United States Patent [19]

Marantette

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[45] **Mar. 27, 1973**

[54] SHEET METAL FORMING APPARATUS

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[73] Assignee: **General Metalcraft, Inc.,** Portland, Oreg.

[22] Filed: **Aug. 20, 1970**

[21] Appl. No.: **65,436**

[52] **U.S. Cl.**.....**72/306,** 72/405

[51] **Int. Cl.**.....**B21d 11/04**

[58] **Field of Search**.....72/298, 299, 403, 319, 379, 72/306, 307, 308, 310, 405, 411, 320–322; 113/120 E, 120 G, 54

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Primary Examiner—Charles W. Lanham
Assistant Examiner—Michael J. Keenan
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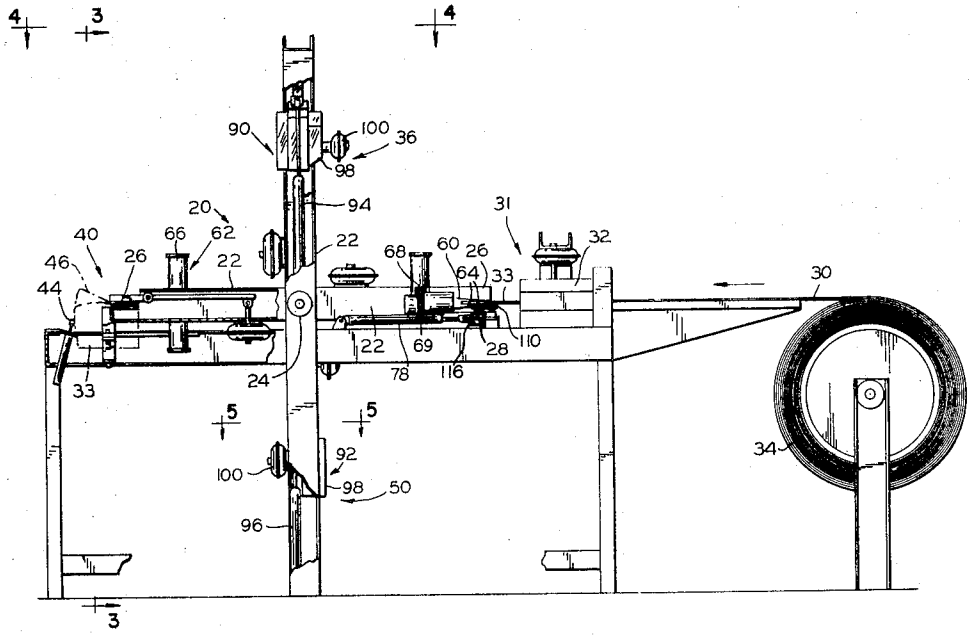
[57] **ABSTRACT**

A sheet metal blank is fed from a cutter to a clamp of a turret mechanism and is stepped from station to station, where forked twisters form loose tucks in portions of the blank, flatteners press the tucks to tight folds to form well defined corners, and a frustum, which is formed in another portion of the blank as the corners are formed, is bent to a tilted position relative to the portion of the blank in which the corners are formed.

13 Claims, 18 Drawing Figures



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SHEET 1 OF 5

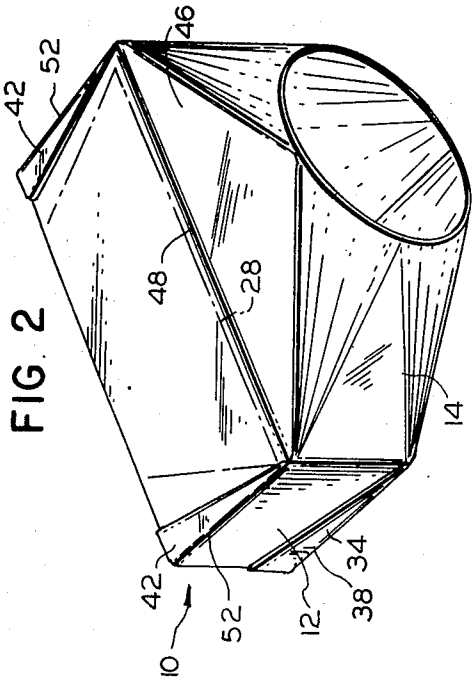

FIG. 2

FIG. 1

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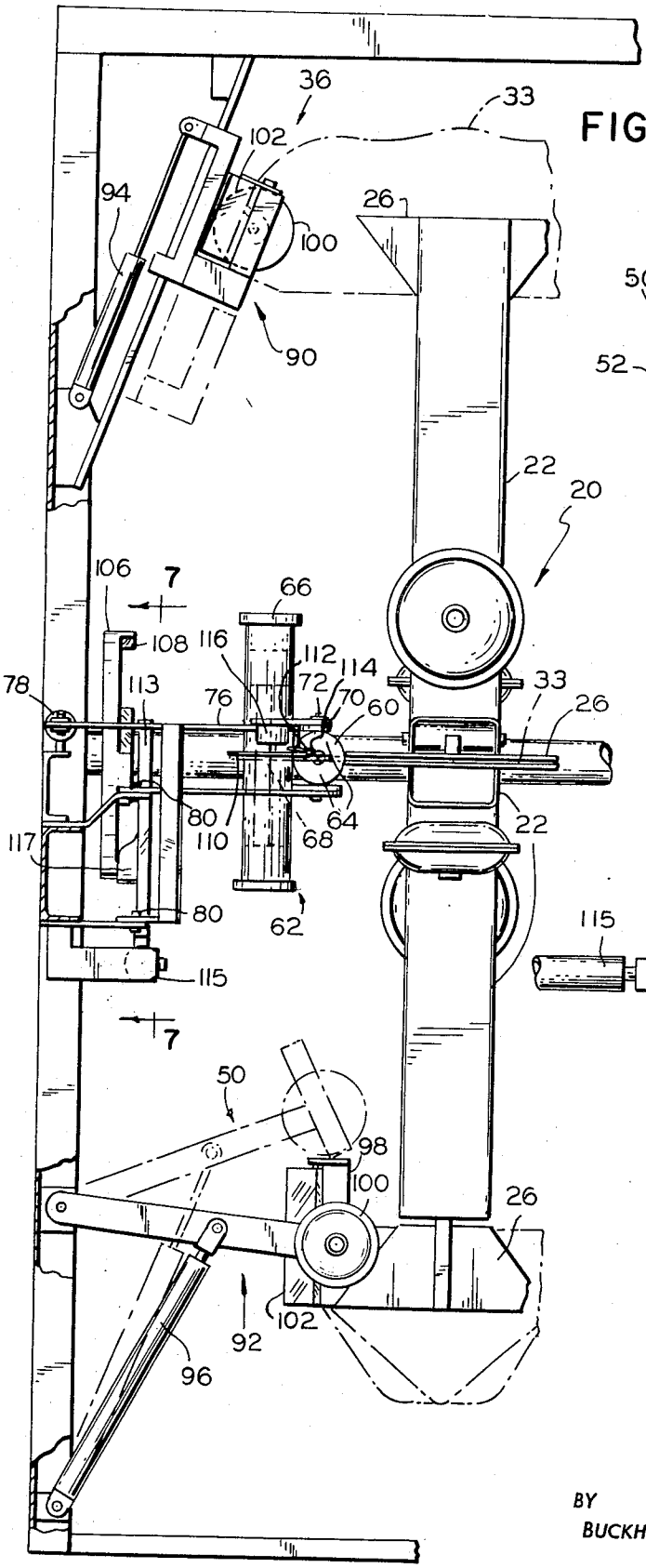


FIG. 3

FIG. 9

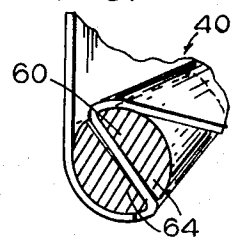


FIG. 10

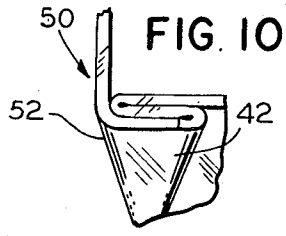


FIG. 7

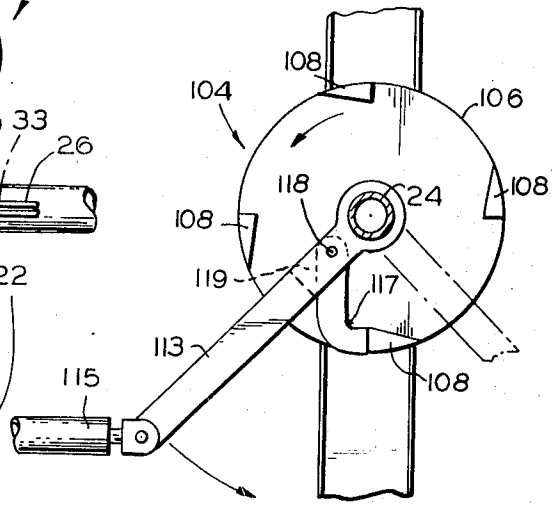
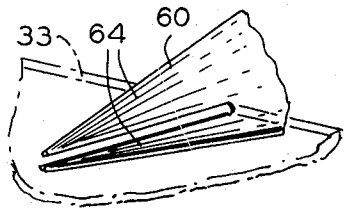


FIG. 8



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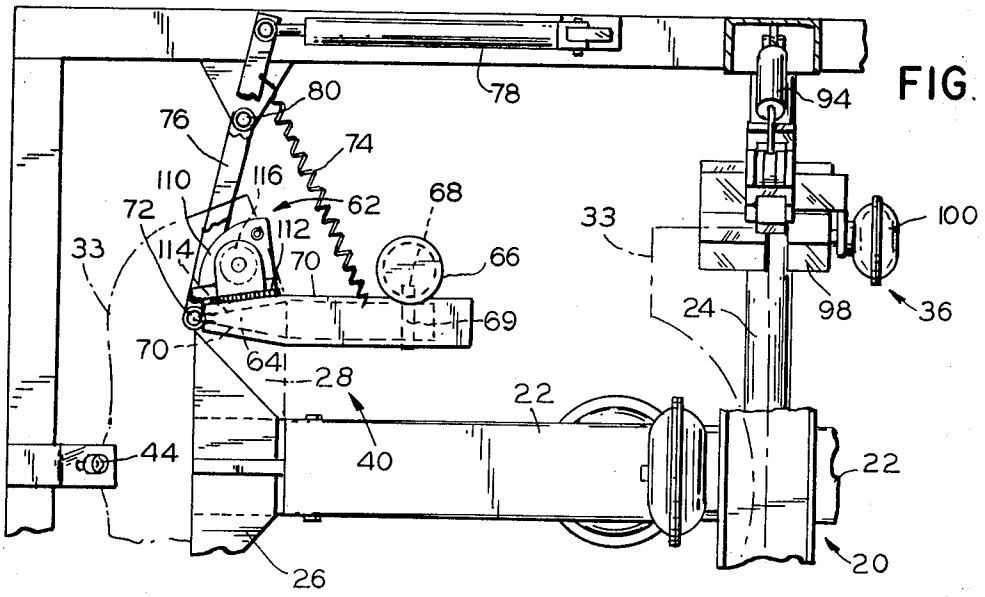

FIG. 4

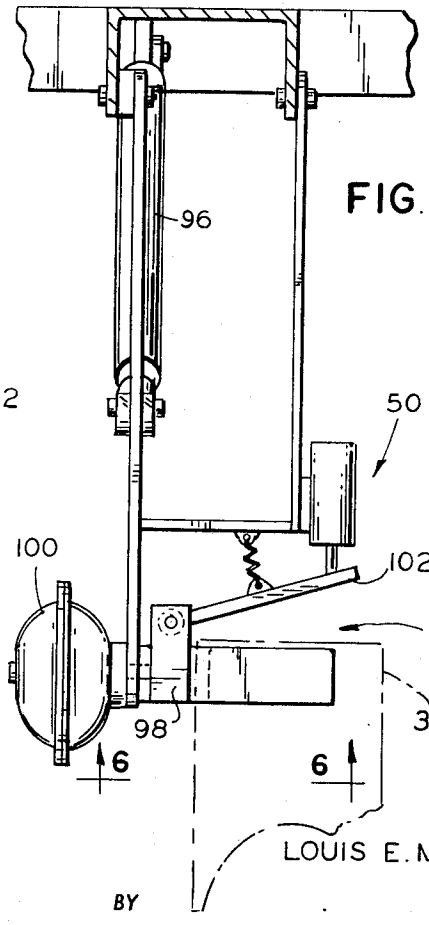

FIG. 5

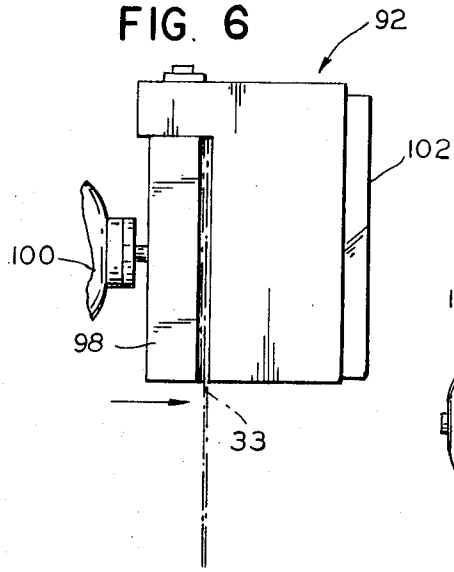

FIG. 6

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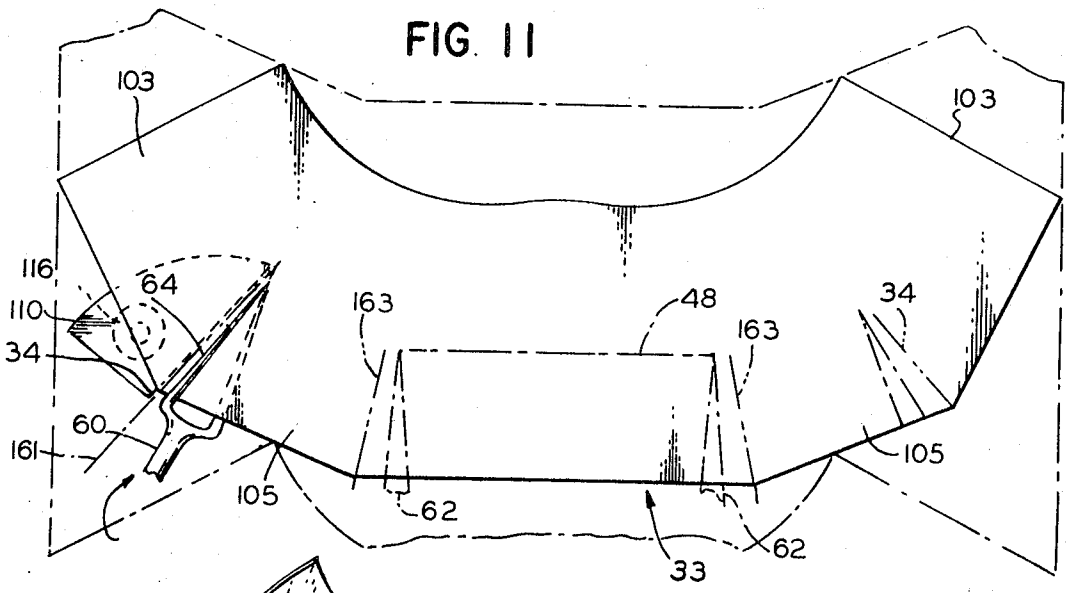
FIG. 11



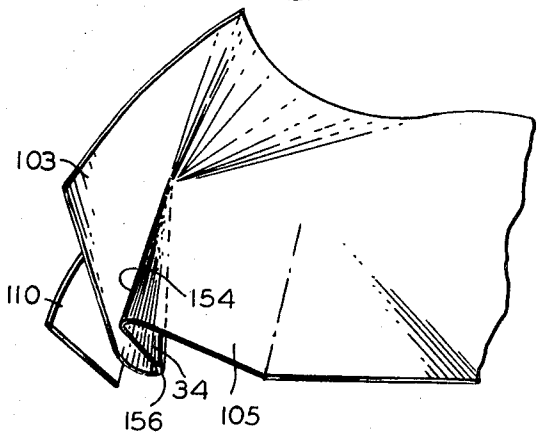


FIG. 12

FIG. 13

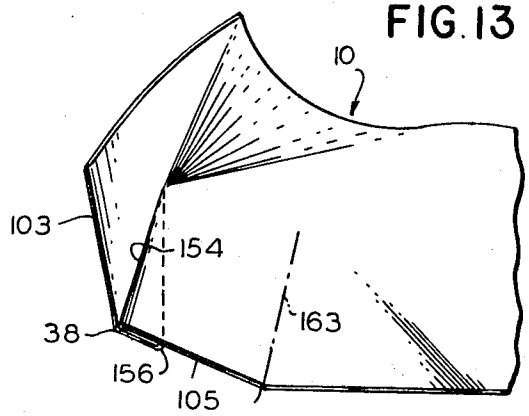


FIG. 14

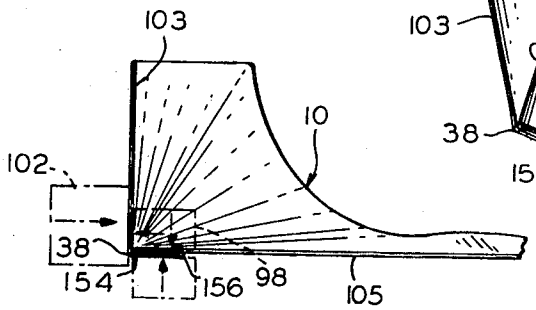


FIG. 15

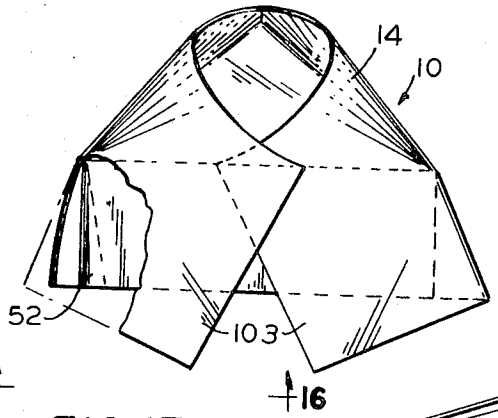


FIG. 16

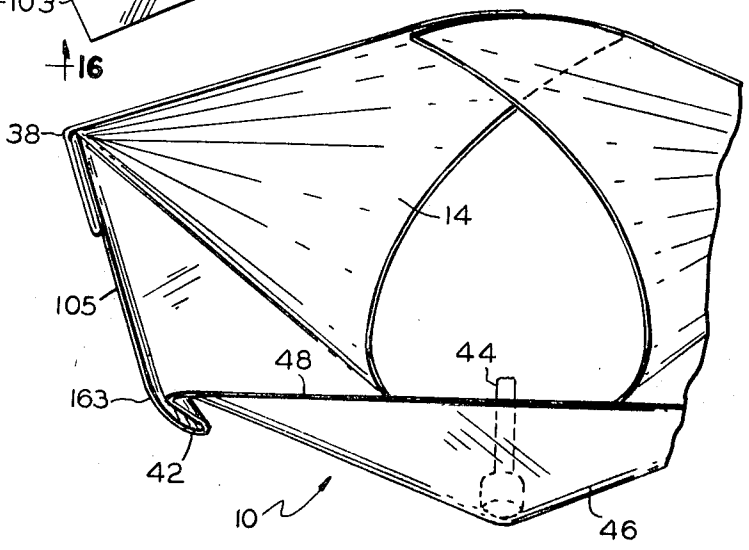


FIG. 17

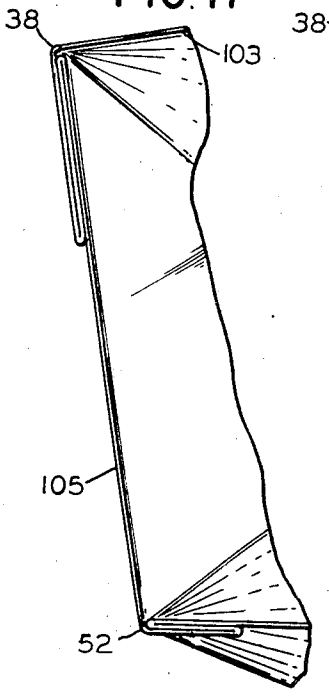
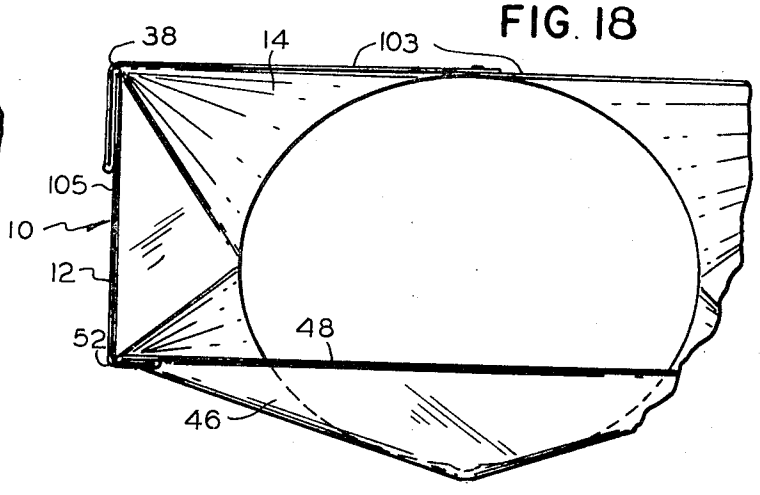


FIG. 18



SHEET METAL FORMING APPARATUS

DESCRIPTION

This invention relates to an improved sheet metal forming apparatus and more particularly to an apparatus for forming sheet metal transition boots.

An object of the invention is to provide a new and improved sheet metal forming apparatus.

Another object of the invention is to provide an apparatus for forming sheet metal transition boots.

A further object of the invention is to provide an apparatus for twisting tucks into a planar sheet metal blank to form the blank into a polygon.

Another object of the invention is to provide a twister fork adapted to twist a generally triangular tuck into an initially planar sheet metal blank to form the blank into an angle having a corner at the tuck.

Another object of the invention is to provide an apparatus for forming a planar sheet metal blank into a transition boot having a polygonal portion and a frustoconical portion.

In the drawings:

FIG. 1 is a front elevation view of an improved sheet metal forming apparatus forming one embodiment of the invention;

FIG. 2 is an enlarged, perspective view of a transition boot member formed by the apparatus of FIG. 1;

FIG. 3 is an enlarged, side elevation view of the apparatus of FIG. 1;

FIG. 4 is an enlarged, fragmentary horizontal view taken along line 4—4 of FIG. 1;

FIG. 5 is an enlarged, fragmentary horizontal sectional view taken along line 5—5 of FIG. 1;

FIG. 6 is an enlarged, fragmentary vertical sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is an enlarged, fragmentary vertical sectional view taken along line 7—7 of FIG. 3;

FIG. 8 is an enlarged, fragmentary perspective view of a twister of the apparatus of FIG. 1;

FIG. 9 is an enlarged, fragmentary vertical sectional view of the twister of FIG. 8;

FIG. 10 is an enlarged, fragmentary perspective view of a corner portion of the boot member of FIG. 2;

FIG. 11 is a top plan view of a blank of sheet metal from which the transition boot member of FIG. 2 is formed;

FIG. 12 is a fragmentary, perspective view of the blank of FIG. 11 with a tuck started;

FIG. 13 is a fragmentary, perspective view of the blank of FIG. 11 with the tuck completed;

FIG. 14 is a fragmentary, end view of the blank in the condition of FIG. 13;

FIG. 15 is a top plan view of the blank of FIG. 11 with further tucks started;

FIG. 16 is an enlarged, fragmentary view taken along line 16—16 of FIG. 15;

FIG. 17 is an enlarged, fragmentary view of the blank of FIG. 11 with the further tucks of FIG. 15 flattened; and

FIG. 18 is an enlarged, fragmentary end view of the blank of FIG. 11 in substantially completed form.

Referring now in detail to the drawings, there is shown therein a sheet metal forming apparatus forming one embodiment of the invention and serving to make a transition boot member 10 having a rectangular section 12 adapted to join to a register or duct and a generally

frustoconical section 14 tilted angularly to the section 12 to offset a sleeve (not shown) to be attached to another air duct. The forming apparatus includes a spoked turret or wheel 20 having arms 22 and rotatable by shaft 24. Each arm carries a pair of clamps 26, which clamp a partially blanked central, forward portion 28 of a sheet metal strip 30 at a blanking station 31. After one of the pairs of clamps is moved to the blanking station, the blanked forward end portion of the strip is fed from sheet metal blanking dies 32 to draw the strip further through the dies and from a coil 37. Then the pair of clamps is closed to clamp the central portion of the forward edge portion, and the dies then are operated to blank a rear edge of a blank 33 and blank a forward edge on the forward end of the strip. Then two tucks 34 are started by twisting. The turret then is rotated 90° counterclockwise, as viewed in FIG. 1, and the clamps 26 advance the blank with the started tucks 34 to a tuck flattening station 36, where the tucks 34 are squeezed to complete them and form corners 38. Then, the clamps 26 are advanced 90° further counterclockwise to a tilting and tuck-forming station 40, where two tucks 42 are started by twisting and a cylinder drive 44 bends a side 46 of the frustoconical portion 14 along a fold line 48 to tilt the frustoconical portion relative to the rectangular portion. Then the turret is stepped another 90° counterclockwise, and the clamps 26 move the partially formed blank to a tuck flattening station 50 where the tucks 42 are flattened to form corners 52 and the formed, but unseamed, boot is then unclamped and discharged by dropping from the turret.

A pair of twisters or tine pairs 60 (FIG. 1) at the blanking station 31 twist portions of the blank to start the tucks 34, and a pair of twisters or tine pairs 62 at the station 40 twist portions of the blank to start the tucks 42. Since these twisters are quite similar, only one of the twisters 62 will be described in detail. As best shown in FIGS. 3 and 4, the twister 62 includes a split or forked, tapered or frustoconical tine pair 64, which slides over or receives the portion of the blank to be tucked. A cylinder drive 66 drives a rack 68 to rotate the tine pair 64 through a pinion 69, and the rack and the tine pair are mounted on a frame 70 pivotal on pin 72 to permit the tine pair to swing as the twist forms the tuck, a spring 74 biasing the frame toward its normal or start position. An arm 76 mounts the frame 70, and a cylinder drive 78 swings the frame 70 about a pin 80 between a retracted position out of the path of the blank 33 for indexing and to operative position for twisting after the turret has indexed.

Two pairs of flatteners 90 and 92 (FIGS. 3, 4 and 5), after indexing of the turret, are brought by cylinders 94 and 96 from retracted positions to flattening positions. While in their flattening positions, forming or flattening clamps 98, of the flatteners, are closed by pneumatic actuators 100 to squeeze the loose tucks formed by the twisters, and benders 102 fold the flaps 103 and 105 of the blank to tighten the corners 38 and 52 further. The flatteners 92 are swung into position by pivotal carriers, and the flatteners 90 are movable linearly by carriers to and from their operative position.

The indexing of the clamp carrying arms 22 is accomplished through a cam and pawl system 104. A disk 106 is secured to cross shaft 24 on which indexing cams

108 are positioned 90° apart to accomplish the four forming operations. When the forming is completed at each of the stations, a valve (not shown) provides fluid to cause a cylinder 115 to actuate an arm 113 that is pivoted about shaft 24 through the cams 108 to the next station. Stop 119 forms part of arm 113 and maintains pawl 117 in contact with cams 108 as cylinder 115 is extended; but when cylinder 115 is retracted, the pawl 117 is permitted to pivot on pin 118 and thereby slides up incline or cam 108 and drops into position for the next sequence.

Pads 110 (only one being shown) which are hinged at 112 for pivoting along axes adjacent to and parallel to edges 114 of the twisters 62, are swung upwardly by pneumatic cylinders 116 at the start of the twisting operation to move the end portions of the blank upwardly to help form the corner. Similar pads mounted adjacent the twisters 60 similarly serve to start and help form the secondly formed corners.

In FIG. 11 there is shown the blank 33 in planar form with one of the twisters 60 in position to start to twist one of the tucks 34 (FIG. 12) to start the forming of one of the corners 38. When the twister is turned in the direction desired, the triangular tuck or fold 34 is started to be formed to form folded edges 154 and 156, pad 110 deflecting the end portions 103 upwardly. The two corners 38 preferably are so twisted first and then the flattening members 98 (FIG. 14) flatten the folded edges 154 and 156 and one member 98 and the flattening member 102 form the corner 38 sharply at the angle desired. Then somewhat narrower tucks or folds 42 are twisted (FIG. 16) and flattened in by twisting, flattening and side folding steps like those described above to roll the tuck 42 from side portion of the blank. These tucks are narrower than the tucks 34 to allow for asymmetry or tilting of the frustoconical portion relative to the rectangular portion. Fold lines 161 and 163 (FIG. 11) illustrate the positions of the corners.

What is claimed is:

1. In a sheet metal forming apparatus, holding means for limiting turning movement of a first portion of a sheet metal blank and permitting turning movement of a second portion,

the holding means comprising clamping means clamping the first portion of the blank,

and bifurcated twisting means for engaging a third portion of the blank between the first and second portions and for twisting a tuck from the third portion of the blank to tend to turn the second portion angularly relative to the first portion and form a corner,

the twisting means comprising a pair of tines on opposite sides of the blank and means mounting the tines for turning and movement toward the clamping means as the tuck is twisted, the tines having converging leading edge portions for forming folded edges extending in converging directions from one edge of the blank.

2. The sheet metal forming apparatus of claim 1 wherein the tines form a tapered frustum.

3. The sheet metal forming apparatus of claim 1 including auxiliary forming means adjacent the twisting means for preventing movement of the second portion of the blank with the twisting to aid in forming the corner.

4. The sheet metal forming apparatus of claim 3 wherein the auxiliary forming means includes a pad extending along the twisting means.

5. The sheet metal forming apparatus of claim 4 wherein the auxiliary forming means includes means hinging the pad along a line substantially parallel to the adjacent portion of the twisting means, and means for pivoting the pad about the line during the twisting.

6. The sheet metal forming apparatus of claim 1 including means for flattening the tuck.

7. The sheet metal forming apparatus of claim 1 wherein the twisting means includes a twister for loosely rolling the tuck and clamping means for flattening the tuck.

8. The sheet metal forming apparatus of claim 7 including means for pressing the second portion tightly against the flattening means to form the corner.

9. In a sheet metal forming apparatus,

holding means for holding a central and edge portion of a planar sheet metal blank,

a first pair of tucking means for forming a first pair of tucks in the blank and forming the end portions of the blank into flat side portions and curved portions of generally frustoconical shape,

and a second pair of tucking means for forming a second pair of tucks in the blank between the first pair of tucks and the holding means and forming the portions of the blank adjacent the end portions into flat side portions and curved portions of generally frustoconical shape.

10. The sheet metal forming apparatus of claim 9 wherein each tucking means includes twisting means for forming a loose tuck, flattening means for forming the loose tuck into a flat tuck and corner forming means.

11. The sheet metal forming apparatus of claim 9 including a presser for pressing a portion of the blank adjacent the holding means to tilt the frustoconical portions relative to the flat portions.

12. In a sheet metal forming apparatus,

turret means including a plurality of holding means and means for moving the holding means seriatim to a first, second, third and fourth stations,

means for feeding a sheet metal blank to each holding means at the first station,

a pair of twisting means at the first station for forming loose tucks in portions of the blank adjacent one edge and adjacent end portions of the blank,

a pair of corner forming means at the first station adjacent the twisting means for bending portions of the end portions adjacent the tucks to right angle positions and curving the remainder of the end portions into frustoconical shape,

a pair of tuck-flattening means at the second station,

a pair of corner-tightening means at the second station,

a second pair of twisting means at the third station for forming loose tucks in portions of the blank adjacent said one edge and between the first-mentioned tucks and the holding means,

a pair of corner-forming means at the third station for bending flat portions of the blank outside the second pair of twisting to right angle portions and curving other portions of the blank into frustoconical shape,

a pair of tuck-flattening means at the fourth station,

and a pair of corner-tightening means at the fourth station.

13. The sheet metal forming apparatus of claim 12 including tilting means at the third station for tilting the curved portions of the blank relative to the flat portions thereof.

* * * * *