G. B. JOHNSON.

APPARATUS FOR PRODUCING CORRUGATED METAL SHEETS.

APPLICATION FILED JAN. 26, 1910.

971,277.

Patented Sept. 27, 1910.

5 SHEETS—SHEET 1.

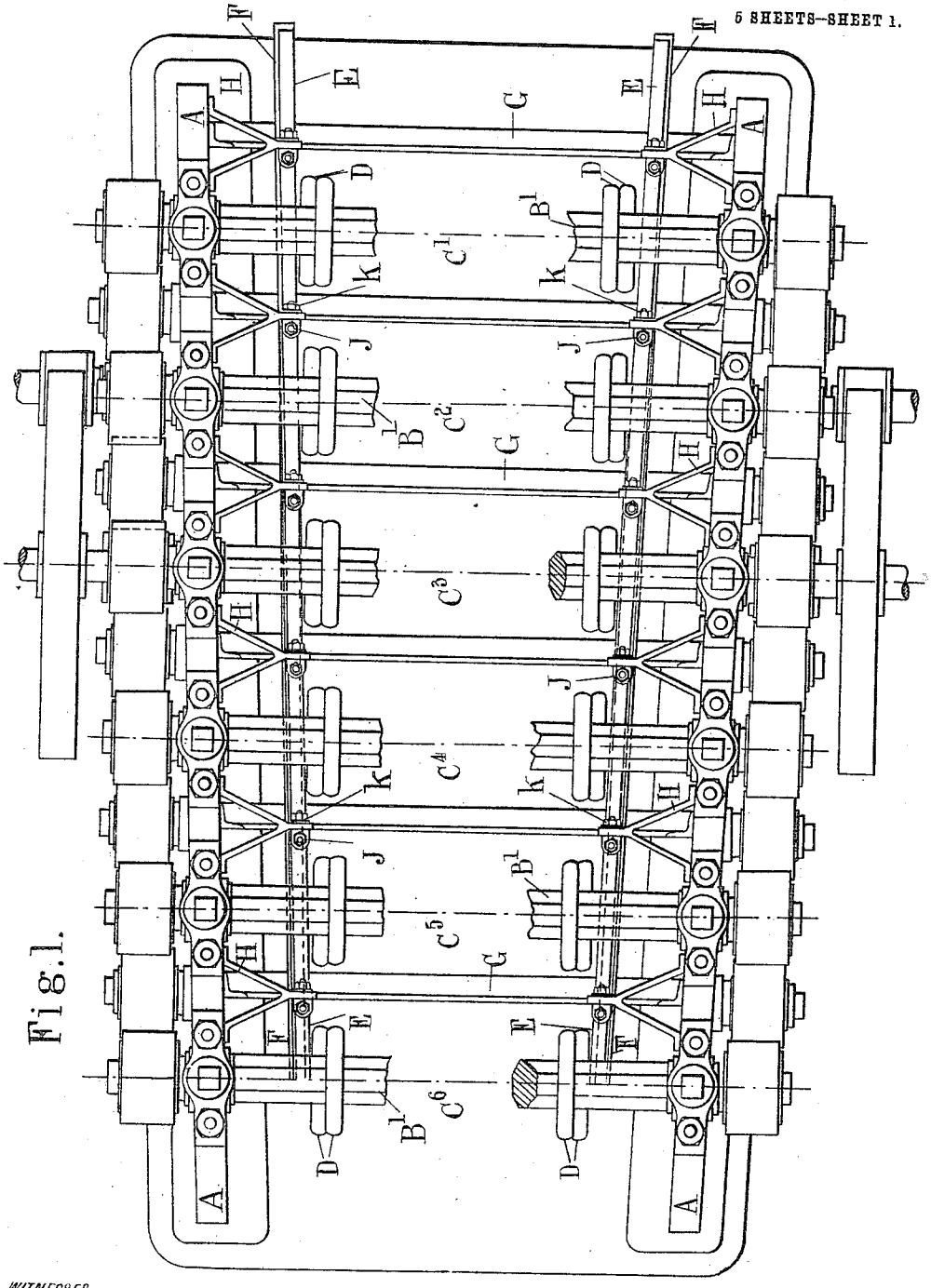

Fig. 1.

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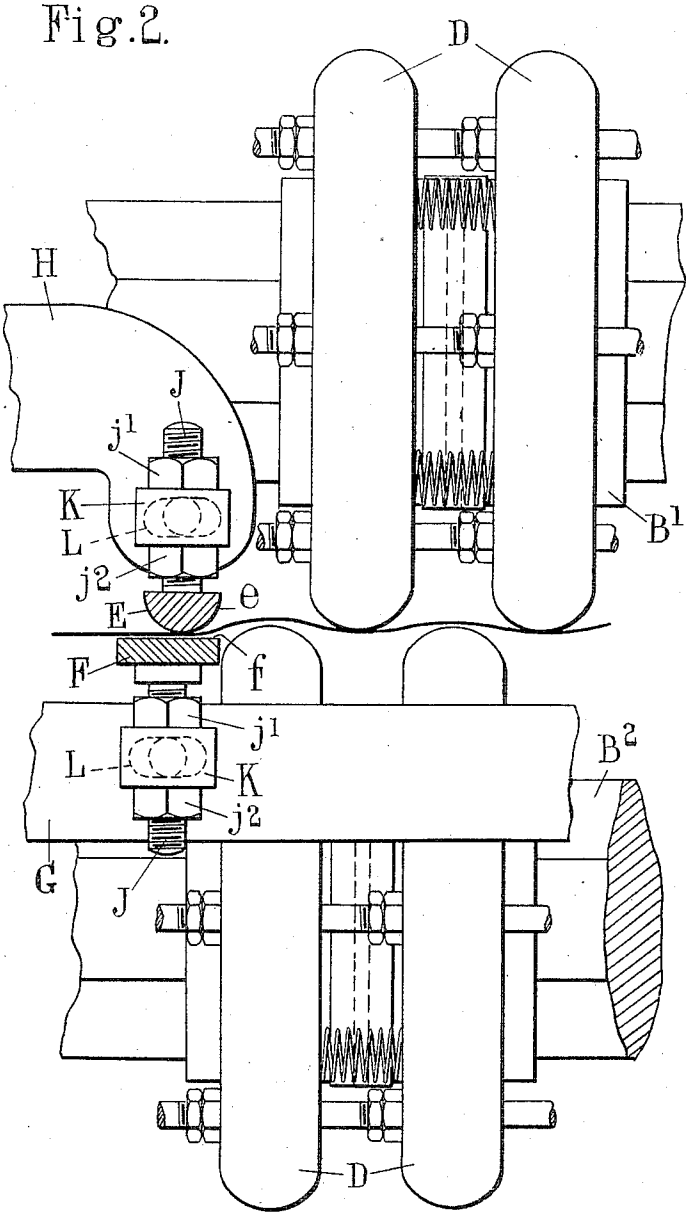
5 SHEETS—SHEET 2.

Fig. 2.



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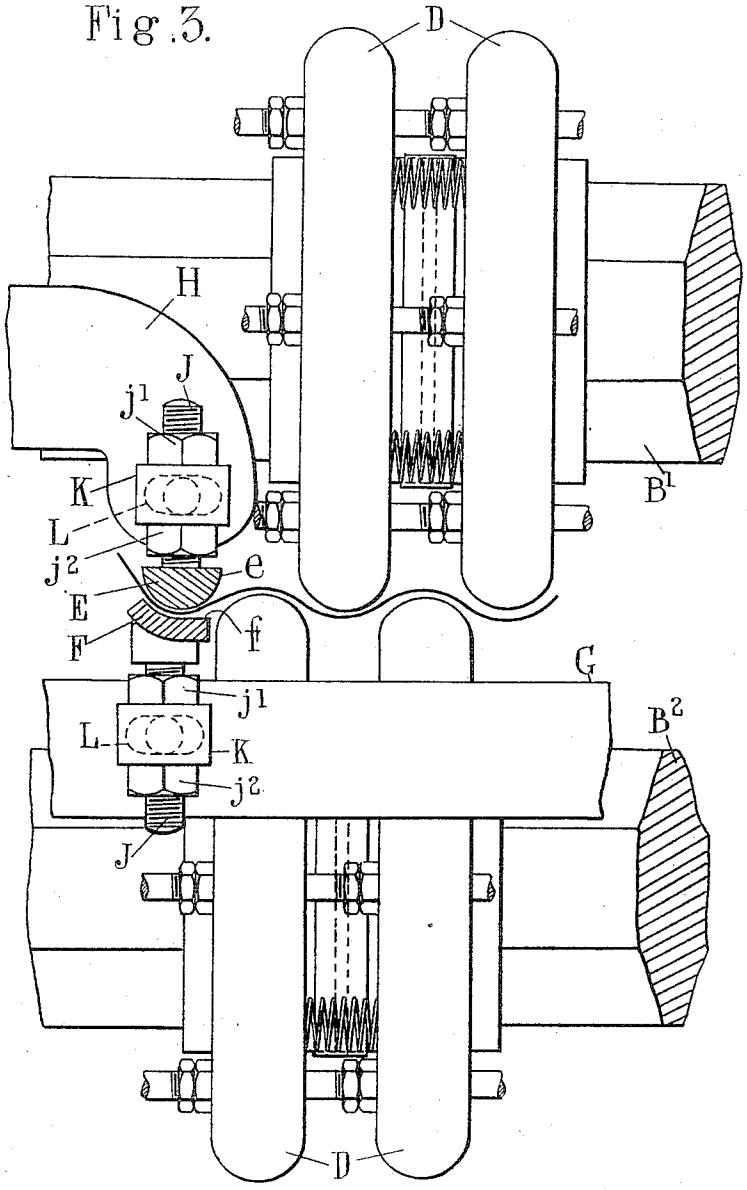
5 SHEETS—SHEET 3.

Fig. 3.



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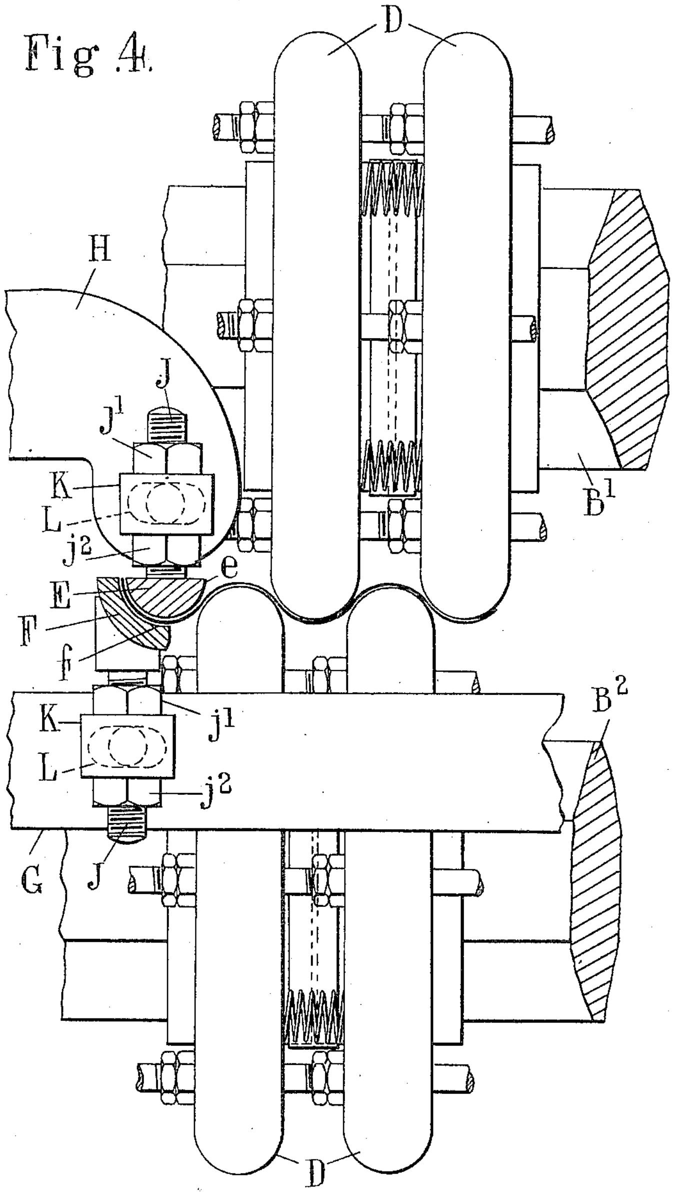
5 SHEETS—SHEET 4.

Fig 4.



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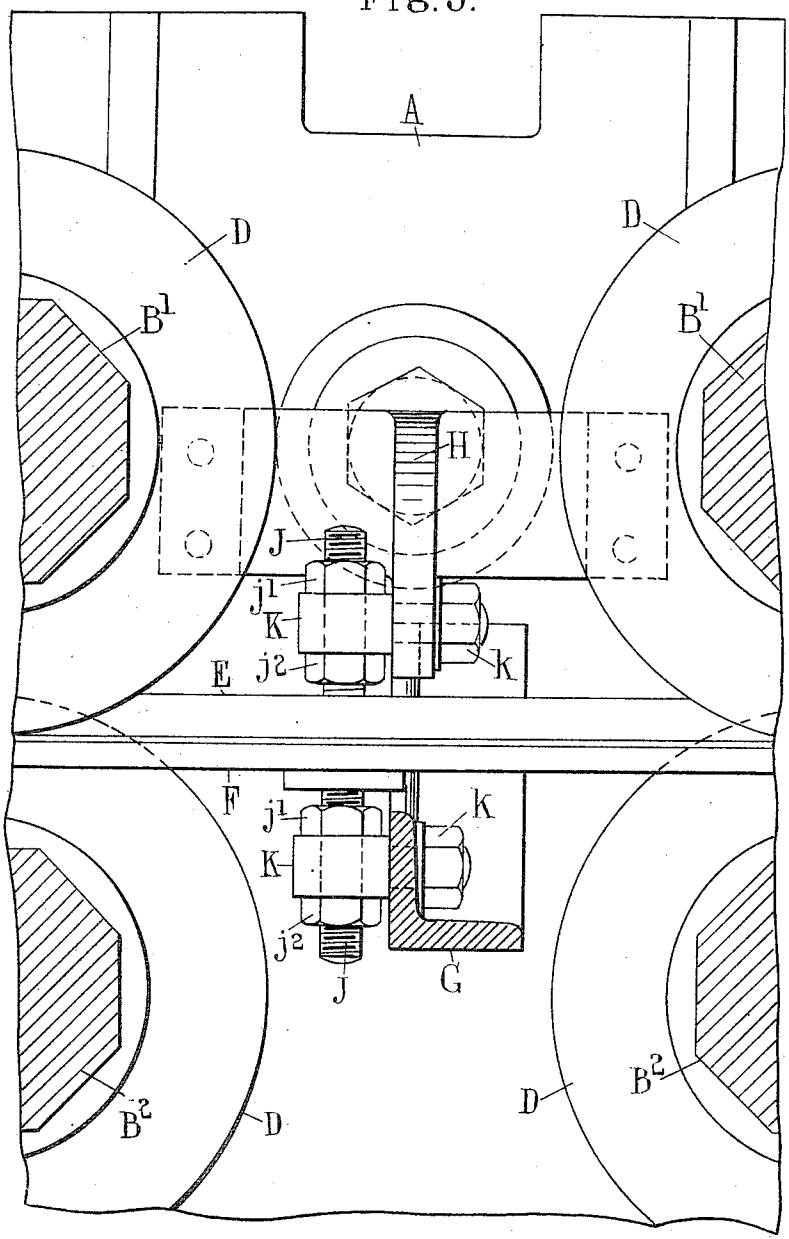
5 SHEETS—SHEET 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PRODUCING CORRUGATED METAL SHEETS.

971,277. Specification of Letters Patent. Patented Sept. 27, 1910.

Application filed January 26, 1910. Serial No. 540,168.

To all whom it may concern:

Be it known that I, GODFREY BENINGTON JOHNSON, a subject of the King of Great Britain, and resident of London, England, have invented certain new and useful Improvements in Apparatus for Producing Corrugated Metal Sheets, of which the following is a specification.

This invention relates to improvements in machines for producing a plurality of parallel corrugations in metal sheets by a continuous rolling process, of the type described in the specification of Letters Patent 815710 previously granted to me, for a corrugating machine, on March 20th, 1906.

The object of the present invention is to provide a machine of the type specified with means for shaping the outer flank of the outermost corrugation at each side of a corrugated sheet in such manner as to render said corrugation of sharper curvature than the rest of the corrugations, so that its flank is more nearly perpendicular to the general plane of the sheet than heretofore.

To this end, the invention consists in the employment of a stationary device mounted at either side or both sides of the machine for the purpose of producing one or both of the marginal corrugations in a sheet during its passage through the machine, each such device comprising two main members whereof one constitutes a mandrel extending transversely of the several pairs of rolls throughout the length of the machine and having a convex operative surface uniformly curved to correspond with the finished form of the marginal corrugation to be produced, while the other member constitutes a forming-die extending alongside of the mandrel and presenting toward the operative surface thereof a surface which at the entering end of the machine is flat and which thereafter assumes a concave form with a progressively diminishing radius of curvature.

Corrugated metal sheets, such as are commonly used for roofing and other structural work, have heretofore, as a rule, been so made that the marginal corrugations in any sheet have the same cross-sectional configuration as the other corrugations throughout the sheet. Consequently, as the arc of curvature in either direction is not of great amplitude, so that a plane which is tangent to the sheet at the line of reversal of curvature in any corrugation does not closely approach perpendicularity to the general plane of the sheet, it has usually been found necessary, in order effectually to exclude wet which would otherwise be liable to be driven by the wind through the overlapping joint between two contiguous sheets, to joint the sheets together by superposing not one but two marginal corrugations of the one sheet upon the corresponding corrugations of the other sheet.

The employment of corrugated sheets provided with outer corrugations of sharper curvature than the rest of the corrugations enables a considerable saving in material to be effected by obviating the necessity for thus superposing two marginal corrugations of each of two contiguous sheets so as to form a weatherproof joint.

In cases where only the outer half of each outermost corrugation is made as just described, it will be evident that upon this corrugation being superposed upon the corresponding corrugation of the contiguous sheet, the free edge of the superposed sheet will contact with the flank of the corrugation which it overlies, in such manner as to oppose the drawing of the two sheets together by the usual bolts, and will therefore (on the bolts being tightened) be forced into such close contact with the other sheet as to insure the formation of a tight and thoroughly weatherproof joint along the edge of the superposed sheet.

In cases where both flanks of the outermost corrugation at each side of a sheet are made steeper than those of the remaining corrugations relatively to the general plane of the sheet, although the action explained above may not be so marked, the overlying corrugation, on the bolts being tightened, will nevertheless be caused to clip over the underlying corrugation so tightly as to produce a close and weatherproof joint between them; and in order more effectually to secure this result, the extreme marginal portion of the sheet at each side may be made slightly wider than would otherwise be the case, so as to cause the free edge of the overlying sheet to contact closely with the contiguous portion of reversed curvature on the underlying sheet.

In the accompanying drawings, Figure 1 is a plan view of the corrugating machine referred to, with the so-called hollow mandrels in place at both sides of the machine, the middle portion of the length of each pair of rolls being broken out. Fig. 2 is a part

cross section taken near the entrance end of the machine, showing the mandrel at the left-hand side in section. Fig. 3 is a similar view taken near the middle of the length of the machine. Fig. 4 is another similar view taken near the delivery end of the machine. Fig. 5 is a part longitudinal section of the machine showing a means of adjustably supporting the mandrel. Figs. 2 to 5 are drawn to a larger scale than Fig. 1.

A, A are the side frames of the machine, which support bearings wherein are journaled the upper and lower arbors B^1, B^2 of each pair of rolls, there being six successive pairs of rolls C^1–C^6 shown in the machine illustrated in Fig. 1. Each arbor B^1 or B^2 has splined upon it a series of independent roll-sections D which are separated from one another by a yielding medium, the normal distances apart of the sections in each roll diminishing progressively in successive pairs of rolls. The axes of the two arbors B^1, B^2 of a pair are set progressively closer together in successive pairs of rolls, all the arbors being positively rotated at the same angular velocity and the maximum diameters of all the roll-sections D being equal throughout the machine.

The device which, according to the present invention, is employed to produce the marginal corrugations at either side of the sheet, comprises two main members, namely, a convex mandrel E of uniform cross-sectional form throughout its length, and a forming-die F for progressively bending the sheet about the mandrel; these two members being mounted just outside the outermost roll-sections so as to extend alongside of one another between the upper and lower arbors B^1 and B^2 of all the pairs of rolls C^1–C^6. The machine illustrated in the drawings being arranged to deliver the sheets with their lateral edges upwardly turned, the mandrel E is shown as placed with its operative surface *e* downwardly presented and the forming-die F with its operative surface *f* upwardly presented. In the most convenient construction, the mandrel E consists of a straight bar of steel of approximately half-round cross-sectional form throughout its entire length, while the forming-die F is made from a bar of steel of rectangular form in cross-section, which at the entering end of the machine is left flat and which is brought, by a process of transverse bending, to a curved form in cross-section, the radius of curvature progressively diminishing so that the operative surface *f* of the bar becomes in effect gradually lapped about the outer side of the convex operative surface *e* of the mandrel E toward which it is presented. The marginal corrugating devices at the opposite sides of the machine converge toward one another from the entrance to the delivery end of the machine in accordance with the gradual diminution which occurs in the effectual width of the sheet during its progress through the machine, while the operative surfaces *e* and *f* of the respective members of each device are opposed to one another at such a distance apart that the corresponding margin of the sheet, when drawn through between the members by the action of the rolls, will be brought to the desired configuration.

The respective members of each marginal corrugating device may be retained in place by means of brackets attached to the side frames A of the machine. In the example illustrated, the lower members F, F at opposite sides of the machine are supported by a series of cross stays G connecting the side frames A, A, each cross-stay consisting of a length of angle-bar extending between two adjacent rolls of the lower tier, while each of the upper members E is supported by brackets H projecting from the adjacent side frame A between two adjacent rolls of the upper tier. At each point of support the attachment is designed to afford means of adjustment in both the transverse and vertical directions. For this purpose each attachment comprises a screw-threaded stud J projecting vertically from the back of the bar E or F, the stud J passing through the eye of an eye-bolt K wherein it is adjusted vertically by means of top and bottom nuts j^1, j^2. The shank of the eye-bolt K passes through a horizontal slot L provided in the transversely extending vertical web of the cross-stay G or bracket H, the eye-bolt being thus adjustable, transversely of the machine, in the direction of the length of the slot L, wherein it is fixed by means of the nut *k* which screws on the threaded shank of the bolt.

The upper and lower bars E and F are preferably splayed apart at the entrance end of the machine so as to facilitate the slipping of the sheets between them.

If desired, the final portion at the delivery end of the forming-die may have the same cross-sectional form for some distance, so as to insure what may be termed confirmation of the shape ultimately given to the margin of the sheet; just as, in the case of the corrugating rolls, it is preferred to make the two (or more) last pairs of rolls at the delivery end of the machine identical in form with a view to more effectually finishing the sheet and better insuring uniformity in the contour of the corrugations throughout the whole length of the sheet. Obviously the bars E and F may be formed so as to give any desired degree of curvature to the marginal corrugations.

The surfaces of the bars E and F which contact with the sheet should be burnished or otherwise rendered as smooth as is practicable so as to diminish friction; and it is found that where this is done, in conjunc-

tion with the use of forming-dies whose progressively varying cross-sectional curvature is properly graduated, injury to the galvanized coating (where such is applied as usual prior to the corrugating operation) is effectually obviated.

It will be obvious that the lateral guides previously employed, as described in the specification already referred to, for insuring the straight passage of the sheets through the corrugating machine, are rendered unnecessary by the use of the devices of the present invention at both sides of the machine.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. In a machine of the kind specified for producing a plurality of parallel corrugations in a metal sheet by a continuous rolling process, means for forming a marginal corrugation on the sheet, consisting in the combination with a stationary mandrel which extends transversely of the several pairs of corrugating rolls throughout the length of the machine and which has a convex operative surface uniformly curved to correspond with the finished form of the marginal corrugation to be produced, of a stationary forming-die extending alongside of said mandrel and presenting toward the operative surface thereof a surface which at the entering end of the machine is flat and which thereafter assumes a concave form with a progressively diminishing radius, substantially as and for the purpose set forth.

2. In a machine of the kind specified for producing a plurality of parallel corrugations in a metal sheet by a continuous rolling process, means for forming a marginal corrugation on the sheet, consisting in the combination with a mandrel constituted by a metal bar of approximately half-round cross-sectional form so fixed as to extend transversely of the several pairs of corrugating rolls throughout the length of the machine, of a forming-die made from a bar of metal of rectangular form in cross-section and so fixed as to extend alongside of the mandrel, the bar constituting said forming-die being flat at the entering end of the machine and thereafter assuming a curved form in cross-section, the radius of curvature progressively diminishing so that the operative surface of the forming-die becomes in effect gradually lapped about the outer side of the convex operative surface of the mandrel, substantially as specified.

Dated this 6th day of January, 1910.

GODFREY B. JOHNSON.

Witnesses:

H. D. JAMESON,

F. L. RAND.