(No Model.)

W. C. WESTAWAY.

MACHINE FOR ROLLING SHEET METAL INTO CURVED FORMS.

No. 471,407. Patented Mar. 22, 1892.

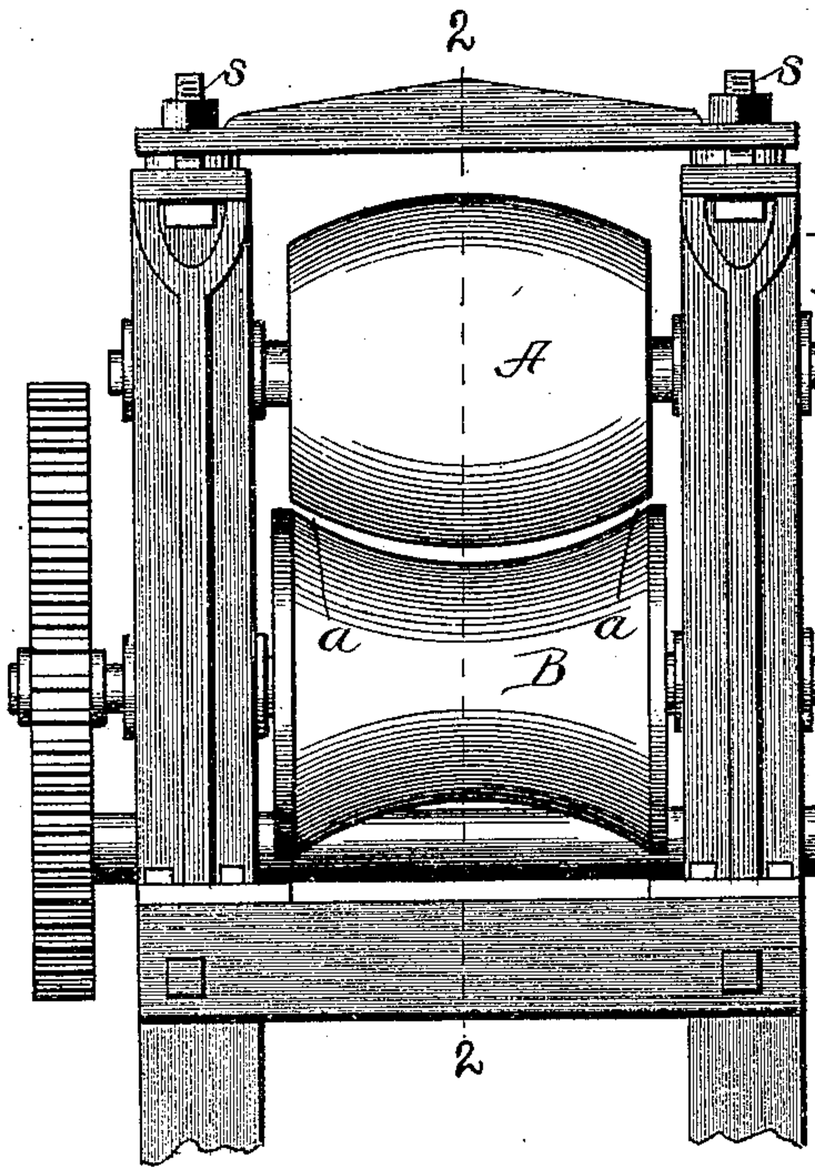

Fig 1

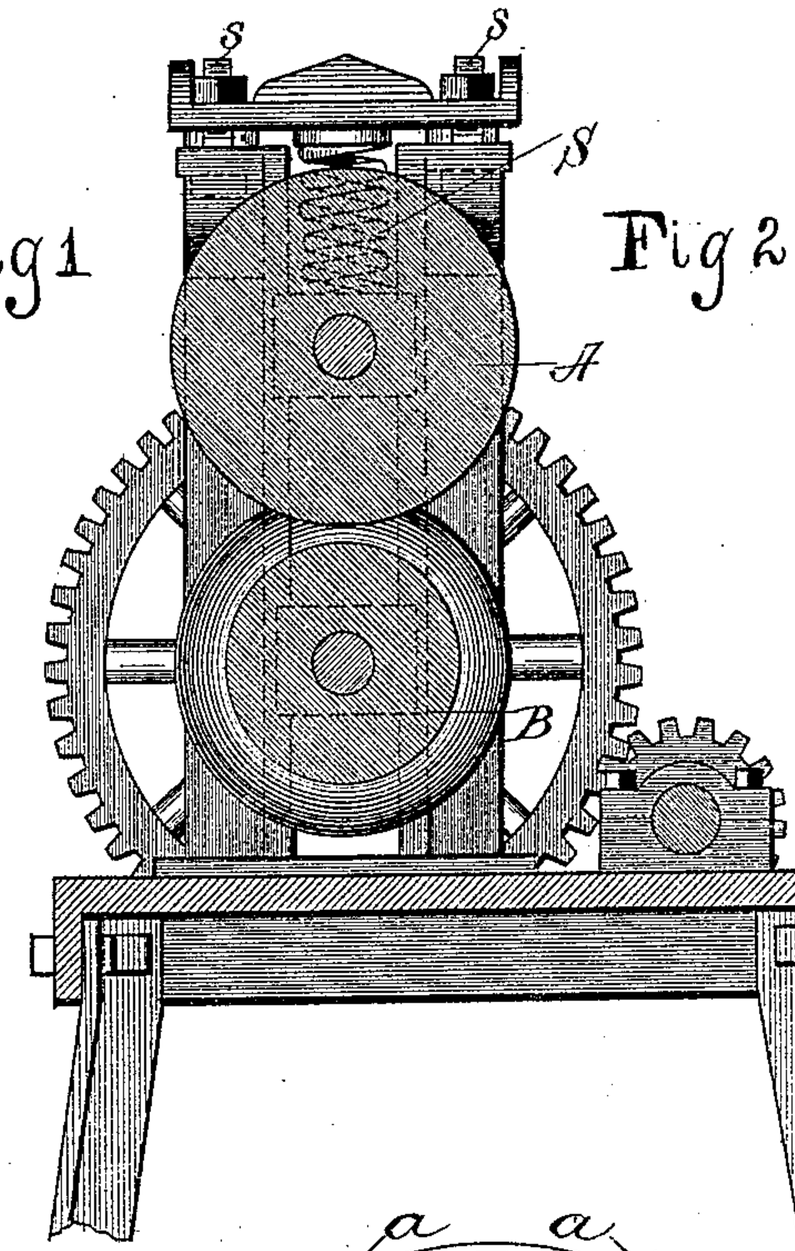

Fig 2

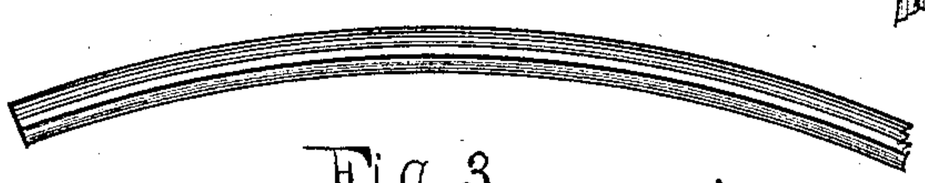

Fig 3

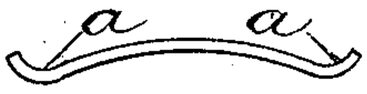

Fig 4

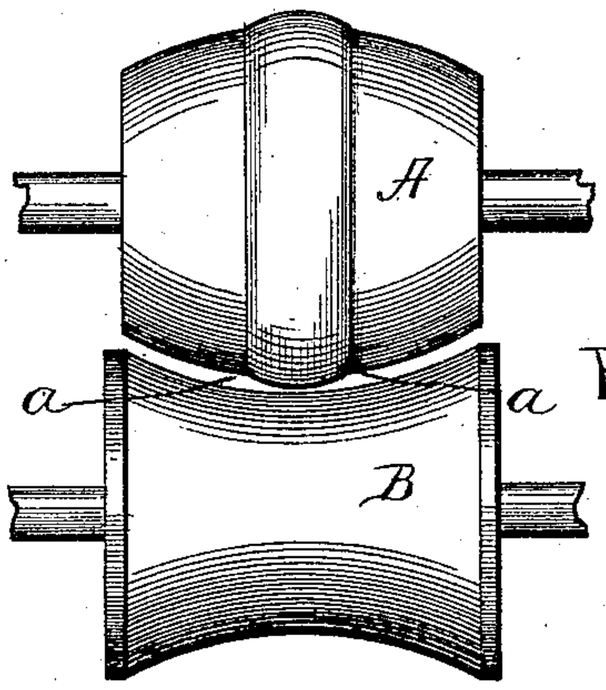

Fig 5

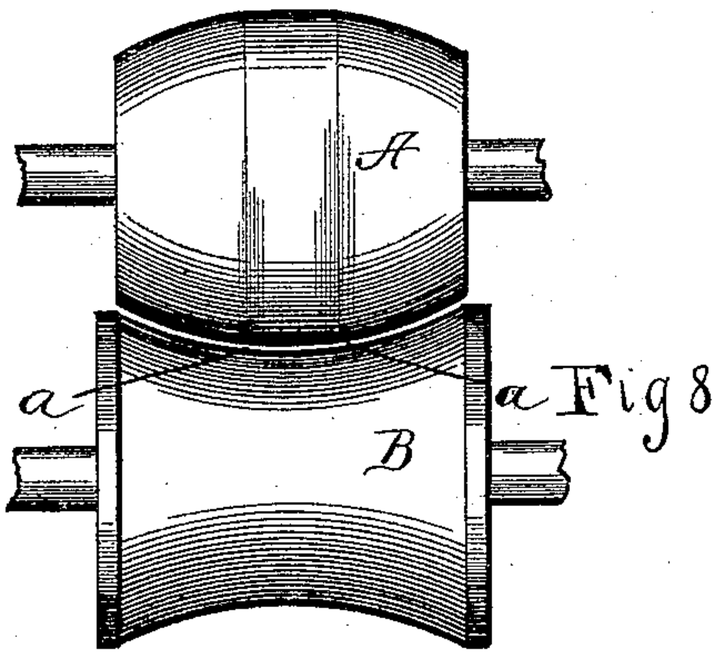

Fig 8

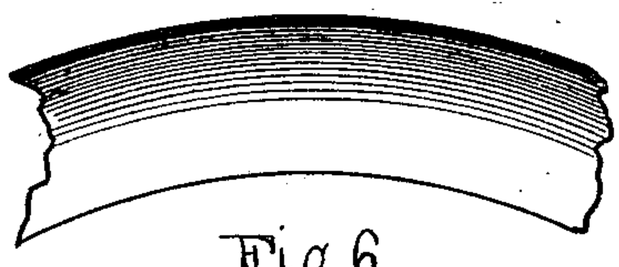

Fig 6

Fig 7

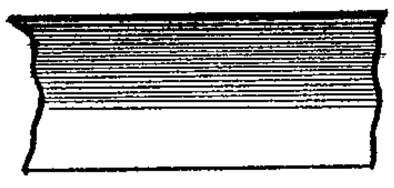

Fig 9

Fig 10

Witnesses.
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UNITED STATES PATENT OFFICE.

WALTER C. WESTAWAY, OF DECORAH, IOWA, ASSIGNOR TO THE DECORAH WINDMILL COMPANY, OF SAME PLACE.

MACHINE FOR ROLLING SHEET METAL INTO CURVED FORMS.

SPECIFICATION forming part of Letters Patent No. 471,407, dated March 22, 1892.

Application filed February 26, 1891. Serial No. 382,958. (No model.)

To all whom it may concern:

Be it known that I, WALTER C. WESTAWAY, a citizen of the United States of America, residing at Decorah, in the county of Winneshiek and State of Iowa, have invented a certain new and useful Improvement in the art of Rolling Sheet Metal into Curved Forms, of which the following is a specification.

The accompanying drawings, in which like reference-letters indicate the same or corresponding parts, illustrate a few of the many different curved forms of sheet metal that may be produced by the aid of my invention, and also illustrate the way in which the principle of the invention is applied to the machine to produce the general result and varied in its mode of application to vary the specific form of result.

Figure 1 is a side elevation of the machine; Fig. 2, a vertical section in line 2 2 of Fig. 1; Fig. 3, an edge view of the form of sheet metal produced by the rolls shown in Figs. 1 and 2; Fig. 4, an end view of the sheet shown in Fig. 3; Fig. 5, a modification of the rolls; Figs. 6 and 7, side and end views, respectively, of the form of sheet produced by the rolls shown in Fig. 5; Fig. 8, another modification of the rolls; and Figs. 9 and 10, side and end views, respectively, of the form of sheet produced by the rolls of Fig. 8.

My invention is based on the discovery made by me that if a sheet of any metal capable of upsetting or becoming permanently altered in form by pressure be passed between two rolls, one of which is convex and the other concave, not only will the resulting form of the sheet be curved, but the specific form of its curvature will depend upon the way in which the rolls "bite" the sheet as it passes between them, and hence that by varying the bite of the rolls metal sheets may be caused to assume a great variety of useful or ornamental curved forms by the simple process of rolling. This fact and its underlying mechanical principle can best be explained by reference to the illustrative drawings.

The machine shown in Figs. 1 and 2, except as to the form of its rolls, is an ordinary rolling-machine, known to every mechanic, and therefore requiring no specific description, except so far as may be necessary to point out the fact that one of the two rolls is convex and the other concave and that one of them is preferably mounted in sliding bearings held to their seat by the action of stout springs S, adapted for adjustment of the pressure by means of adjusting-screws *s s*. I have discovered that if a pair of rolls A B of this general form be so shaped and set as to bite or press upon the metal somewhat harder at and near their ends than at other points and the sheet be fed between them the resulting form of sheet will be substantially such as is outlined in Figs. 3 and 4—that is to say, its cross-section or end view will exhibit the reversed curves of Fig. 4 and its side view the slight longitudinal curve of Fig. 3. The increased pressure at and near the ends of the rolls is indicated in Fig. 1 by the convergence of their outlines at the points marked *a a*. If, on the other hand, the rolls be formed and set, as shown in Fig. 5, so that the increased bite comes at and near the middle, as indicated at *a a*, the resulting form of sheet will be substantially as represented in Figs. 6 and 7, having the semicircular or approximately semicircular cross-section of Fig. 7 and the circular longitudinal bend of Fig. 6. Again, if the rolls be formed and set, as shown in Fig. 8, so that the increased bite comes at each side of the middle line and a short distance therefrom, as indicated at *a a*, the resulting form of sheet will be longitudinally straight, as represented in Fig. 9, but semicircular or approximately semicircular in cross-section, as shown in Fig. 10. These illustrations will suffice to show that by varying the position of the bite or zone of greatest pressure in a pair of rolls, one of which is convex and the other concave, the manufacturer can produce a corresponding variety of useful products by the simple process of rolling between two rolls not heretofore known to be available for such purpose.

It would be impracticable to attempt to illustrate or describe all possible variations in the position of the bite and in the consequent forms of the product and impossible to point out with scientific exactness the precise interaction of the forces concerned in producing

the different results, which depend in part upon the degree of curvature of the rolls and in part upon the drawing effect of the unequal bite and of the differential speed of the rolls along their line of contact with the sheet metal.

The drawings exaggerate the increase of bite in order to render the fact visible to the eye. In practice the space between the rolls needs to be varied only minutely, and the variation would hardly be perceptible in the full-sized roll, much less in the reduced drawing.

As an example of the utility of this invention I would state that I have for some time been rolling sheet-metal sails for windmills in a machine having the form of rolls represented in Fig. 8. The sheet-metal blanks in this case are about one-sixteenth inch thick, three feet long, nine inches wide at the wider end, and three inches wide at the narrower end, and are fed endwise to the rolls. They come out of the machine curved in cross-section, but straight longitudinally, and ready for immediate application to the windmill. Other manufacturers make the same form of sail by the use of a drop-press or by feeding sidewise through a three-roll rolling-machine; but, as compared with the work of such machine, the increased output and the saving of labor effected by my improved process of rolling enable me to save about four-fifths of the cost of manufacture, besides producing sails which retain their curvature more permanently than those made with the three-roll machine or with the drop-press.

I am aware that in forming articles of sheet metal by means of rolls it is common to so shape the rolls as to leave a space between them to which the sheet conforms itself as it passes through—for example, by beading one roll and grooving the other to form a corresponding corrugation in the sheet. In such cases the resulting form of the sheet is due to pressure alone, the rolls merely acting as a continuous die, pressing the sheet at once into its desired shape as it passes between them. The principle of my invention is altogether different. The resulting form of the sheet in its cross-section does not correspond to the form of the space between the rolls and is not due to pressure alone nor effected by an action similar to that of dies nor by an action like that of spinning rolls or disks. On the contrary, it is due to the unequal draft or tensile strain upon the metal, causing the sheet to curl up transversely and to issue from the rolls in a form which is determined by the position at which the lines of greater strain have been applied to it, and not at all corresponding to the form of the space through which it has passed. Thus in Figs. 4, 7, and 10 the transverse section of the resulting sheet does not correspond to the shape of the space seen between the rolls in Figs. 1, 5, and 8, and therefore cannot have been produced by the pressure alone.

I am aware that in the patent to S. E. Nichols, dated February 5, 1867, No. 61,856, it was proposed to bend narrow strips of sheet metal longitudinally by pinching one edge between rolls. Such longitudinal bending, while produced by some modifications of my rolls, as in Figs. 1 and 5, is not by others, (see Fig. 8,) and is therefore merely incidental and wholly immaterial to my invention.

At the middle of my rolls the convex surface travels faster than the concave, and therefore produces a drawing strain upon one side of the sheet along its middle line. At the ends of the rolls the concave surfaces travel faster than the convex, and therefore produce drawing strains upon the other side of the sheet along its lateral lines. At some intermediate point between the middle and each end the opposed roll surfaces travel at equal speed, and no strain is produced. I have discovered that if under such conditions the rolls be caused to pinch the sheet metal at or near their middle or at or near their ends more strongly than at other points the resultant of the tensile strains will be such as to cause the sheet to curl up transversely as it issues from between the rolls, taking a shape which is determined by the position of the point or points at which the greater pinching is applied, and by utilizing this discovery in the manner herein set forth I have been enabled to effect a great practical and economical improvement in the manufacture of various kinds of sheet-metal articles.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

In a sheet-metal rolling or forming machine, the combination of convex and concave rolls A B, constructed and arranged to present along their lines of pressure on the metal sheet zones or regions *a*, constructed to bite with unequal force in different places along the line of contact with said sheet, substantially as described.

WALTER C. WESTAWAY.

Witnesses:
W. M. HILL,
L. HILL.