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L. HARPER

3,427,847

ROTARY STAMPING MACHINE

Filed Feb. 23, 1967

Sheet 1 of 2

FIG_1

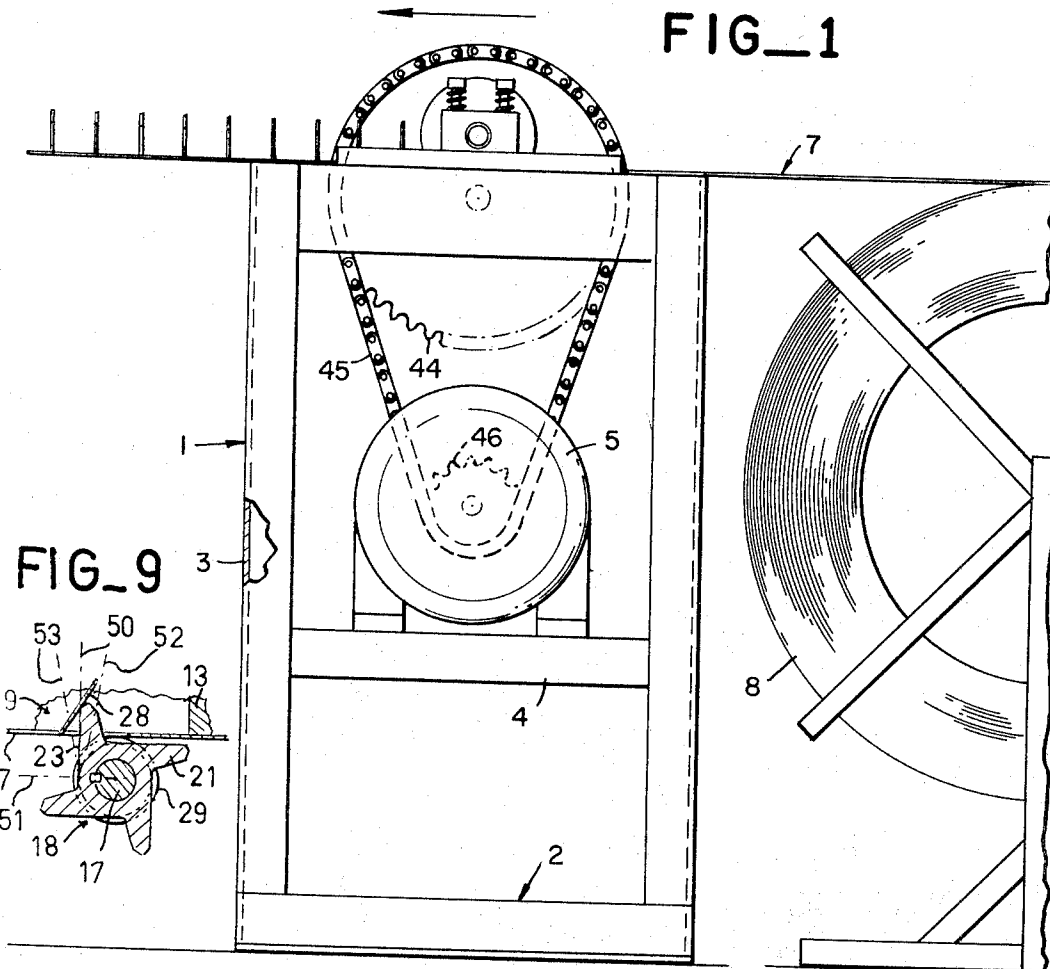


FIG_9

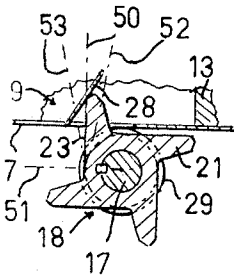


FIG_3

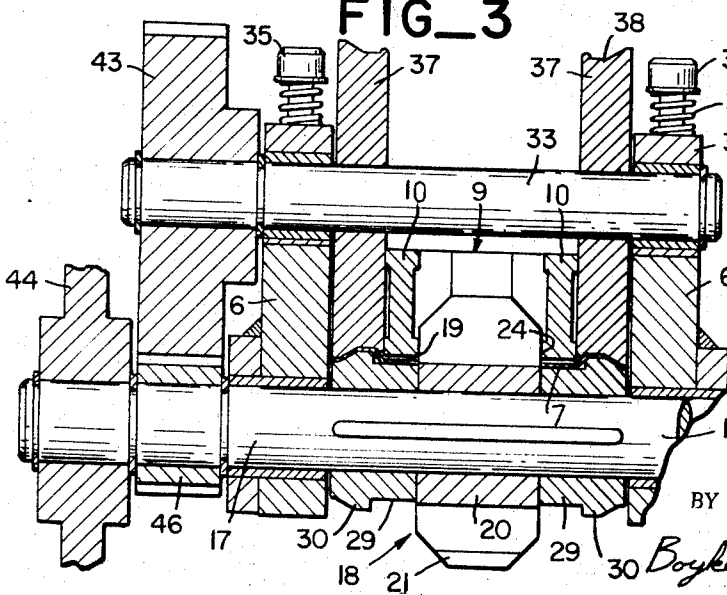
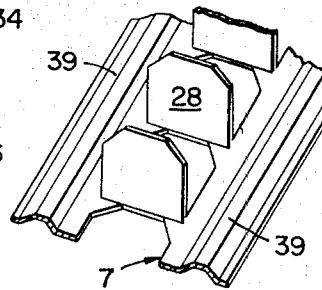


FIG_8



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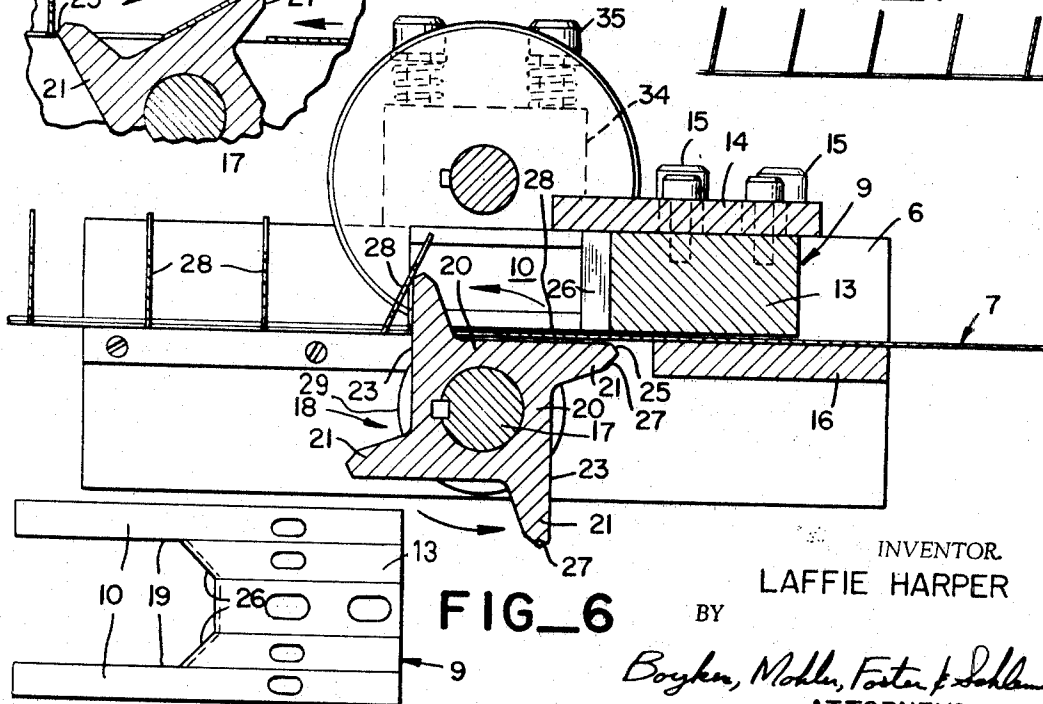
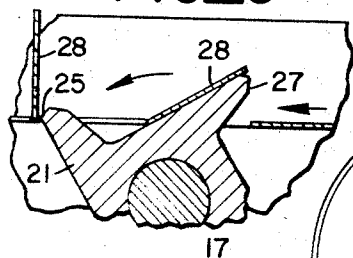
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Sheet 2 of 2

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ROTARY STAMPING MACHINE
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7 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a machine having a stationary female shear plate and a rotary shear die between and past which plate and die a sheet of metal is driven. Said plate and die are formed and positioned, relatively, so that sections of the sheet are progressively cut therefrom and progressively bent to one side of the sheet as the latter is driven past the plate and die, leaving a row of such sections connected with and projecting to said one side.

Background of invention

Products, such as sheet metal rails for supporting hollow turning vanes of the type shown in my copending application Ser. No. 442,689, filed Mar. 25, 1965, now patent No. 3,353,248, have heretofore been formed in stamp presses of the conventional reciprocating type to form projections adapted to be forced into the ends of such vanes for supporting the latter in a row within elbows in air conduits. In this operation the sheet metal is in strips of predetermined lengths, and the punches and dies of the required number and spacing must be respectively carried by the reciprocable ram and a flat bed. The sheet metal strips must be straight, and the capacity of the press for each stamping operation is directly proportional to the number of projections adapted to be formed; hence, the size of the press from structural and practical considerations must be limited to strips of a limited length.

In the present invention, only one rotary member having one or a plurality of shear dies thereon is required, and only one female shear plate is required in order to rapidly form each row of sections projecting to one side of a strip of sheet metal of indefinite length from a coil thereof. Obviously, any number of such rows may be formed by duplicating the rotary member and female shear plate, and, in the present invention, the angle at which each section projects from the sheet or strip is controlled by varying the angle of the cutting edges of the male rotary die relative to a point on a line extending through the axis of rotation of the rotary member. Also, the means for driving the sheet or strip of sheet metal past the shear plate and die also is adapted to form one or more ridges for reinforcing the sheet or strip after the projections are formed.

Field of invention

The invention is not necessarily to be restricted to the forming of sheet metal rails for vanes, since any sheet material or strip having the cutting and bending characteristics of sheet metal may have sections similar to the projections on the aforesaid rails formed by said shear plate and rotary die member. One example of such projections are those on sheet metal fence posts, each post being formed with a row of projections for supporting strands of wire, and there are other articles having similar projections for other purposes. The word "strip" as hereafter used, includes a sheet of material, and the words "sheet metal" are intended to include any sheet material having the characteristics of sheet metal.

Summary of invention

In the present invention a sheet of metal is continuously moved in one direction in the plane of the sheet between a stationary female die having a pair of shearing edges and a male die member that is rotatably supplied for movement of a male die into the female die between said spaced edges of the latter, and which male die has shearing edges that are in shearing relation to the edges of the female die to progressively cut a section of the sheet and to bend it to a position between the cutting edges of the female die as the sheet is moved in said one direction and as the rotary die is rotated.

Normally the male die member has a plurality of male dies projecting generally radially outwardly therefrom to successively cut and form projections on said sheet.

Brief description of drawings

In the drawings, FIG. 1 is a side-elevation view of the machine, a coil of the sheet material to be fed through the machine being partially indicated;

FIG. 2 is an enlarged top plan view of the working portion of the machine of FIG. 1 excluding the coil and supporting frame;

FIG. 3 is a fragmentary cross-sectional view along line 3-3 of FIG. 2;

FIG. 4 is a cross-sectional view along line 4-4 of FIG. 2, with the rotary male die portions in positions in which one section is almost finished and the next die is ready to cut and bend;

FIG. 5 is a fragmentary cross-sectional view of a portion of FIG. 4 showing the position of one male rotary die relative to the stationary female shear plate and sheet material at the completion of a cutting and bending operation of a section of said sheet material, and showing the next male die in a position progressively cutting and bending the next section, a row of completed sections being also shown at the left-hand side of the male die member;

FIG. 6 is a top plan view of the female shear plate separate from the machine;

FIG. 7 is a fragmentary cross-sectional view through a strip of sheet metal showing the row of projecting sections at a different angle than in FIG. 5 and a different spacing of the projections;

FIG. 8 is a fragmentary perspective view of the product from the machine of FIGS. 1-5;

FIG. 9 is a reduced size fragmentary cross-sectional view illustrative of changes in the angle of the cutting edges of the male dies to provide differently inclined projections on a strip.

Description of embodiment

In detail, a rectangular frame generally designated 1 is provided (FIG. 1), which frame may include a base 2, a pair of spaced, opposed, vertically disposed frame plates 3, and a pair of spaced opposed horizontal supports 4 intermediate the upper and lower ends of frame plates 3 connect said plates and support a motor 5. A pair of parallel, horizontally spaced, horizontally extending bearing supports 6 (FIG. 2) extend between and are supported by said frame plates 3.

The strip of sheet metal operated on by the machine is generally designated 7, and extends from a coil 8 (FIG. 1).

The stationary female die member comprises a horizontally disposed, generally U-shaped shear plate 9, the top plan view of which is shown in FIG. 6 separate from the machine. Shear plate 9 thus provides a pair of spaced, opposed legs 10 connected at one of their ends by an end piece 13 integral therewith, and the end of the shear plate 9 opposite to said end piece 13 is open, and when the

3

shear plate is in the machine the legs 10 are horizontally spaced apart.

Shear plate 9 is adjustably secured to and below a cross plate 14 (FIGS. 1, 2, 4) that is bolted to one of the ends of bearing supports 6, by machine screws 15 (FIGS. 2, 4).

The strip 7 is adapted to be fed lengthwise and horizontally into the machine between the right-hand ends of bearing supports 6, as viewed in FIG. 1 and said right-hand end is the feed end. Cross plate 14 is adjacent to said feed end, and a supporting platform 16 (FIG. 4) extends between the bearing supports adjacent to said feed end, which platform is at a slight level below the shear plate 9, with a portion of said platform projecting from block 9 toward said feed end.

The portion of the end piece 13 of shear plate 9 that is over the platform 16 is spaced above said platform a distance sufficient to slide the strip 7 lengthwise thereof from coil 8 to a position extending below legs 10 and across the space between said legs as the strip is moved to the discharge end of the machine. The bearing supports 6, shear plate 9 and platform 16 coact to provide guide means for strip 7, said bearing supports being spaced apart substantially the width of strip 7.

At a point intermediate the ends of the bearing supports is a horizontally disposed shaft 17 extending between said supports rotatably extending therethrough and supported thereby. Shaft 17 is positioned at a level below that of the shear plate 9, and the rotary male die member, generally designated 18, is keyed to shaft 17 in a position for projecting between legs 10 as the member 18 is rotated.

The lower edges of legs 10 are flat and perpendicular to the opposed surfaces of legs 10 providing cutting edges 19 (FIG. 3) along the junctures between said opposed surfaces and the flat lower surfaces of legs 10.

The male rotary shear die member 18 is provided with a central body or hub portion 20 having equally spaced shear dies 21 (FIG. 4) rigid therewith projecting outwardly thereof in the same direction generally tangentially of a circle coaxial with and spaced outwardly of shaft 17.

Each die 21 is relatively thick at its base in a direction circumferentially of the above-mentioned circle and fits between the legs 10 of the shear plate 9, and the leading face 23 of each die, relative to the direction of rotation of the die member 18, is flat with the side edges 24 (FIG. 2) at the junctures between the axially outwardly facing surfaces of the male dies and their flat leading faces parallel and in shearing relation to the edges 19 of the shear plate 9. The opposed sides of legs 10 of the shear plate 9 may be relieved about a point spaced from said edges 19, as seen in FIG. 3, to reduce any possible frictional drag of the edges of the sections cut and bent from strip 7 as the strip is moved between the die member 18 and the shear plate 10 in a cutting and bending operation. Also, each die 21 preferably progressively tapers from maximum thickness, circumferentially of the member 18 at the hub 20, to a minimum thickness at its outer end.

The position of the leading face 23 of each die 21 relative to the plane of the strip 7, is such that the strip and said leading face are relatively close together and parallel at the commencement of each shearing operation, and the edge 25 of each die (FIG. 4) at the juncture between the face 23 and the outer end of the die conform in linear outline to the linear outline of the lower edge 26 (FIG. 2) of end piece 13 of the shear plate 9, and said edges 25, 26 are in shearing relation. In FIG. 4 the direction of rotation of the dies 21 is counterclockwise, and the outer end of each die is slanted at 27 to clear the shearing edge 26 of end piece 13 of the shear plate 9 upon rotation of the member 18, and to facilitate clearing the end edges of the opening formed on the strip 7.

As the member or rotary die 18 rotates the end shear-

4

ing edges 25, 26 will commence shearing section 28 from the strip 7, and as the strip is moved in the same direction as the movement of the die that performs the cut through the positions shown in FIG. 5, the section 28 will be bent to the upwardly projecting position as seen at the left end of FIG. 5 as each die 21 leaves the strip.

At opposite sides of the rotary die member 18 are male drive-out ridge-forming rollers 29 that are keyed to shaft 17 so as to rotate with the rotary die member 18, each roller having an annular, radially outwardly projecting ridge 30 integral therewith. The diameter of the rollers 29 may be approximately equal to that of hub 20 of the die member 18. These rollers 29 are adjacent to the bearing supports 6.

Spaced above shaft 17 and parallel therewith is a shaft 33 that is rotatably supported at its opposite end portions in bearings 34 that, in turn, are secured to the bearing supports 6 by bolts 35, and springs 36 between the bolt heads and bearings permit yieldable upward movement of the shaft 33.

Female ridge forming rollers 37 are secured on shaft 33, directly above rollers 29 and the outer peripheries of said rollers 37 are each formed with an annular outwardly opening groove 38 (FIG. 3) that is complementary in cross-sectional contour to each ridge 30. Springs 36 yieldably urge the rollers 37 downwardly in tight engagement with rollers 29 except when the strip 7 is fed from the feed end of the machine to said rollers and thereafter the rollers form parallel ridges 39 in the strip 7 (FIG. 8) conforming the cross-sectional outlines of the ridges 30 and grooves 38. The ridges 39 stiffen the strip against flexing, and the roller 29 being power-driven, as will appear, cooperate with rollers 37 to drive the strip 7 through the machine and the shear member also cooperates to drive the strip and to bend each section 28 to one side of the strip and to progressively cut the sections for bending.

One end of each of the ends of shafts 17, 33 projects outwardly from one of the bearing supports 6, and a pinion gear 40 (FIG. 3) is secured on the projecting end of shaft 17 adjacent to said bearing support 6, while a gear 43 is secured on the projecting end of shaft 33 with its teeth in mesh with the teeth of the pinion gear.

Shaft 17 projects beyond the pinion gear 40 and a sprocket wheel 44 is secured on shaft 17 outwardly of the pinion gear 40. A sprocket chain 45 (FIG. 1) connects wheel 44 with sprocket wheel 46 that is driven by motor 5 whereby rollers 29, 37 will be driven by said motor to drive the strip 7 through the machine.

The progression of the strip 7 past the shear plate 9 and the rotary die member 18, and the progressive cutting and bending of each section 28 from the strip 7, are best seen in FIGS. 4, 5. In FIG. 2 it is seen that the sections 28 are each perpendicular to the strip 7 and the openings 46 in the strip 7 from which the sections have been cut extend substantially the full distance between said sections. The outer edge 25 of each male die 21 and the edge 26 of the shear plate each have a central section and corresponding side sections extending divergently outwardly in a direction toward the hub 20 to connecting relation with the ends of cutting edges 24, 19, respectively, along the sides of each die 21 and the legs of shear plate 9, whereby portions 48 at the ends of the lower edges of the sections 28 will connect with the longitudinally extending marginal portions of strip 7 (FIG. 2) to support the sections 28.

Fewer dies 21 on the die member 28, but of the same size, and equally spaced around the latter, would result in a greater spacing between the projecting sections 28, or if the dies 21 were shorter, and the shear plate were adjusted to shearing relation to the dies, the sections 18 would be shorter.

Referring to FIG. 9, the rotary male die member 18 is shown in the same position as in FIG. 4 relative to strip 7.

Vertical line 50 is perpendicular to a horizontal line

51 from a point tangential to a circle from which faces 23 are also tangential, line 51 being parallel to strip 1, and the former being coincidental with the vertical upwardly extending leading face 23 of the uppermost die 21. This arrangement will produce sections 28 that are perpendicular to the strip 7, but if the face 21, (and consequently shearing edges 24) were inclined rearwardly to be coincidental with line 52, the sections 28 would incline rearwardly, according to the degree at which line 52 were inclined, substantially as seen in FIG. 7, while the inclination of the face 21 and edges 24 would be forwardly if they correspond in inclination to line 53.

Dies 21 and drive rollers 29 are rotated at the same rate, and the linear speed of strip 7 is the same as the surface speed of driver rollers 29, and is the same as the points on the shearing edges of dies 21 that are the same distance from the axis of shaft 17 as the outer peripheries of the driving rollers. Thus speed may, for example, be approximately 110 feet per minute, although it may vary as desired.

By this arrangement, it is obvious that the points on dies 21 radially outwardly of the vertical distance to strip 7 will move in circular paths faster than the surface speed of strip 7, but in an arc rather than in a straight line, with the result that each section 28 is bent upwardly as it is being cut, and the die preceding the one that is performing the cutting and bending operation will be moving out of the opening in strip 7 from which the preceding section 28 has been bent.

By inclining the face 23 of each die rearwardly, as has been explained above, the dies 21 will pull out of the strip 7 earlier than where faces 23 are coincidental with lines 50, (when each die is uppermost as in FIG. 9) hence the sections 28 will not be fully bent to positions perpendicular to the strip 7, and where said faces are coincidental with line 53, the dies pull out of the strip 7 even later, and the sections are inclined forwardly relative to the direction of travel of strip 7.

From a practical standpoint, where the sections are to be inclined, as where used in the assembly with turning vanes, and other uses, the inclining of the faces 21 rearwardly is adequate since any desired inclination can be obtained by varying the inclination of the cutting edges 19, 24, or faces 23 from the point on line 51 from which said faces extend.

The lines of the bends of sections 18 occur at the points where the relative rates of movement between cutting edges 19, 24 is such that the cutting of the sections ceases, and the bending ceases when the outer ends of the dies 21 and the sections 28 are moving at the same rate of speed linearly of the strip as the dies move to pull out of the strip 7, and no more pressure from the dies is applied to the sections.

The strip having the projections 28 formed thereon may be cut into any desired lengths in any manner. It is manifest, however, that by the simple arrangement disclosed, the projections 28 may be of any desired outline and the production of the machine will be far greater than where strips of predetermined lengths must first be cut and positioned in a conventional press and stamped, and then removed.

The method involved may be said to be one in which the strip 7 of sheet metal is continuously moved longitudinally thereof in one direction along a path of travel extending longitudinally of said strip prior to, during and after the sections 28 are cut and bent to one side of said strip, whereby the sections in said strip prior to said cutting and bending and while in the plane of the strip will each have a leading end and a trailing end. The sections, in succession, are progressively cut and bent to one side of said strip in the direction of and during said movement of said strip, commencing at said trailing end and terminating at said leading end, leaving each section integrally connected with said strip at said leading end, and the said cutting and bending step being simultaneously performed at a

predetermined location along said path of travel. In the disclosure, the strip is supported at said predetermined location against a rigid stationary surface in engagement with said one side of said strip adjoining each section during said progressive cutting and bending, and the cutting of said sections is along lines extending transversely of said strip at said trailing ends, and is along spaced lines in side-by-side relation extending longitudinally of said path that terminates at said leading ends.

I claim:

1. A rotary stamping machine for cutting sections, in succession, from a strip of sheet metal and bending said sections to one side of said strip to positions projecting to said one side for forming a row of said sections extending longitudinally of said strip, comprising:

(a) means for moving said strip longitudinally thereof in one direction along a path of travel;

(b) a stationary female die supported at a point along said path against one side of said strip having shearing edges corresponding in linear outline to the outline of each of said sections;

(c) a rotary die member at the opposite side of said strip from said stationary die, rotatable about an axis spaced from said strip at said opposite side and extending transversely of said path, said die member having at least one male die rigid therewith, projecting generally radially outwardly therefrom, and having shearing edges similar in linear outline to the shearing edges on said female die;

(d) means supporting said rotary die member in a position for arcuate movement of said male die about said axis and in said one direction through said strip during said movement of the latter and past the shearing edges of said female die and then out of said female die and strip with said shearing edges of said male die in shearing relation to the shearing edges of said female die during said movement of said male die when said shearing edges thereon are in shearing relation to the shearing edges of said female die;

(e) means connected with said rotary die member and with said means moving said strip and for rotating said male die in said one direction at substantially the same rate of speed at points substantially equal to the closest distance of said strip from said axis whereby a section of said strip will be cut from the latter and bent to said one side of said strip during said movement of said strip and male die.

2. In a machine as defined in claim 1:

(f) said stationary die being a plate of generally U-shape providing a pair of spaced legs and an end portion closing one end of the U with the shearing edges on said female die being in a common plane and along the inner sides of said legs and across said end portion;

(g) said male die being one of a plurality of arms projecting radially of said axis with the shearing edges of each arm along opposite sides thereof and across the outer end portion.

3. In a machine as defined in claim 1:

(f) said means for moving said strip including a pair of ridge-forming rollers at each of the opposite sides of said stationary die, and a rotatable shaft on which one of the rollers of each pair is secured with said rotary die member secured on said shaft between said one of the rollers of each pair, and power means connected with said shaft for rotating said one of the rollers of each pair and said rotary die member in said one direction.

4. In a machine as defined in claim 2:

(h) said male die being supplied for movement into the space between said legs of said stationary die in a direction from said end portion toward the open end of said stationary die for movement of the

sections cut and bent by said male die out of said open end during said movement of said strip.

5. In a machine as defined in claim 2:

(h) means for supporting said strip horizontally on one side below said stationary die with the legs of said stationary die extending longitudinally of said strip and substantially against the latter, and

(i) means for rotatably supporting a supply of said strip in a roll with said strip extending from said roll below the closed end of the U of said female die for movement of said strip from said roll successively past said closed end and legs.

6. In a machine as defined in claim 5:

(j) said means for moving said strip including an upper and a lower ridge-forming roller at each of the opposite outer lateral sides of said stationary die for engaging the upper sides of said strip along its longitudinally extending marginal portions for forming a ridge in each marginal portion and for driving said strip in said one direction,

(k) a rotatable shaft on which the lower roller of each pair is secured, and said rotary die member being secured on said shaft between said lower rollers.

7. The method of cutting sections from a strip of sheet material and bending them to one side of said strip to form a row of said sections with said row extending longitudinally of said strip and in positions projecting to one side of said strip, comprising the steps of:

(a) moving said strip longitudinally thereof in one direction along a path of travel at a substantially uniform rate of speed, and

(b) progressively cutting each of said sections, in succession, from said strip in the direction of and during said movement of said strip, and at the same time

(c) progressively bending each of said sections as they are cut to said one side of said strip,

(d) said cutting and bending steps being at a predetermined location along said path,

(e) supporting said strip at said predetermined location against a rigid, stationary surface in engagement with one side of said strip during said cutting and bending,

(f) uniformly discontinuing the cutting step of each successively cut section short of the cut of the preceding projection, and uniformly ceasing the bending step of each section upon the latter being at a predetermined angle to said strip.

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30 72—326, 379; 29—163.5