WORTHEN & RENWICK.

Corrugating Sheet Metal.

No. 24,689. Patented July 5, 1859.

Fig. 1,

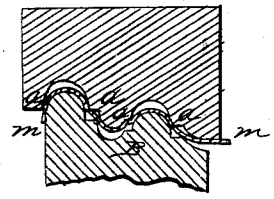


Fig. 4,

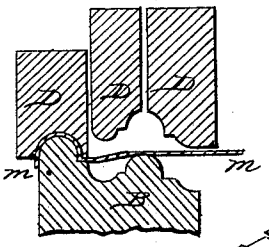


Fig. 2,

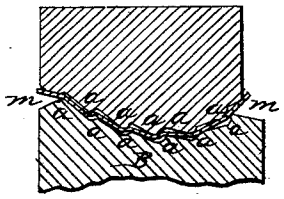


Fig. 7,

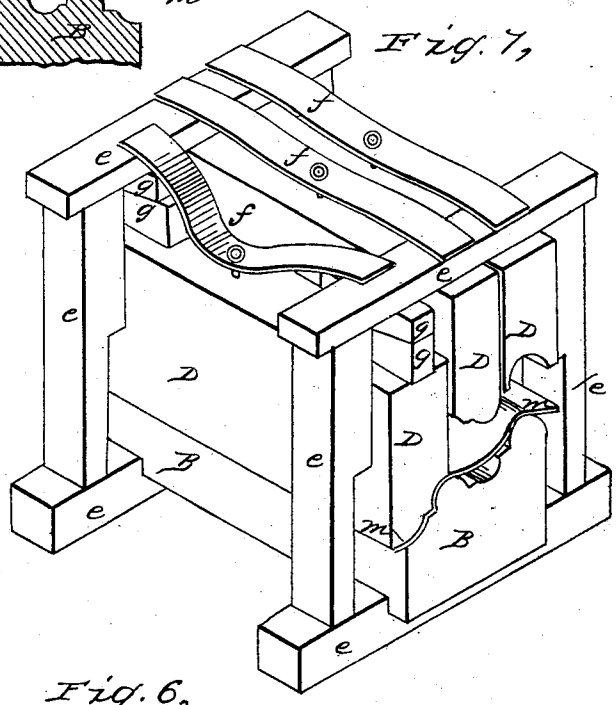


Fig. 5,

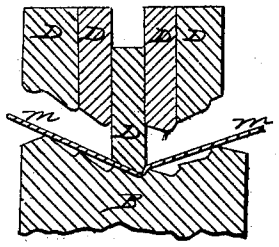


Fig. 6,

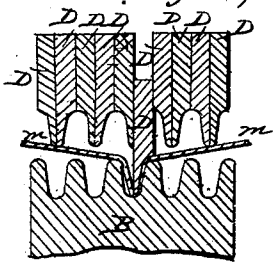
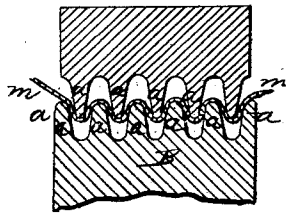


Fig. 3,



UNITED STATES PATENT OFFICE.

WILLIAM E. WORTHEN AND HENRY B. RENWICK, OF NEW YORK, N. Y.

IMPROVEMENT IN CORRUGATING SHEET METAL.

Specification forming part of Letters Patent No. **24,689**, dated July 5, 1859.

To all whom it may concern:

Be it known that we, WILLIAM E. WORTHEN and HENRY B. RENWICK, civil and mechanical engineers, and both of the city, county, and State of New York, have discovered a certain new and useful Method of Corrugating Sheet Metal, or of molding it into conformations similar in their nature to corrugations; and we do hereby declare that the following specification, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings, Figures 1, 2, and 3 are sections of pairs of dies with sheet metal between them, representing the plans by which sheet metal is corrugated or attempted to be corrugated by methods now in use, Fig. 2 being a section through dies substantially such as are now in use for corrugating metallic boats. Figs. 4, 5, and 6 are sections through dies representing the manner in which pieces or sheets of metal are to be corrugated by the method devised by us; and Fig. 7 is a perspective drawing of a machine by means of which our method has been successfully applied in practice.

Corrugated or molded sheet metal is now extensively used for floors, partitions, beams, cornices, and gutters of buildings, or for similar articles; also, for boats, small vessels, and a great variety of other uses; but its general employment is hindered by the expense and difficulty of corrugating it, according to the methods now in use. These are three, chiefly: First, by means of hammers and sets, which are applied chiefly to corrugating floors, partitions, and similar articles; second, by similar means applied to sections of different moldings—such as cornices—which are afterward brazed or otherwise attached to each other so as to make up a whole; and, thirdly, by means of properly-shaped male and female dies extending over the sheet or sheets to be corrugated or molded, and between which the sheet is placed. These dies are then caused to approach the one to the other generally by means of powerful hydrostatic presses, and the metal usually conforms itself to the desired shape. The two first are essentially hand processes, while the third is a mechanical method, and our invention is an improvement upon it. In this process as now practiced the upper die approaches the lower one, acting upon the metal between them, and commences to form it with great ease and small expenditure of power until the corners of the die, if there be corners, or certain salient parts, begin to nip the sheet, as at *a a a*. As the metal approaches nearer to its ultimate shape it must creep in toward the center of the die, in order to supply sufficient surface to conform to the curves and angles of the mold, and this creeping must take place not only under the resistance due to the friction of the bent metal sliding over the curves of the dies, but the creeping is further resisted by the force required to bend the metal out of the shape it has already taken and into the shape of the next succeeding corrugation. As the dies continue to approach, making the bends shorter and the nips tighter, the power required becomes enormous, and the friction is so great that the sheet usually ceases to creep and actually stretches in its efforts to afford sufficient surface. This stretching takes place in actual practice even in corrugating the sides of small boats, where the metal is not thick and the corrugations are shallow. If the sheet be highly ductile, it does not tear, but is only weakened and rendered brittle; but it often happens that the sheets rend apart in several places, thus not only losing the labor expended, but destroying the sheet itself. The difficulties thus set forth are so great that it is not attempted to corrugate metal deeply by this process, and resort is had to hand hammers and sets. Now, our invention, as is proved by actual practice on an experimental machine, remedies the evil completely, lessens the power required very materially, does not render the sheet brittle to any practical extent, entirely prevents fracture, and by its use we are enabled to corrugate moldings even more difficult than that represented in Figs. 1, 2, and 3, and on a sufficient scale for the cornices of large buildings.

The nature of our discovery consists in corrugating or molding sheet metal by means of properly-shaped dies acting in succession upon different parts of the sheet, substantially in the manner and for the purposes herein specified. One method of effecting this process is to procure a lower or female die, of wood, metal, or any suitable material, whose cross-section is

the same, or nearly so, as that desired to be produced in sheet metal, (see B B B,) and this die does not differ from those now in use. A set of upper dies, D D D, are then procured, whose acting surfaces, when properly arranged, shall constitute a single surface conforming in shape to that of one side of the corrugated sheet to be produced, and we usually intend to arrange them within a proper framing, as *e e e*, so that they shall be free to move toward and away from the under die. These dies should be properly guided so as to match the lower die with precision when forced toward it.

In the machine represented in Fig. 7 the dies serve partially as guides for each other, the outer sides of the outer dies being kept in place by part of the frame, and the sides of the dies which otherwise would touch being kept apart by small projections. (Not represented in the drawings.)

The acting surfaces of the sectional dies may make up a complete surface, as in Figs. 5 and 6, or there may be an interval between the sections, as in Figs. 4 and 7.

We usually intend to support these dies in some proper manner, as by the springs *f f f*, and to apply some mechanism for lifting and forcing them down—such as the springs and the wedges *g g g*.

In molding or corrugating sheet metal by our process the sheet or sheets are to be laid loosely upon the lower or bed die, and then any one of the upper dies is forced down upon it until the metal takes its proper shape. This die is then held or left in that position, and the next die in succession in the series is brought down and held, and thus in succession until the operation is finished. If a die at or near the center be brought down first, then the plan is to work right and left from it. If one of the end dies be first brought down, then the workman must continue in succession die by die to the other end. The precise lines of division of the sectional dies must depend to a great extent upon the configuration of the corrugation and the thickness and rigidity of the metal, which will govern the judgment of the constructor. The more frequent the divisions are (so long as there are not more than two dies for each separate wrinkle, member, or corrugation) the easier will be the operation; but in all ordinary cases it will be a safe rule to make one die for each decided member of a molding or each depression of a corrugation. The instances shown in the drawings, taken in connection with this specification, will serve as a sufficient guide for a skillful workman. In all the figures the metal being acted upon is represented at the letters *m m m*, and a simple inspection of the drawings shows that it is perfectly free to creep in and conform to shape when acted upon by numerous sectional dies acting in a series, and that it is nipped, strained, and impeded wherever it is attempted to be molded according to the old plan, as in Figs. 1, 2, and 3.

We do not think that any explanation can show more clearly the advantages of our process, and the distinction between it and the old one can in no way be made more clear than by a simple inspection of the drawings. We intend to raise and lower the dies in any convenient manner by screws, levers, cams, pistons or plungers of pumps or small steam-cylinders, or otherwise, and sometimes to use them as rams acting by their own weight, when dropped, or being forced down by blows of hammers. We intend to guide these dies in any convenient manner, and to cause them to approach the lower bed in parallel lines or otherwise, as may be most convenient. We also intend at times to use a sectional lower die in connection with sectional upper dies acting in succession, as a convenient method of obtaining several distinct patterns from a comparatively small number of dies and for other purposes.

We claim as new and of our own invention—

The method of corrugating or molding sheet metal by several dies acting in succession, substantially in the manner specified, upon a sheet resting upon a bed die or dies, so as to cause the metal to conform to shape, substantially in the manner herein described.

In testimony whereof we have hereunto subscribed our names, in the city of New York, on this 24th day of February, A. D. 1858.

W. E. WORTHEN.
HENRY B. RENWICK.

In presence of—
R. S. GILLESPIE,
CHAS. WRIGHT.