No. 726,691. PATENTED APR. 28, 1903.

G. B. JOHNSON.

MACHINERY FOR ROLLING SHEET OR OTHER METAL STRIPS OR BARS OF CURVED OR OTHER SECTION.

APPLICATION FILED DEC. 9, 1902.

NO MODEL. 7 SHEETS—SHEET 1.

FIG. 1a.

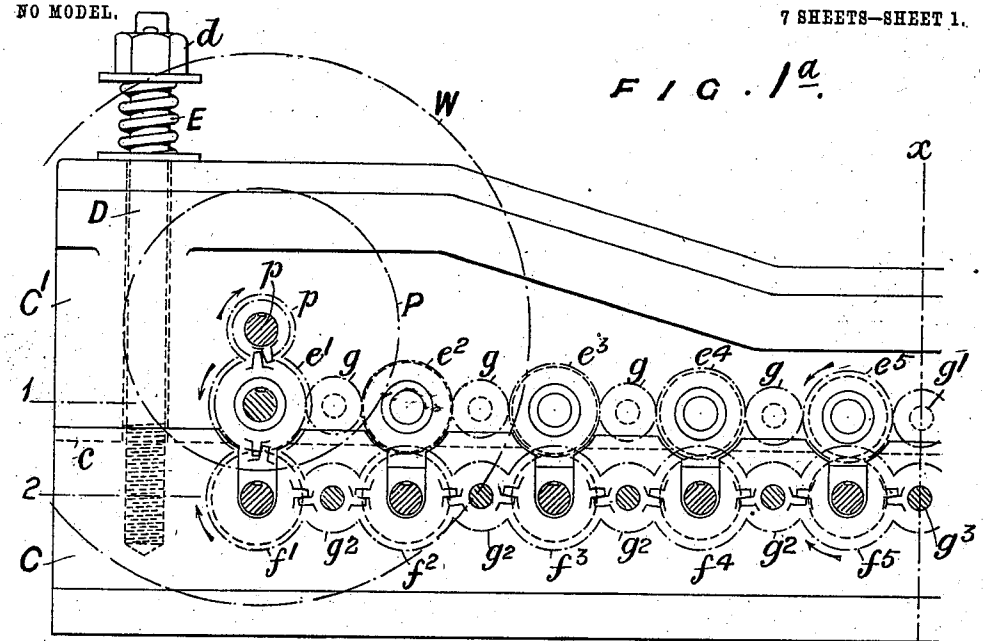
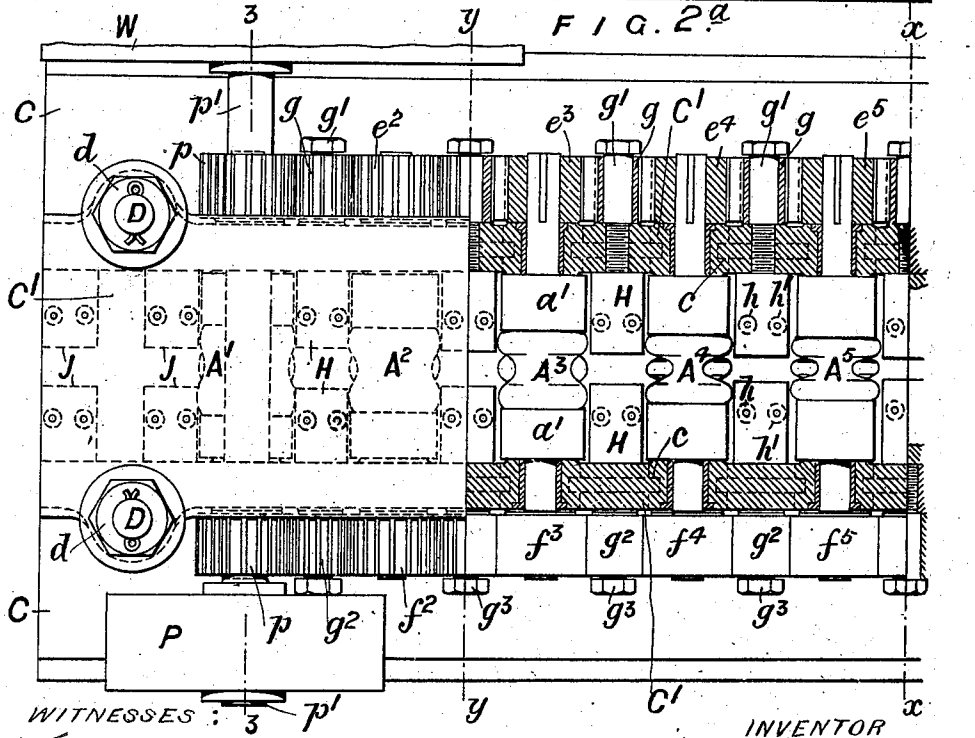


FIG. 2a.



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NO MODEL. 7 SHEETS—SHEET 2.

FIG. 1b.

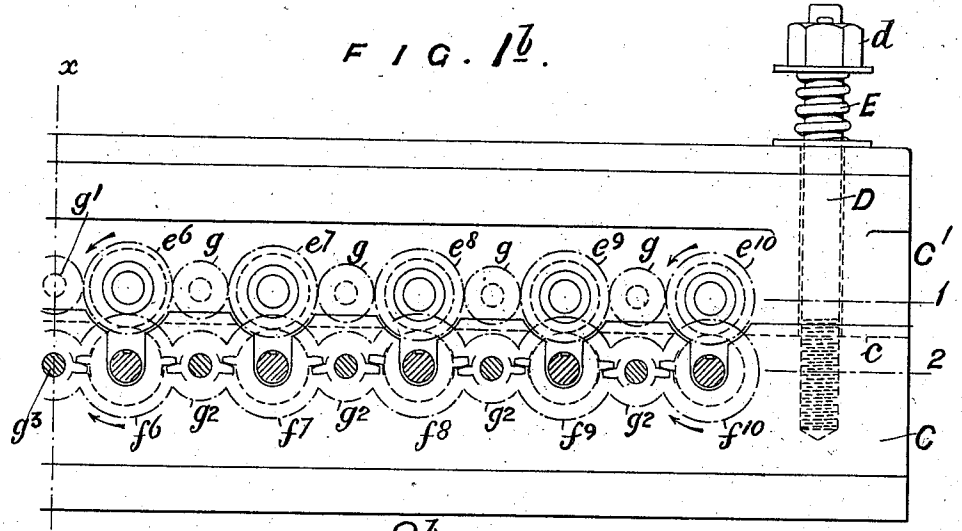
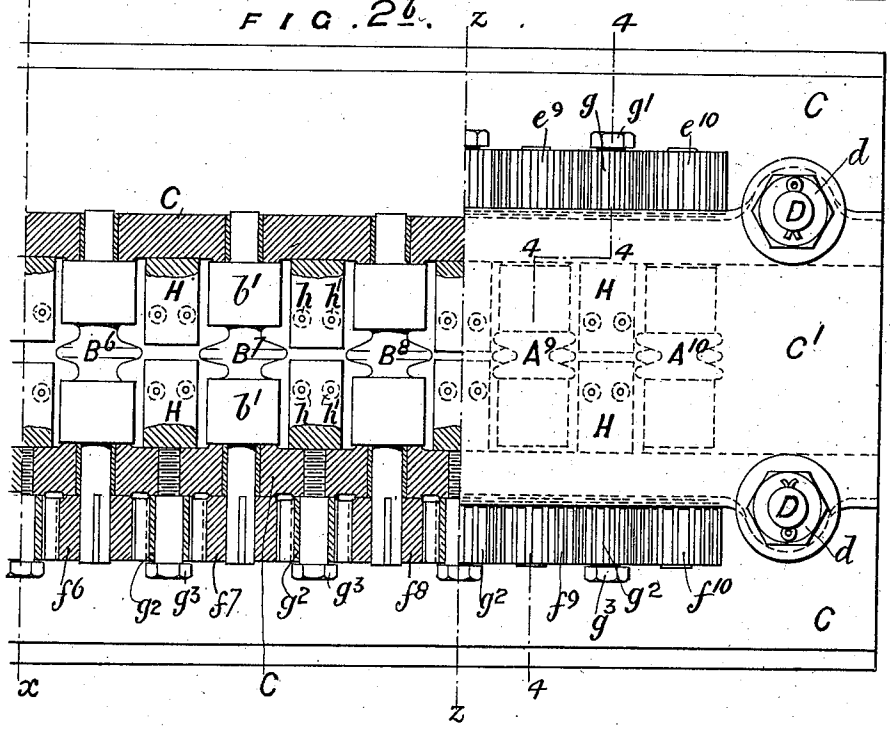


FIG. 2b.



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NO MODEL. 7 SHEETS—SHEET 3.

FIG. 3.

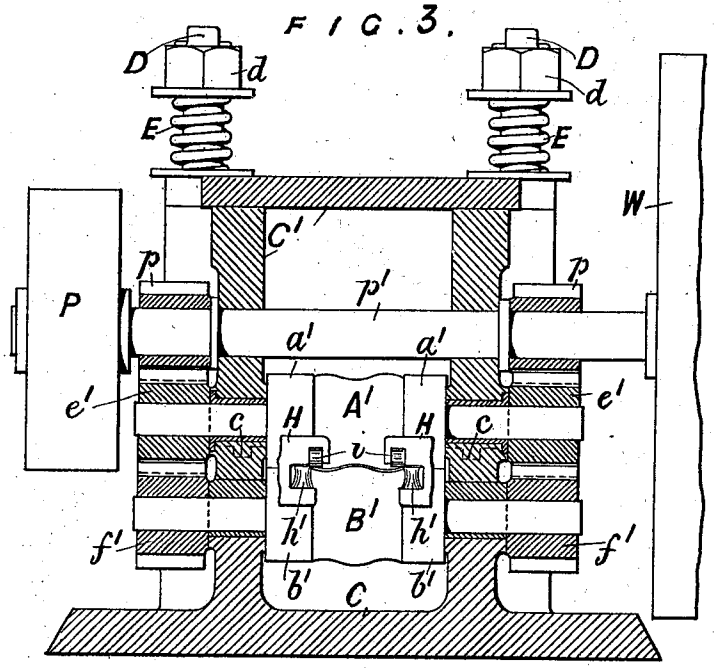
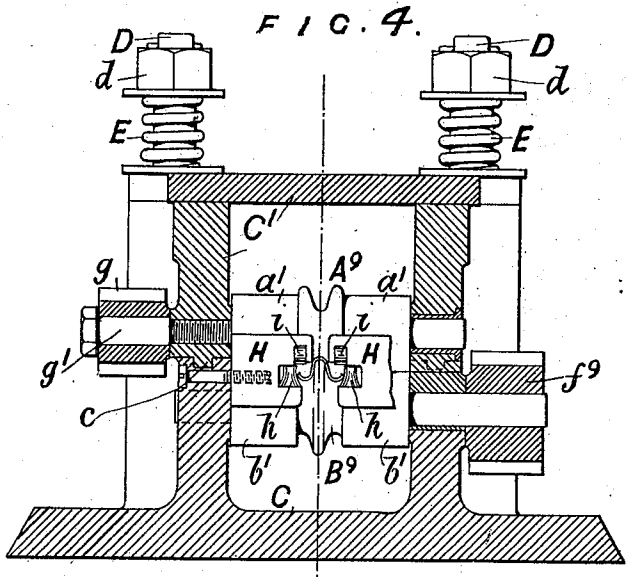


FIG. 4.



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NO MODEL. 7 SHEETS—SHEET 4.

FIG. 5.

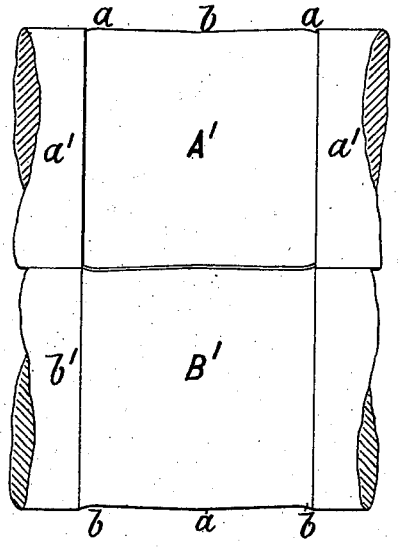


FIG. 6.

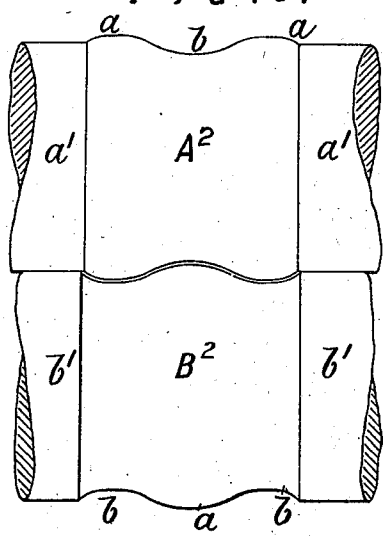


FIG. 7.

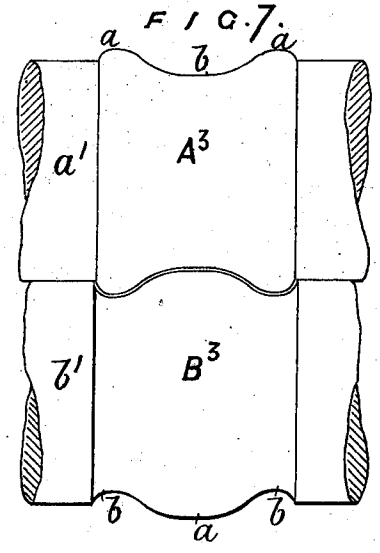
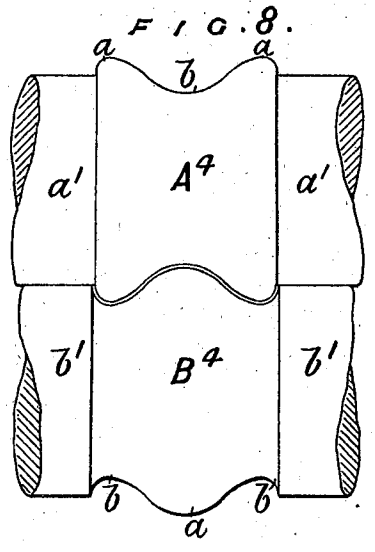


FIG. 8.



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NO MODEL. 7 SHEETS—SHEET 5.

FIG. 9.

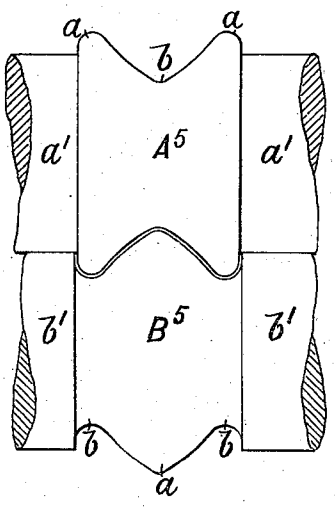


FIG. 10.

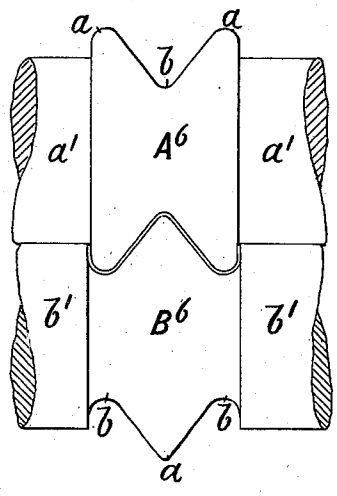


FIG. 11.

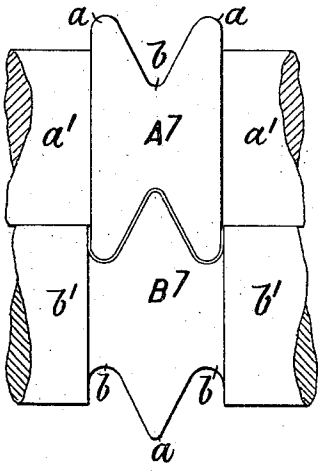
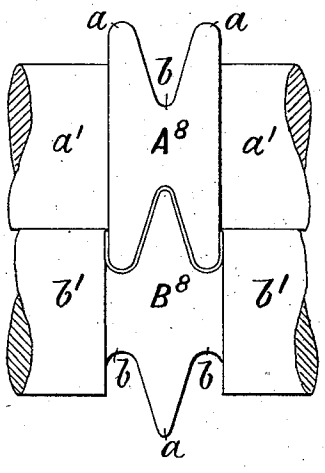


FIG. 12.



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NO MODEL. 7 SHEETS—SHEET 6.

FIG. 14.

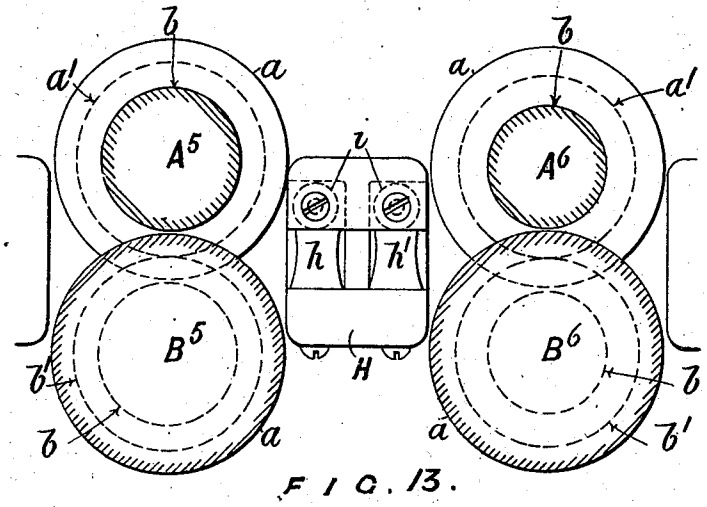
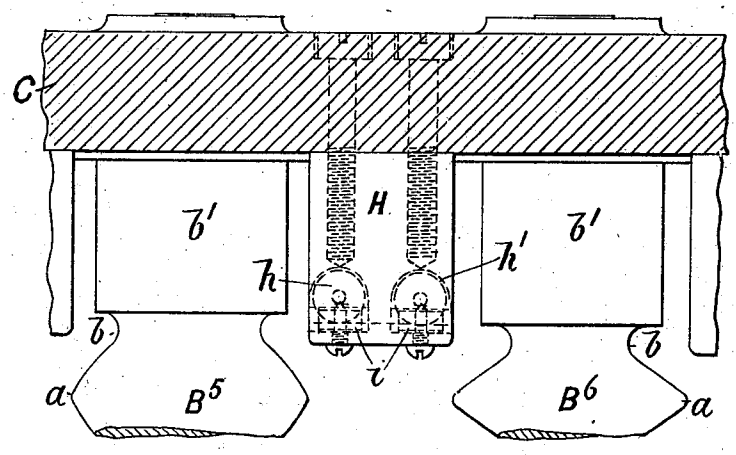


FIG. 13.



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NO MODEL. 7 SHEETS—SHEET 7.

FIG. 15.

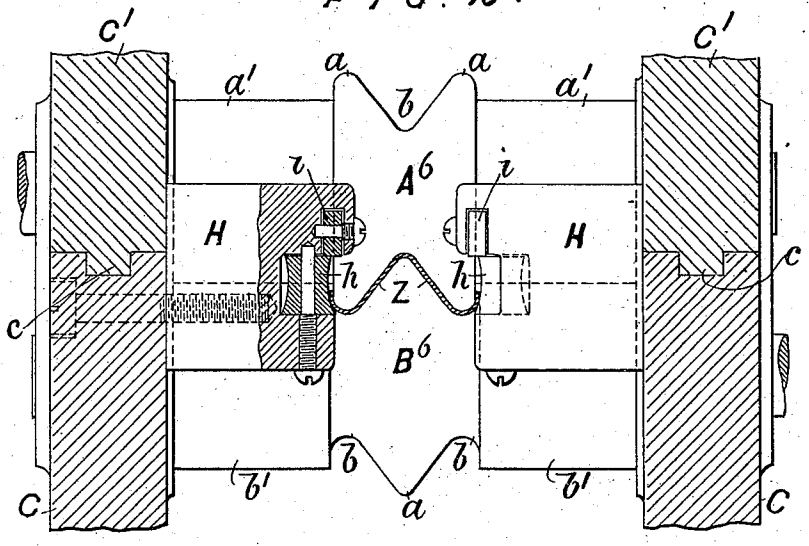


FIG. 17.



FIG. 18.

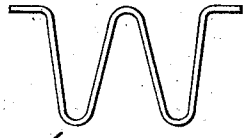


FIG. 16.

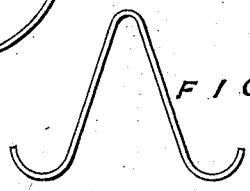


FIG. 19.

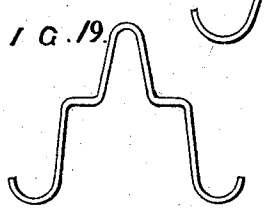
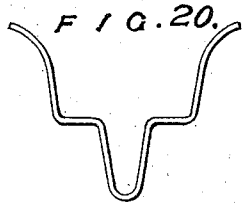


FIG. 20.



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UNITED STATES PATENT OFFICE.

GODFREY BENINGTON JOHNSON, OF LONDON, ENGLAND.

MACHINERY FOR ROLLING SHEET OR OTHER METAL STRIPS OR BARS OF CURVED OR OTHER SECTION.

SPECIFICATION forming part of Letters Patent No. 726,691, dated April 28, 1903.

Application filed December 9, 1902. Serial No. 134,497. (No model.)

To all whom it may concern:

Be it known that I, GODFREY BENINGTON JOHNSON, engineer, a subject of the King of Great Britain, residing at 8 Victoria street, Westminster, London, England, have invented certain new and useful Improvements in Machinery for Rolling Sheet or other Metal Strips or Bars of Curved or other Section, of which the following is a specification.

My invention relates to machinery for longitudinally corrugating or fluting sheet-metal strips—such, for example, as what are known as "standards" and "droppers" of approximately W or other reversely-curved section—for wire fencing, pales for other fencing, sheet-zinc for guttering and for capping the sash-bars of roof-lights, and the like; and it has for its object to substitute for the ordinary operations of stamping or drawing in dies a series of progressive continuous cold-rolling operations, whereby the metal is gradually brought at a single pass through the series of sets of rolls from the form of a flat strip to that of the longitudinally-corrugated reversely-curved section required.

The invention is illustrated in the accompanying drawings as applied to rolling strips of approximately V-section, as shown in Figure 16, to form fence-standards and droppers; but it is to be distinctly understood that the profile of the rolls may be variously modified to produce work of other sectional forms suited for a variety of purposes, such as are shown, for example, in Figs. 17 to 20.

Figs. 1^a and 1^b together form a side elevation of the machine, the two figures registering with one another on the line $x\,x$. Figs. 2^a and 2^b together form a plan view, the two figures registering on line $x\,x$. In Fig. 2^a the portion comprised between the lines $x\,x$ and $y\,y$ is in section on line 1 1, Fig. 1^a, and in Fig. 2^b the portion comprised between the lines $x\,x$ and $z\,z$ is in section on line 2 2, Fig. 1^b. Figs. 3 and 4 are cross-sections on lines 3 3 and 4 4, respectively, of Figs. 2^a and 2^b. Figs. 5 to 12 show the profiles of the first eight successive pairs of rolls and the corresponding sections of the work thereby produced. Figs. 13 and 14 are respectively a plan and side elevation of one of the lateral guides and adjacent parts, Fig. 15 being a part cross-section of the machine, showing a pair of said guides in operation. Figs. 5 to 15 are drawn to a larger scale. Figs. 16 to 20 show examples of sectional forms that may be produced for various purposes.

The machine comprises a series of consecutive pairs of rolls A′ B′, A^2 B^2, &c., having their main line of bite in a common plane, the axes of the lower rolls B being journaled in a lower frame C and those of the upper rolls A in an upper frame C′. The upper frame C′ is vertically guided by bolts D, fixed to the lower frame, and is loaded by springs E, whereby the upper rolls of all the pairs are pressed firmly but yieldingly down toward the corresponding lower rolls, the side members of the frames C and C′ engaging the one with the other by a tongue and groove, as at *c*, in order to maintain them in correct relative position laterally. The operative or shaped portions of the rolls are situated at the middle of their length and are constituted of circumferentially-reëntering portions or grooves *b* and circumferentially-projecting portions or ribs *a*, a groove or grooves *b* and rib or ribs *a* of the one roll matching a rib or ribs *a* and a groove or grooves *b*, respectively, of the other roll of each pair, the shaped profile thus formed being varied progressively for successive pairs of rolls, the variation of profile progressing by easy stages from the initial to the final forms, as shown by Figs. 5 to 12, so that each pair of rolls will perform an equal or approximately equal share of the work from the inception to the completion of the desired shape to be imparted to the strip. In the example illustrated there are eight pairs of rolls of progressively-varying profile; but I do not limit myself to this particular number of pairs, which may be augmented or decreased, according to the nature, quality, and thickness of the metal operated on and the form to which it is to be brought. In order to straighten and finish the shaped strip, it is preferred to employ, say, two additional pairs of rolls A^9 B^9, A^{10} B^{10} of identical form to the rolls A^8 B^8 and in succession thereto. In the drawings the lower rolls B have a central rib *a* and two lateral grooves *b*, while the upper rolls A have a central groove *b* and two lateral ribs *a*, corresponding thereto; but it will be obvious that the relative arrangement might be re-

versed and that the rolls might be differently profiled, according to the form of the work to be produced. It is, however, an essential feature of the machine that in every pair of rolls the maximum diameter of the rib or ribs *a* of the one roll is equal to that of the ribs or rib *a* of the other roll of the pair and that the ribs *a* of all the pairs shall be of equal diameters. Furthermore, the axes of the rolls of successive pairs must be placed progressively closer to each other in correspondence with the progressive increase in the depth of the grooves *b*. The length of the shaped or profiled portions of successive pairs of rolls measured in the line of the axis is, of course, gradually diminished for successive pairs approximately in correspondence with the contraction in width which the work undergoes in consequence of the increase of curvature or depth. It is desirable that the cylindrical end portions of the rolls situated at either side of the middle or shaped portions of the rolls should run in close contact, those *a'* of the one roll A of a pair with those *b'* of the other roll B of the pair, and consequently it is necessary that these portions *a' b'* of successive pairs should be of diameters progressively diminishing in correspondence with the progressive diminution of diameter of the rolls measured at the bottoms of the grooves *b*, the diameters of the portions *a b* of the two rolls of a pair being equal and such as to limit the approach of the shaped portions of the two rolls and insure that the spaces between the profiled portions of the two rolls of each pair will be equal throughout the machine and so much greater than the thickness of the strip operated on that the latter will not be nipped between the grooved part *b* of one roll and the rib *a* of the other roll of a pair, but will contact only or mainly with the salient portions of the one and the other of the two rolls, so that the rate of feed or travel shall remain uniform throughout the machine. The upper and under rolls of all the pairs are positively driven at equal angular velocities. This may be done by worm-gear or by spur-gear or by the two combined. For instance, the lower rolls of all the pairs may be driven from a longitudinal shaft common to all and having worms in gear with worm-wheels on the roller-axes, the upper rolls of all the pairs either being driven from the lower rolls by equal spur-wheels or being driven by a similar worm-shaft preferably mounted at the other side of the machine, both worm-shafts being positively driven from the same main shaft. In the example illustrated spur-gear is used, the rolls A' B' of the first pair having their axes geared together at both ends by equal pinions *e' e'* and *f' f'* and the pinions *e'* on the axis of the upper roll A' of the first pair being driven by pinions *p* on a transverse shaft *p'*, provided with a belt-pulley P and fly-wheel W. The upper rolls $A' A^2$, &c., of all the pairs are geared in continuous series by equal pinions $e' e^2$, &c., keyed upon their axes, the pinions $e' e^2$, &c., gearing together through intermediate or idle pinions *g*, turning on studs *g'*, fixed to the framing C', while the lower rolls $B' B^2$, &c., of all the pairs are similarly geared by equal pinions $f' f^2$, &c., upon their axes gearing together through intermediate or idle pinions g^2, turning on studs g^3, fixed to frame C, the pinions $e' e^2$, &c., being at one side and the pinions $f' f^2$, &c., at the other side of the machine. The rolls of each pair therefore have their adjacent surfaces running in the same direction, all the pairs being similarly rotated at the same angular velocity, so as to carry the strip onward without any tendency to cause it to become buckled in the direction of its length. The axes of any one of the intermediate pairs of rolls might be provided with fly-wheels in order to store power and assist in the transmission of power to the succeeding pinions, or any of the intermediate pairs of rolls might be directly driven with the same object

Intermediate of each two successive pairs of rolls are placed pairs of guides H for laterally compressing the partially-shaped strip as it passes from one to the other of the successive stages of the operation, the position of each pair of guides being so adjusted as to laterally contract the width of the work to the extent necessary to prepare the strip for entrance between the shorter profiled portion of the next pair of rolls, whereby the contraction consequent on the increased depth of curvature imparted by those rolls is rendered permanent, the action of the guides taking effect mainly on the leading end of the strip. To reduce friction and avoid wear of the guides, their acting faces would be preferably constituted by rollers suitably shaped, each guide comprising, preferably, two successive rollers *h h'*, turning on vertical axes in a block H, fixed to the side frame C, the successive rollers *h h'* of a guide being set progressively nearer to the center line of the machine, so that the rollers *h* will bear against the edge of the strip Z (see Fig. 15) as it comes from the preceding pair of shaping-rolls and press the strip inward sufficiently to lead it to the succeeding guide-roller *h'*, by which the strip is further contracted, so as to lead it fairly to the operative or shaped portion of the next succeeding pair of shaping-rolls.

The guide-rollers *h h'* are of concaved form and of rather larger diameter at the lower end, so as, while causing the edge of the strip to be pressed inward, to permit it to readily accommodate itself to the change of cross-sectional shape of the strip. To prevent the strip being deflected upward or downward, additional guide-rollers *i*, adapted to engage the edges of the strip, may be mounted above, as shown, or beneath the rollers *h h'*, with their axes at right angles to those of rollers *h h'*.

Two or more pairs of guides J, which may be similar in construction to those, H, above

described, are provided at the feed end of the machine for the purpose of insuring the strip being correctly presented to the first pair of rolls.

The pressure of the springs E may be regulated by nuts *d*, and the upper frame C′ being free to rise by the compression of the springs the upper rolls are self-adjusting to suit the gage of the strip to be rolled.

I claim—

1. A machine for longitudinally corrugating or fluting sheet-metal strips consisting essentially of successive pairs of rolls positively driven at the same angular velocity, the central portions of the rolls being shaped by being formed of circumferential salient and circumferential reëntering surfaces each matching the conversely-shaped surface of the other roll of a pair, said shaped portions varying progressively for successive pairs but the maximum diameters of all the rolls being equal, while the minimum diameters progressively diminish for successive pairs of rolls, whereof the axes are set progressively closer together as specified.

2. A machine for longitudinally corrugating or fluting sheet-metal strips consisting essentially of successive pairs of rolls positively driven at the same angular velocity, the rolls having central shaped portions and plain cylindrical end portions running in contact with each other, the shaped portions being formed by circumferential salient and circumferential reëntering surfaces those of each roll matching the conversely-shaped surfaces of the other roll of the pair and varying progressively for successive pairs in such manner that the maximum diameters of all the rolls remain equal while the minimum diameters progressively diminish for successive pairs of rolls, the diameters of the cylindrical end portions being equal for each pair but progressively diminishing for successive pairs of rolls and being so proportioned as to limit the approach of the shaped portions of the two rolls of a pair toward each other and preserve such clearance between them relatively to the thickness of the strip operated on as to prevent contact of the reëntering parts of either roll with the strip, as specified.

3. A machine for longitudinally corrugating or fluting sheet-metal strips consisting essentially of successive pairs of shaped rolls, the successive pairs of rolls being shaped progressively and being set with their axes progressively closer together and all positively driven at the same angular velocity, in combination with pairs of lateral guide-rollers intermediate of successive pairs of shaping-rolls, the guide-rollers having their axes at right angles to those of the shaping-rolls, and the guide-rollers of successive pairs being set at progressively-diminishing distances apart so as to be adapted each pair to receive the strip from the preceding pair of shaping-rolls, and by pressure against the edges of the strip to contract it laterally to an extent sufficient to prepare it for entry between the next succeeding pair of shaping-rolls as described.

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C. G. CLARK.