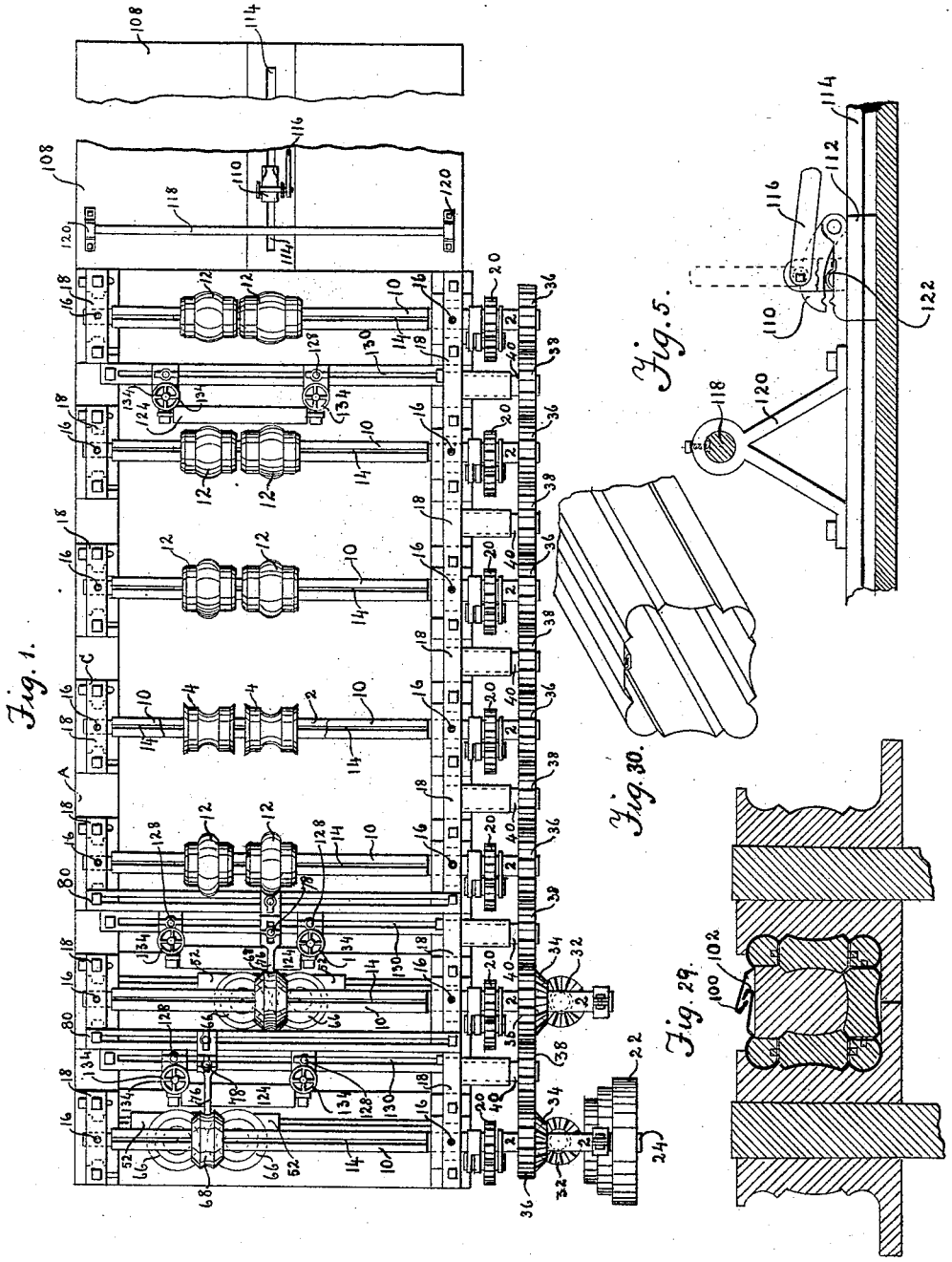

Fig. 1.



Fig. 5.



Fig. 30.



Fig. 29.

Witnesses
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 2.

# C. D. PRUDEN.

## SHEET METAL MOLDING MACHINE.

No. 489,498. Patented Jan. 10, 1893.

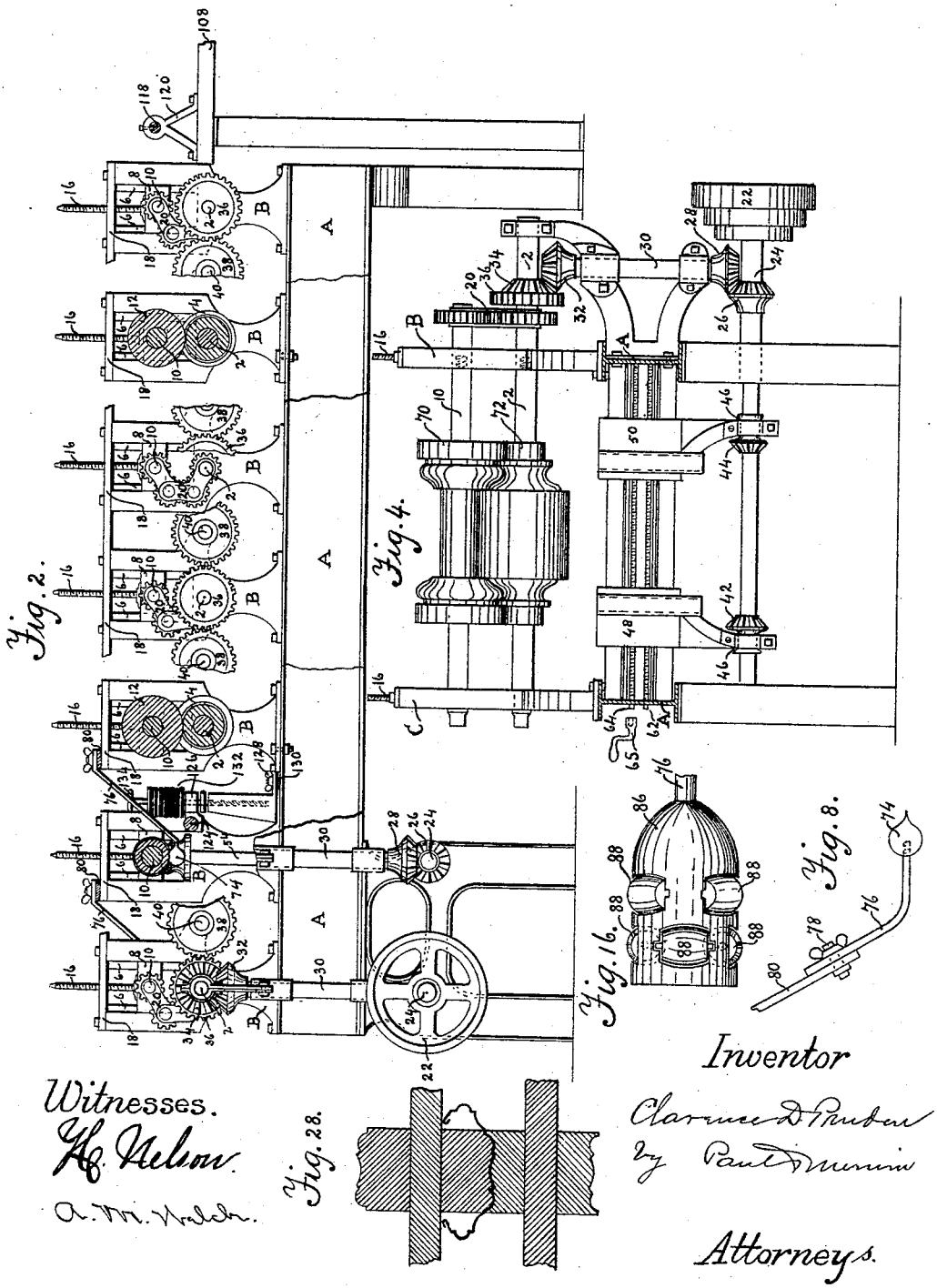

Fig. 2.



Fig. 4.



Fig. 16.



Fig. 8.



Fig. 28.

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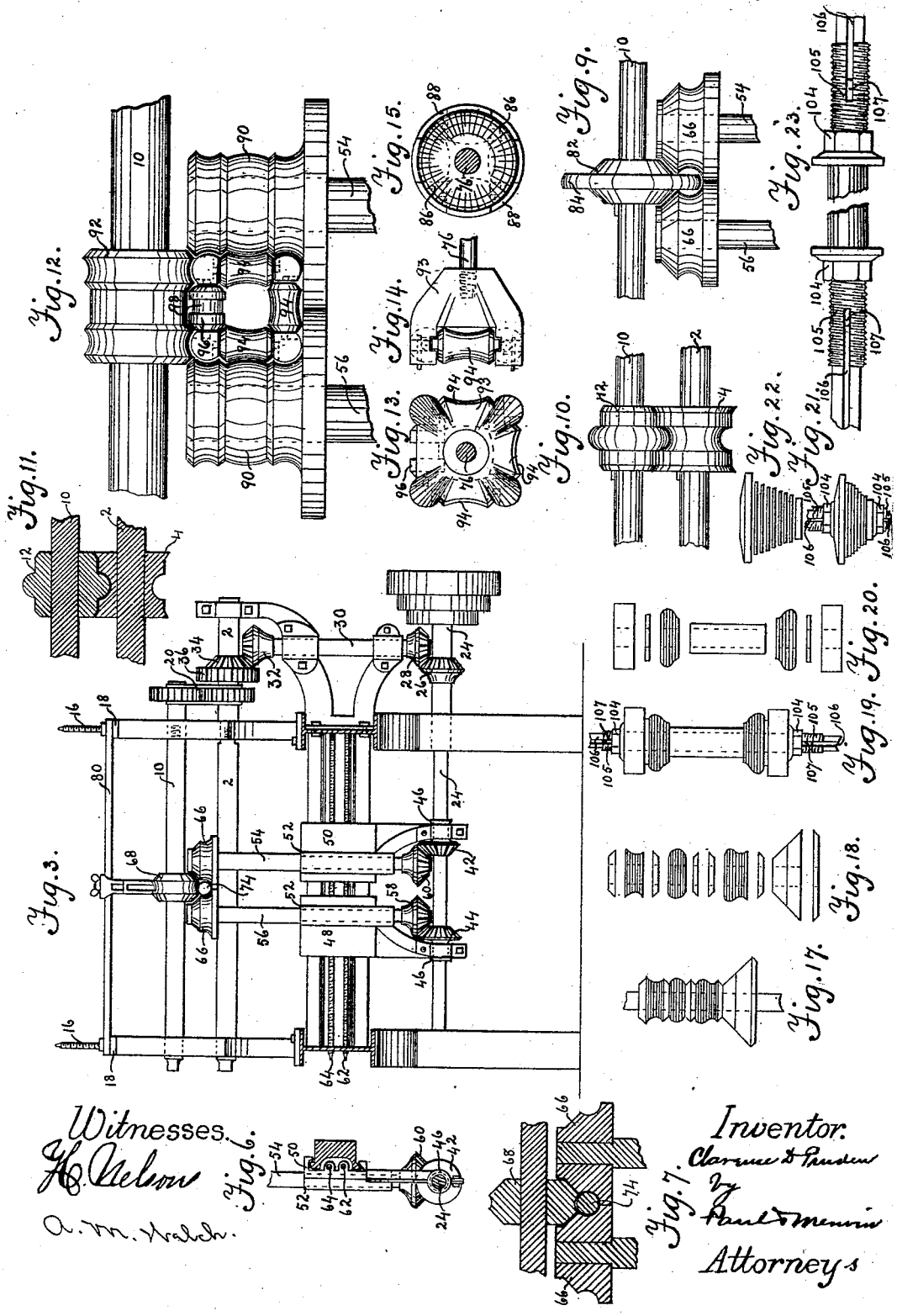
(No Model.) 4 Sheets—Sheet 3.

# C. D. PRUDEN.

## SHEET METAL MOLDING MACHINE.

No. 489,498. Patented Jan. 10, 1893.

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(No Model.)

4 Sheets—Sheet 4.

# C. D. PRUDEN.

## SHEET METAL MOLDING MACHINE.

No. 489,498. Patented Jan. 10, 1893.

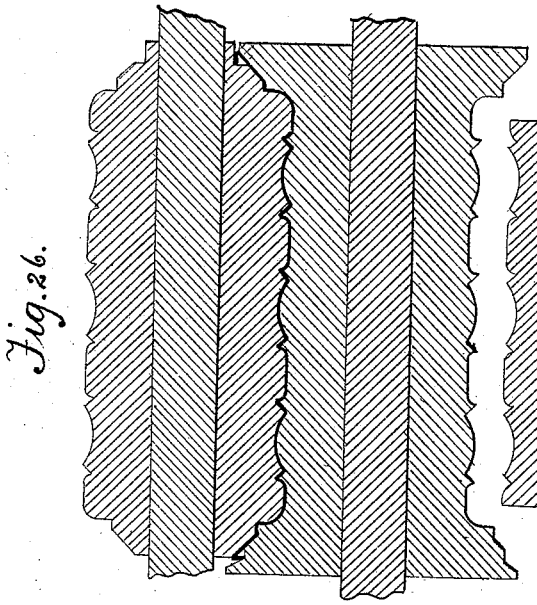

Fig. 26.

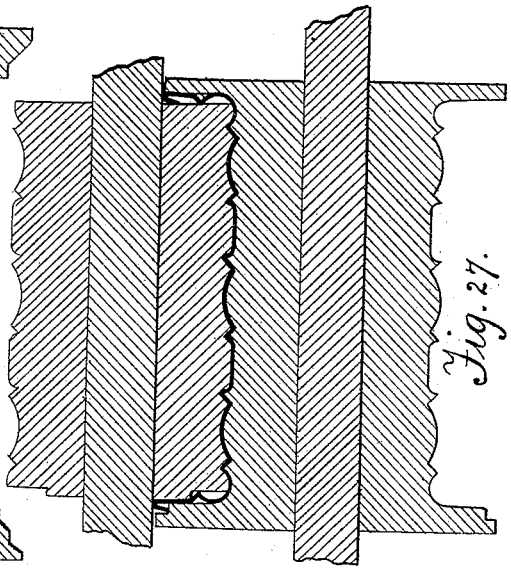

Fig. 27.

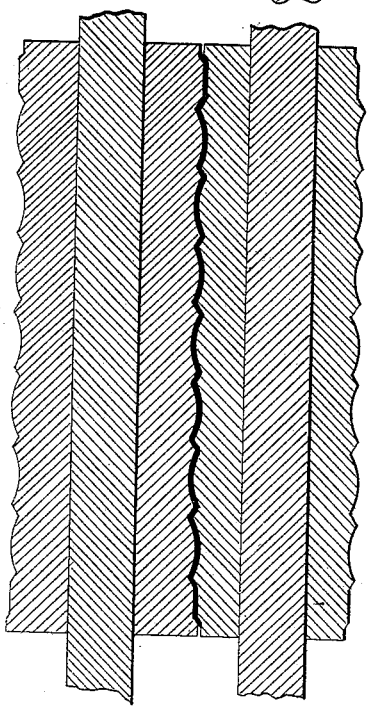

Fig. 24.

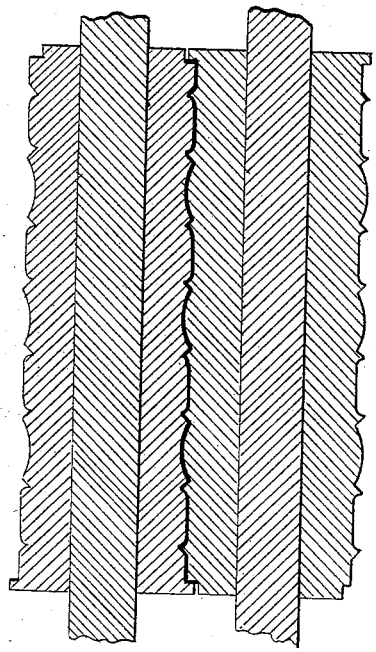

Fig. 25.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

CLARENCE D. PRUDEN, OF ST. PAUL, MINNESOTA, ASSIGNOR OF ONE-HALF TO PHILIP A DESLAURIERS, OF SAME PLACE.

## SHEET-METAL-MOLDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 489,498, dated January 10, 1893.

Application filed January 5, 1892. Serial No. 417,078. (No model.)

*To all whom it may concern:*

Be it known that I, CLARENCE D. PRUDEN, of St. Paul, Ramsey county, Minnesota, have invented certain Improvements in Sheet-Metal-Molding Machines, of which the following is a specification.

My invention relates to improvements in machines for the forming of sheet metal into straight moldings or similar forms, especially for architectural purposes; and consists in providing a machine with graded series of male and female rolls, their lines of longitudinal contour being of equal length, through which the sheet is successively passed to receive gradual and progressive shaping. Guide rolls are arranged intermediate of said shaping rolls for directing the course of the sheet from one pair of shaping rolls to the next. The sheet is further held in proper position and guided through the machine by means of a clamp secured to the rear end of the sheet, and sliding in a guide longitudinally of the bed of the machine, which prevents its lateral displacement. In addition to the series of horizontal shaping rolls, I also provide a pair of duplicate rolls, having vertical shafts and a third roll having a horizontal shaft adjacent to the other rolls, through which the sheet may be carried from the last shaping rolls. Supported in the space between these three rolls is a shaping point, around which point and between the three rolls is passed the partially formed sheet, the duplicate rolls thus giving an "under-cut" to the sheet; and the shaping point, which in form corresponds to the curve or angles of the three rolls, serves to keep the fold or bend of the sheet pressed against the rolls, and thus causes it to receive its accurate shape from the rolls. For some work a modified form of third roll can be used with a circumferential rib, which takes the place of a shaping point.

My invention further consists in making the shaping rolls of sections or washers, which can be arranged in any desired relation and clamped together, whereby almost any desired design of molding can be secured with a limited number of sections.

My invention further consists in the construction and combination hereinafter described and particularly pointed out in the claims.

In the accompanying drawings, forming part of this specification; Figure 1 is a plan view of my improved machine shown with two sets of shaping rolls, one pair of upper rolls being removed to show the form of the under rolls; Fig. 2 is a sectional side elevation of the same; Fig. 3 is a front end elevation showing a single triple set of finishing or under-cut rolls; Fig. 4 is a front, end elevation showing a modified form of shaping rolls, the duplicate under cut rolls being removed; Fig. 5 is a sectional detail of a part of the extension or table at the rear end of the machine, showing the traveling clamp and the tripping bar for the same; Fig. 6 is a detail side elevation of the supporting frame and connections for one of the undercut roll shafts; Fig. 7 is a sectional detail of the undercut rolls, showing the shaping point and sheet between the same; Fig. 8 is a detail of a shaping point adapted to be used in connection with the undercut rolls shown in Figs. 2, 3 and 7; Fig. 9 is a detail of a modified form of a set of undercut rolls, the third roll being provided with a circumferential rib which takes the place of the shaping point; Fig. 10 is a detail of the pair of shaping rolls by which the sheet is formed to pass between the undercut rolls shown in Figs. 2 and 3, or the modified form shown in Fig. 9; Fig. 11 is a central, longitudinal section of the roll shown in Fig. 10, also showing the sheet of metal between them; Fig. 12 is a detail of a modified form of triple or under cut rolls, designed to form a sheet metal tube, the shaping point being shown in front elevation between the rolls; Fig. 13 is a detail rear elevation of the shaping point; Fig. 14 is a detail side elevation of the same; Fig. 15 is a detail front end elevation of a round shaping point, provided with anti friction rolls; Fig. 16 is a detail side elevation of the same; Fig. 17 is a detail of a sectional shaping roll shown in position clamped on its shaft; Fig. 18 is a detail of the same with the sections removed from the shaft, and separated from each other; Fig. 19 is a detail of another form of sectional roll; Fig. 20 a detail of the same with the sec-

tions removed from the shaft and separated; Fig. 21 shows a third form of sectional roll, and Fig. 22 the same with the sections removed from the shaft and separated; Fig. 23 is a detail of the sectional roll shaft showing the sleeve for holding the roll sections, and the clamping nuts therefor; Figs. 24, 25, 26, 27, 28 and 29 are central, longitudinal sectional views of a series of rolls for shaping a sheet of metal into a tube, the sheet of metal being indicated in each case by a heavy black line between the meeting faces of the rolls, illustrating the successive steps in the forming of the sheet as it passes through the series in the order of their number; Fig. 29 shows the pair of rolls immediately preceding the undercut rolls, illustrating the manner in which the edges of the sheet are brought together so that their hems will interlock, the undercut rolls closing and compressing the lock, and Fig. 30 is a perspective view of a part of the sheet metal tube as formed by the rolls shown in Figs. 12 and 29.

In the drawings, A represents the bed of the machine having suitable supports, and provided with standards B and C on each side of the bed. The transverse horizontal shafts 2 are journaled in fixed bearings in these standards, and are provided with graded series of shaping rolls 4, the axial length of which successively lessens as the size of the elevations and depressions on the surface increases, the lines of longitudinal contour being equal in length.

Sliding in the guides 6 of the standards, are the bearing blocks 8, in which are journaled the similar horizontal transverse shafts 10, which are provided with other series of rolls 12, in form the complement or counterpart of the lower rolls. The shaping rolls are secured upon the shafts by means of feathers arranged in longitudinal grooves 14 in the shafts. By loosening the standards C upon the bed and sliding them back away from the shafts, the rolls can be removed from the shafts and others substituted for doing different classes of work. The vertical position of the shafts 10 above the shafts 2, is adjusted by means of the set screws 16 threaded into the cross bars or tops 18 of the standards. The shafts 10 are connected to the shafts 2 so as to be driven from them, by means of the expanding gears 20 of ordinary construction.

Power is applied to drive the shafts 2 in any suitable manner, as by means of the pulley 22 mounted upon the shaft 24 journaled in the frame of the machine, and provided with the bevel pinion 26 meshing with the bevel pinion 28 upon the vertical shaft 30. The shaft 30 is provided with a bevel pinion 32, meshing with the bevel pinion 34 mounted on the adjacent shaft 2. The shafts 2 are also provided with spur gears 36 which mesh with the intermediate transmitting gears 38 mounted upon the shafts 40, by means of which power is transmitted from the pulley 22 to all of the shafts 2. The shafts 2 being as before stated are connected to the shafts 10 by the expanding gears 20. Upon the shaft 24 are slidably mounted the bevel pinions 42 and 44, which are provided with rearwardly projecting sleeves 46, on which are mounted the frame pieces 48 and 50, provided with bearings 52 to receive the vertical shafts 54 and 56, having pinions 58 and 60 meshing respectively with the pinions 42 and 44.

The position of the frame pieces is adjusted by means of the screws 62 and 64 connected to the frame, each threaded through one of the frame pieces, and operated by means of a wrench 65 applied to the squared end of the screw. The vertical shafts 54 and 56 carry similar under cut rolls 66, the horizontal shaft 10 immediately above the same being fitted with a shaping roll 68 adapted to fit partly between the rolls 66, as shown in Fig. 3, so as to hold the sheet in place while receiving the under cut from the rolls 66, as hereinafter described. As many sets of the under cut rolls may be used as required for the work of the machine, Fig. 1 showing two sets of shaping rolls, and two sets of under cut rolls, while Fig. 3 shows a single set of under cut rolls. When the under cut rolls are not needed for the work in progress, the shafts 54 and 56 are removed from the bearings 52 and other rolls substituted for them, as for example as shown in Fig. 4, where a modified form of shaping rolls 70 and 72 are shown as the finishing rolls of the machine. The sheet of metal in passing through the machine receives deeper and deeper impressions with each pair of rolls, and where an under cut or partially tubular conformation is required, the sheet is carried from the last pair of shaping rolls, as for example, those shown in Figs. 10 and 11, to the under cut rolls shown in Figs. 1, 3 and 7, the sides being closed in by the rolls 66, giving a partially cylindrical or tubular finish.

In order to hold the sheet in contact with the rolls 66 and 68, a shaping point 74 having a stem 76 is adjustably secured by means of a screw 78 to the arm 80, which in turn is secured upon the frame of the machine, as shown in Fig. 2, and arranged to stand between the rolls 66 and 68, its form being adapted to the contour of the three rolls with space for the sheet to pass between. The sheet is thus held in close contact with the rolls and receives a uniform and proper curvature. In some classes of work, the point may be dispensed with, and a modified form of roll 82 (see Fig. 9) is substituted for the roll 68. The roll 82 has a rounded circumferential rib 84 which stands between the rolls 66 serving the purpose, and taking the place of, the point 74.

In Figs. 15 and 16 is shown a modified form of point 86 provided with anti friction rolls 88, having the proper curvature, which diminish the friction upon the sheet when passing through the machine.

In some classes of work a complete tube with ornamental finish is desired in which case a triple set of rolls 90 and 92 is provided (see

Fig. 12) between which is arranged a shaping point 93, (see also Figs. 13 and 14) which is of such shape as to conform to the rolls, and is provided with suitably shaped anti friction rolls 94, in manner similar to those upon the point 86. The point is also preferably provided with a roll 96 having a circumferential groove 98, adapted to receive the folds or hems of the edges of the sheet and cause them to interlock so that the joint or seam may be smooth surfaced on the outer side, but project slightly within the tube when finished (see Fig. 30).

The series of rolls preceding the triple set 90 and 92 are shown in Figs. 24 and 28 inclusive, the sheet being indicated by the heavy line between the meeting surfaces of the rolls. In passing through these the sheet receives the proper form, and the edges are turned as indicated so as to form the hems 100 and 102, which are brought in position when passing through the final set of rolls, (see Fig. 29,) so as to be interlocked and to be pressed in finished form as shown in Fig. 30. While solid rolls may be used for this work, I prefer to use in the preliminary forming of the sheet where nicety of finish and accuracy of curve or angle are not essential, sectional rolls as shown in Figs. 17, 18, 19, 20, 21 and 22 in which the rolls are made up of a series of sections or washers of varying diameter, either with edges curved or beveled, as indicated in Figs. 17 and 20, or with their faces at right angles with their sides, as shown in Figs. 21 and 22. As will be seen in these illustrative figures, with one set of sections an indefinite number of styles or shapes of rolls may be built up, so as to increase in great degree the capacity of the machine without unnecessary multiplication of parts. When sectional rolls of the class described are applied, I prefer to secure them in place upon a sleeve 105 by means of nuts 104 threaded upon the sleeves, abutting against the ends of the roll and firmly binding the parts together. The sleeve is then adjustably secured in place upon the shaft, by means of feathers 107 inserted in the grooves 106 in the shaft, or in any other suitable manner.

The rear end of the bed or frame of the machine, is provided with an extension or table 108, upon which the sheet is laid and supported to be carried through the machine between the rolls. In order to guide the sheet properly into the machine, I provide a clamp 110 secured to a block 112, which slides in the groove 114 of the table. This clamp can be closed upon the rear end of the sheet by throwing the handle 116 up into the dotted line position. The front end of the sheet then being placed between the rolls, is carried forward, drawing the clamp with it, which being held by the guide prevents lateral displacement of the sheet. When the clamp reaches the cross bar 118 supported on standards 120 at each side of the table, its handle 116 is tripped by the cross bar, and turned downward, when the spring 122 throws the clamp open and releases the sheet, which passes on through the machine. The clamp can then be slipped back to the rear end of its groove in readiness to engage the next sheet.

The sheet in passing through the machine, is guided and held in position by means of the rolls 124 journaled in standards 126, adjustably secured upon the bed of the machine by means of set screws 128 arranged in the transverse slot 130. These standards are also fitted with vertical circumferentially grooved rolls 132, which together with the roll 124 are vertically adjusted by means of set screws 134. The body of the sheet as it passes from one pair of rolls to the next, is supported upon the intermediate roll 124, and each edge of the sheet runs in one of the grooves of the adjacent roll 132, whereby it is accurately guided between the next rolls. It will thus be seen that my improved machine is adapted to form a blank or plain sheet of metal into any desired finished form by a single operation, the machine being fitted with proper forms of shaping roll.

In operation, the selected rolls are placed upon their sleeves or shafts and firmly secured. The blank sheet of metal is then laid upon the table at the rear of the bed, and secured in the clamp 110. It is then pushed forward between the first rolls of the series, which engage and give the first impression to the sheet, thence it passes over the roll 124 the edges of the sheet running in the grooves of the guide rolls 132, and so on through the successive rolls. When the clamp reaches the tripping cross rod, its handle is turned down releasing the sheet, the clamp then being slipped back to receive another sheet. Each pair of rolls of the series increases the impressions upon the plate, until it passes through the last or finishing rolls, whence it is removed from the machine, or is carried between the under-cut or tube forming rolls, as described, where it is formed around the shaping point.

I claim.

1. In a device of the class described, the combination with the series of horizontal shaping rolls, of horizontal guide rolls intermediate of said shaping rolls, vertically and laterally adjustable, and circumferentially grooved vertically arranged and adjustable guide rolls at the ends of said horizontal guide rolls, substantially as described.

2. In a device of the class described, having series of horizontal shaping rolls, of horizontal guide rolls intermediate of said shaping rolls, vertical adjustable bearing supports for said guide rolls and vertical circumferentially grooved guide rolls journaled in said supports at each end of said horizontal guide rolls, substantially as described.

3. The combination with the series of shaping rolls, of the roll conforming to the contour of the sheet, and the duplicate undercut

rolls, the shafts of all said rolls standing in substantially the same vertical plane, substantially as described.

4. In a device of the class described, the combination with the series of shaping rolls, of a roll conforming to the shape of the sheet as formed by said shaping rolls, and the duplicate under-cut rolls arranged on vertical shafts in substantially the same vertical plane with the shaft of said other roll, substantially as described.

5. In a device of the class described, the combination with the series of shaping rolls, of a guide clamp for the free end of the metal sheet, substantially as described.

6. In a device of the class described, the combination with the series of shaping rolls, of a guide clamp for the free end of the metal sheet, and means for automatically releasing said clamp when the sheet shall have traveled a predetermined distance, substantially as described.

7. In a device of the class described, having a series of shaping rolls, the combination with the bed of the machine, of a rear extension thereof, a clamp sliding in a guide in said extension adapted to be secured to the free end of the metal sheet, and means for automatically disengaging said clamp from the sheet when it shall have been carried a predetermined distance, substantially as described.

8. The combination with the machine bed and its series of shaping rolls, of a rear end extension to said bed, a longitudinal guide thereon, a clamp slidable in said guide and adapted to engage the free end of a metal sheet and hold it from lateral displacement, and a cross bar above said extension for tripping the handle of said clamp to release the sheet when it shall have traveled a predetermined distance, substantially as described.

9. In a device of the class described, the combination with the machine bed, and the series of shaping rolls supported thereon, of an extension to said bed, a longitudinal guide in said extension, a clamp sliding in said guide adapted to engage the free end of the metal sheet and means for tripping said clamp when it shall have traveled a predetermined distance, substantially as described.

10. In a device of the class described, having series of shaping rolls, means for giving an "undercut" form to the sheet as delivered from said shaping rolls, comprising in combination a roll conforming to the shape of said sheet, and the duplicate shaping rolls arranged on shafts at right angles with the shafts of said first roll and in substantially the same plane, and means for holding the sheet in bearing contact with said rolls, substantially as described.

11. In a device of the class described, the combination of the roll conforming to the shape of the molded sheet, the duplicate shaping rolls arranged on shafts at right angles to that of the other roll and in substantially the same plane, and a shaping point or guide supported in the space between the three rolls, in shape conforming to the adjacent surfaces of said rolls, substantially as described.

12. The combination with the shaping rolls, of the roll in shape conforming to that of the sheet as delivered from the shaping rolls, the duplicate undercut rolls with their axes in substantially the same vertical plane as that of the first roll, and means for securing the rolls upon their respective shafts in adjusted positions, substantially as described.

13. The combination with the shaping rolls, of the roll in shape conforming to that of the molded sheet delivered therefrom, the duplicate undercut rolls adjacent to said first roll and co-operating therewith, the axles of all said rolls being in substantially the same plane, and means for laterally adjusting the position of the shafts of said duplicate rolls, substantially as described.

14. In a device of the class described, the combination with the under cut or tube forming shaping rolls, of a shaping point arranged in the space between said rolls in cross section conforming to the contour of the adjacent roll surfaces, substantially as described.

15. The combination with the tube forming rolls, of the shaping point arranged between the same, provided with exterior antifriction rolls, one of said rolls being provided with a circumferential groove to receive the lock of the metal sheet, substantially as described.

In testimony whereof I have hereunto set my hand this 30th day of December, 1891.

CLARENCE D. PRUDEN.

In presence of—
T. D. MERWIN,
A. M. WELCH.