March 26, 1963 J. E. DAY, JR., ETAL 3,082,656

AUTOMATIC CONTOUR DIE CUT-OFF APPARATUS

Filed June 30, 1960

3 Sheets-Sheet 1

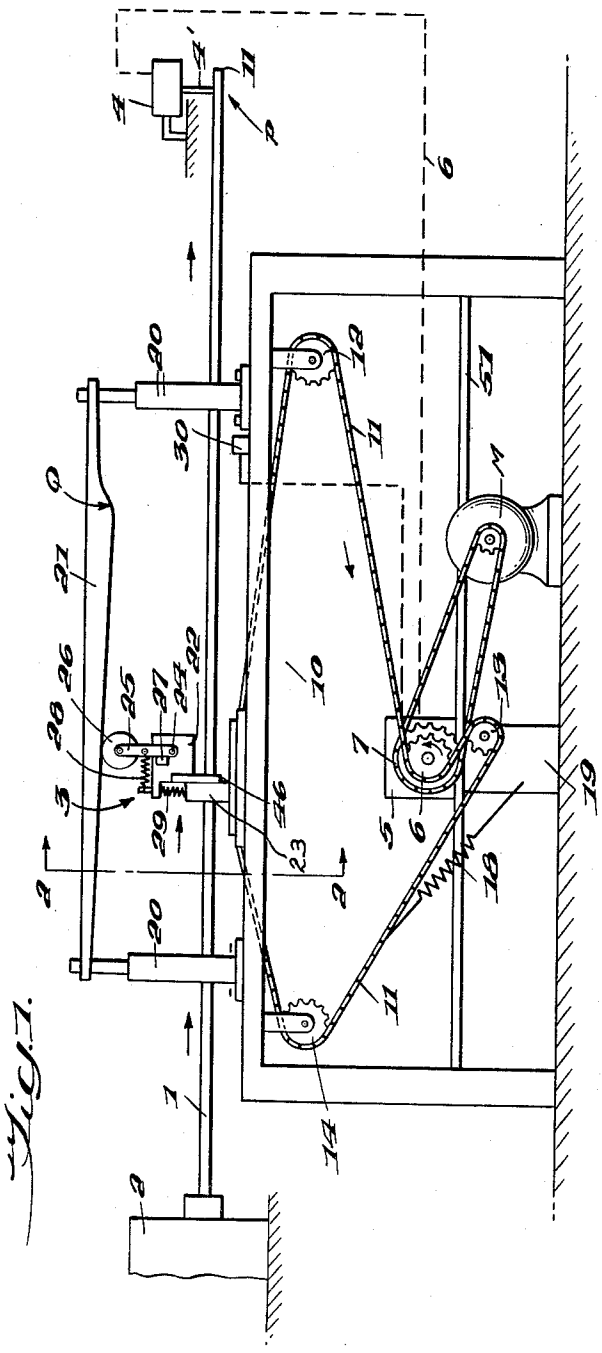


Fig. 7.

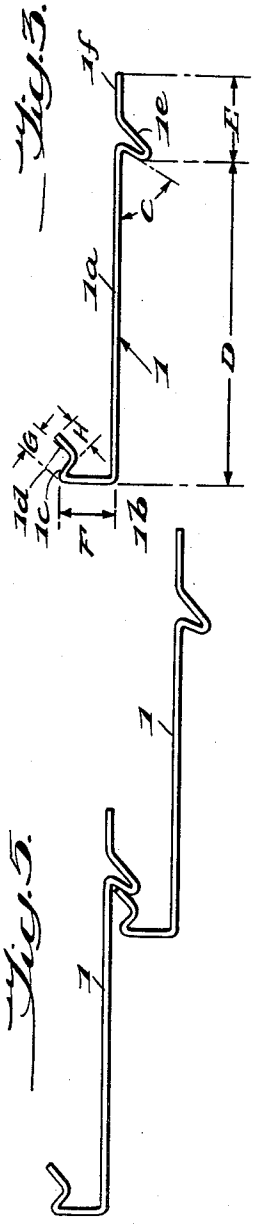


Fig. 3.

Fig. 5.

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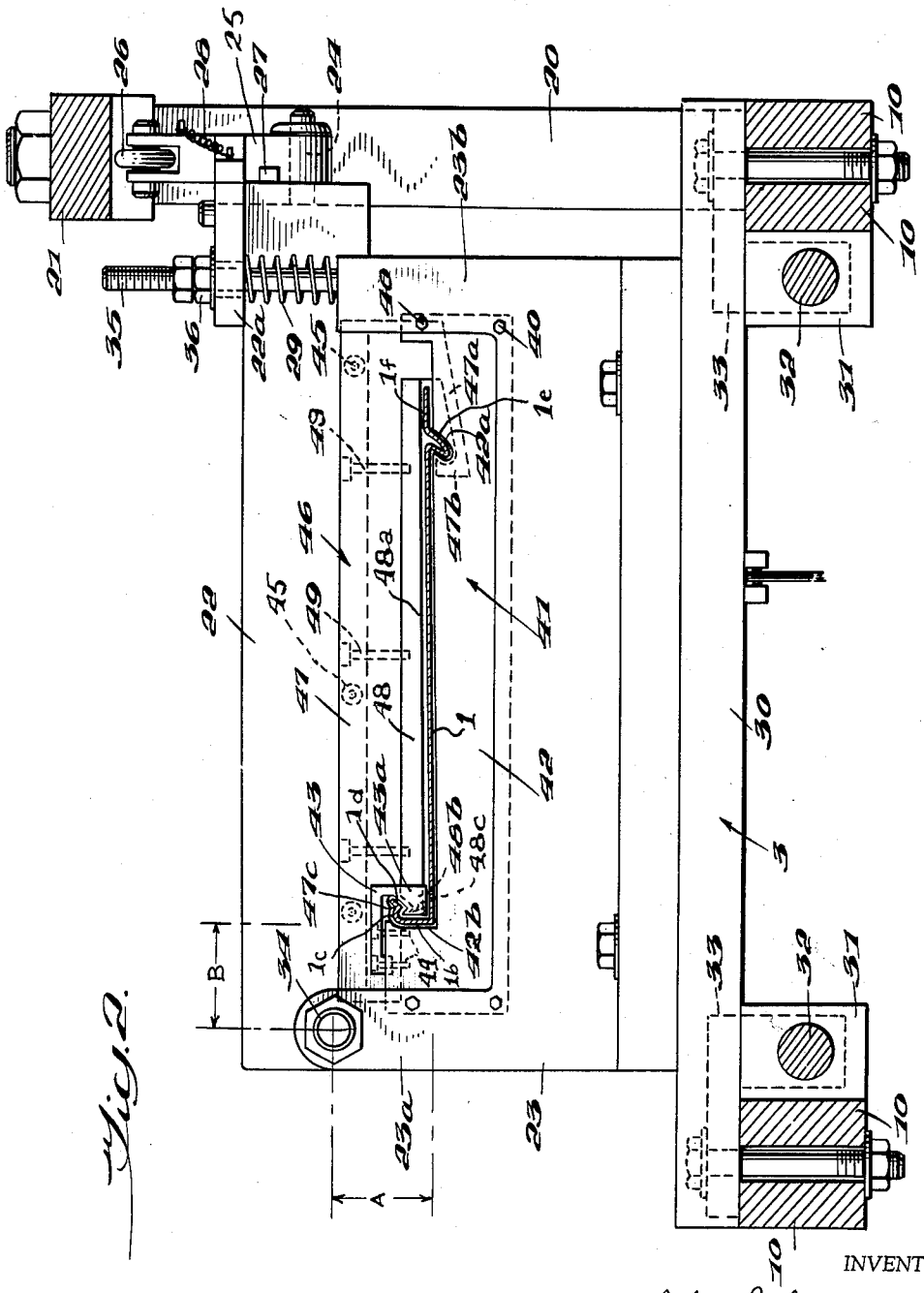


Fig. 2.

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Filed June 30, 1960 3 Sheets-Sheet 3

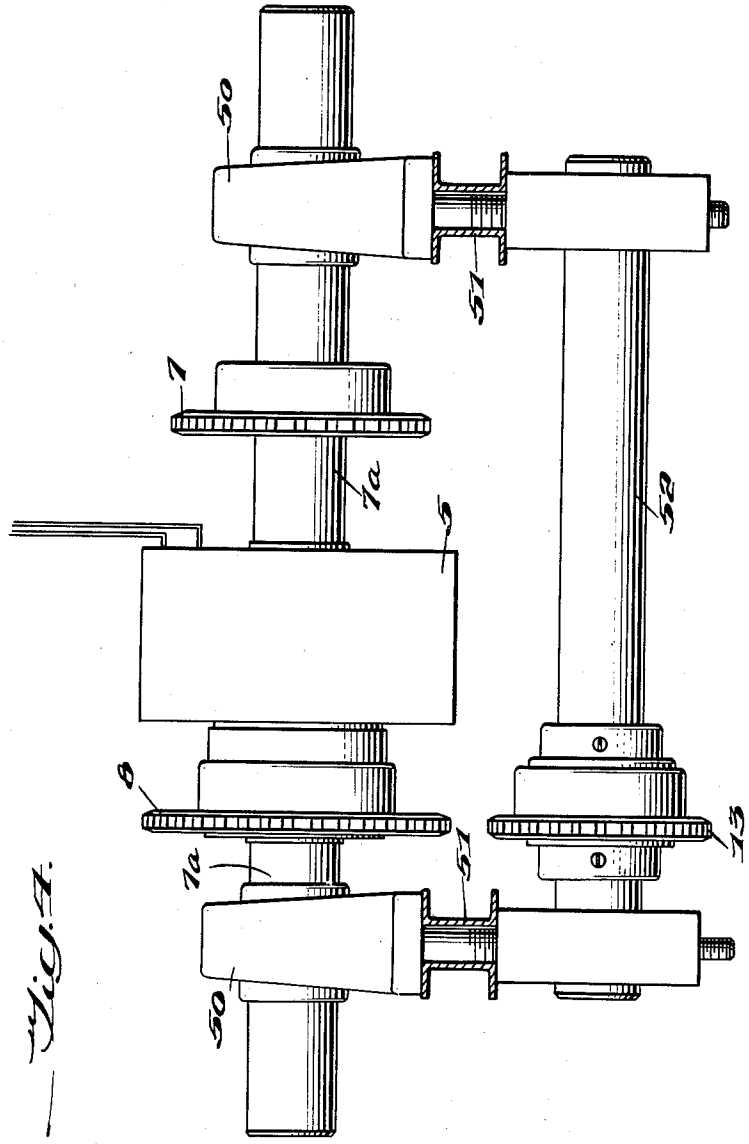


Fig. 4.

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AUTOMATIC CONTOUR DIE CUT-OFF APPARATUS

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This invention relates generally to an automatic contour-die cut-off apparatus, and more particularly to an apparatus for transversely shearing sections of equal length from a continuously-running panel strip by means of transversely-arranged pivotally-connected shear blades, said panel strip being generally horizontal and having a vertical projecting portion adjacent the pivot axis of said shear blades.

It is well known in the prior art to provide "travelling shears" for severing sections of equal lengths from a continuously running sheet. In the known devices an upper cutting blade was generally mounted for vertical reciprocation relative to a stationary lower cutting blade. While these known devices have proved to be satisfactory for the severing of sheets having uniform planar surfaces, they are unsuitable for the severing of continuously running strips having non-planar configurations. For example, in the manufacture of aluminum sheet-metal panels to be used as exterior siding in the building construction trade, the panels are each formed with a horizontal portion having an angularly- arranged longitudinal depression at one side thereof and terminating at the other side in a vertically-formed longitudinal portion having a "reversely bent-back" horizontal extremity, which vertical portion and reversely bent-back extremity of one panel cooperate with the angular depression of another panel to form upon assembly a weatherproof, interlocked connection between the panels. In this case it would be impossible to shear the panel lengths from a continuously-running strip by means of vertical reciprocatory blades without crushing or otherwise deforming the vertical projections and the delicately-formed horizontal bent-back projections, since the aluminum panel is relatively thin and easily deformed.

The primary object of the present invention is to provide an apparatus for severing panels of equal length from a continuously running strip having both horizontal and vertical portions by means of a pair of pivotally connected cutting elements mounted on a reciprocatory carriage adapted to move in the direction of strip feed and at the same speed thereof, whereby transverse severing of the strip is accomplished in a continuous manner similar to the operation of a pair of scissors. The invention is characterized in that the pivot axis of the connection between the two cutting blades is elevated somewhat relative to the horizontal portion of the strip and the vertical portion of the strip is adjacent the pivot axis so that the cutting operation will progress continuously across both the horizontal and vertical portions of the strip.

A more specific object of the invention is to provide an apparatus for shearing a continuously running panel having horizontal and vertical portions by means of a travelling carriage adapted to reciprocate in a direction parallel to the direction of feed of the panel strip, said carriage having a stationary blade and a movable blade pivotally connected to said stationary blade adjacent the vertical portion of the panel strip, and stationary cam means operable upon the free end of the movable blade remote from the pivot axis to progressively cut the horizontal and vertical sections of the panel strip in a manner similar to the operation of common paper cutting shears.

Still another object of the invention resides in the provision of electromagnetically-controlled clutch and chain drive means for moving the carriage in the same direction and at the same speed as the strip feed, and spring means cooperating with said chain to return the carriage to its initial position when the clutch is de-energized by said carriage when it reaches the end of its movement in the strip feed direction after completion of a transverse cutting operation on the strip.

A more detailed object of the invention resides in the provision of specially contoured cutting blades adapted to be removably secured to two pivotally connected shear arms, said cutting blades being adapted to progressively transversely shear a panel strip having a horizontal portion with an angular depression therein and a vertical portion which terminates in a horizontal bent-back terminal portion, said vertical portion being adjacent the pivot connection of the arms.

Other objects and advantages of our invention will become more apparent from a study of the following specification when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic view of the automatic contour die-type cut-off device;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of the non-planar metal panel strip to be cut by the device;

FIG. 4 is a detail view of the clutch and sprocket gear drive means; and

FIG. 5 illustrates the manner in which two panels formed by the instant invention may be assembled.

Referring first more particularly to FIG. 1, the horizontal panel strip 1—which is of a metal (such as aluminum) a suitable alloy, or the like—flows continuously from the forming device 2 at a fairly high rate of speed (on the order of 100 feet per minute) and passes through the contour openings of the cutter elements of the reciprocatory carriage 3, which is initially at a state of rest. When the leading edge 1' of the panel 1 reaches a point "P" a given distance from the forming device 2, actuating element 4' will be engaged to close the switch contacts of sensing means 4. The electrically-controlled clutch means 5—which is electrically connected to the sensing device 4 by means of the conductor 6—is then energized to mechanically connect the shaft of motor driven sprocket gear 7 with the shaft of carriage drive sprocket gear 8 whereby said sprocket gear 8 is driven in the counter-clockwise direction as shown by the arrow.

The carriage 3 is slidably mounted on stationary bed rails 10 for reciprocatory horizontal movement parallel to the longitudinal direction of travel of the panel sheet material 1. One end of sprocket chain 11 is secured to the forward end of carriage 3 and passes over the fixed, rotatably-mounted idler sprocket 12, around the carriage drive sprocket gear 8 and around the fixed, rotatably-mounted idler sprocket gears 13 and 14, the other end of said sprocket chain being secured to the rear end of the carriage 3. Thus rotation of the carriage drive sprocket gear 8 in the counter-clockwise direction will cause movement of the sprocket chain 11 in the direction shown by the arrows so that carriage 3 will be moved in the direction of feed of the panel sheet 1 (i.e., from left to right in FIG. 1). The speed of the driving motor M and the sprocket gear ratios are such that the carriage 3 travels in the direction of strip feed at exactly the same speed of travel as the strip. This is desirous in order to obtain uniform, precise transverse shearing of the panels. Coil spring 18 is secured at one end to the sprocket chain 11 and at the other end to the stationary frame element 19. Movement of the sprocket chain in the direction illustrated by the arrows (to cause movement of the carriage 2, in the direction of travel of the

panel strip) will cause longitudinal expansion and tensioning of the spring means 18.

Rigidly secured to the bed rails 10 by means of the vertical supports 20 is the horizontal cam bar 21 which is arranged parallel to the longitudinal axis of travel of the panel strip 1 and the carriage 3. As will be described in greater detail below, the carriage 3 has an upper blade carrier arm 22 pivotally connected at one end to the lower blade carrier arm 23 about pivot axis 34. Pivotally connected at its lower end to the other end of the upper arm 22 is the cam follower support 25 having a cam follower element 26 at the upper end thereof. Spring means 28 serve to bias the cam follower 25 in the counter-clockwise direction against stop 27 to the vertical position shown in FIG. 1. Other spring means 29 tend to pivotally bias the upper arm 22 upwardly with respect to the lower arm 23 whereby cam follower 26 is normally maintained in engagement with the cam surface of the horizontal cam bar 21.

As the carriage 3 is moved by sprocket gear 8 and chain 11 in the same direction and at the same speed as the panel strip 1, cam follower 26 rides along the cam surface of bar 21. The cam surface of bar 21 is designed to progressively pivot the upper arm 22 downwardly about its pivotal connection to the stationary lower arm 23 as the carriage travels in the direction panel strip feed whereby a predetermined length of panel is severed. When the carriage passes the low point "Q" on the cam bar 21, the follower 26 will be free for upward movement and upper arm 22 will be pivoted upwardly by spring biasing means 29. The carriage 3 will continue to move in the direction of travel of the panel strip until it engages the switch 30 secured to the bed rails 10 whereupon the contacts of the switch are opened to de-energize the electrically-controlled clutch means 5. The carriage drive sprocket gear 8 is then disengaged from the drive gear 7, whereupon the longitudinally-tensioned spring 18 will contract to cause movement of the chain 11 in the opposite direction. Movement of chain 11 in the opposite direction will displace carriage 3 to the left in FIG. 1 at a relatively high rate of speed due to the longitudinally-contracting action of spring 18 on chain 11. As the carriage 3 moves to the left past the low point "Q" on the cam bar 21, the follower support 25 will be pivoted in the clockwise direction about pivot axis 27 against the biasing force of return spring 28. As the carriage is further displaced to the left by the return action of spring 18, follower support 25 will be progressively pivoted in the counter-clockwise direction about pivot axis 24 by the return spring 28 until it is again raised to its vertical position against stop 27. Carriage 3 will continue to be moved to the left by the action of spring 18 until it reaches its initial end position of rest. The carriage 3 will then remain at a position of rest until the severed edge of the panel strip is sensed by the sensing means 4, whereupon the cutting operation described above will be repeated to sever another panel from the strip.

The automatic contour die-type cut-off device is specifically designed to sever panels of equal length from a uniform strip 1 continuously emerging from the forming device 2 and having a non-planar transverse cross-sectional configuration as shown in FIG. 3. The sheet metal strip 1 has a horizontal portion 1*a* and a vertical portion 16 at one side thereof, said vertical portion terminating in a reversely bent-back portion 1*c* and an upwardly bent lip portion 1*d*. Adjacent its other side the panel has therein a longitudinally-extending concave depression 1*e* which is at an acute angle (on the order of 30°) to the horizontal portion 1*a*. The panel terminates at this side in a second horizontal portion 1*f*.

Referring now to FIG. 2, the carriage 3 includes a base 30 resting on the bed rails 10 and having downwardly depending projections 31 slidably mounted upon the guide rods 32. These guide rods 32 are parallel to the direction of travel of the panel strip and are rigidly secured to the bed rails 10 by clamp means 33. Rigidly secured to the carriage base 30 is the stationary lower blade carrier arm 23 having vertical projecting portions 23*a*, 23*b* at each end thereof. Pivotally connected at one end to vertical portion 23*a* about the horizontal pivot axis 34 is the upper blade carrier arm 22. At its other end the upper arm 22 is provided with a horizontal projection 22*a* having a vertical bore therein through which extends the bolt 35. The bolt 35 is rigidly secured at its lower end to the vertical projection 23*b* of lower arm 23 and has stop nuts 36 threaded upon the upper end thereof. Coil spring 29 mounted upon bolt 35 pivotally biases upper arm 22 upwardly to the upper limit of pivotal travel defined by engagement of horizontal projection 22*a* against the stop nuts 36.

Removably connected to the lower arm 23 by means of the bolts 40 is the two-piece lower shear blade 41 which consists of a main shear blade 42 having the generally L-shaped cutting insert 43 secured thereto by means of tap screws 44. Removably connected to the upper arm 22 by means of tap screws 45 is the two piece shear blade 46 which consists of the shear blade 47 having the cutting insert 48 bolted thereto by means of tap screws 49.

As is apparent from FIG. 3, the shear blades 41 and 46 are specifically designed in accordance with the L-shaped cross-sectional configuration of the continuous panel strip 1. The shear blade 42 has an angularly inclined recess 42*a* therein to receive the depression 1*e* of the panel strip and at the other end the shear blade 42 has a vertical shear edge 42*b* parallel to the vertical portion 1*b* of the strip. The L-shaped insert 43 has a horizontal portion 43*a* extending beneath the bent-back extremity (1*c*, 1*d*) of the panel, the upper surface of the horizontal portion 43*a* having a concave recessed configuration corresponding to the lower surface of said panel strip bent-back extremity (1*c*, 1*d*).

Similarly, the upper shear blade cutting insert 48 has a horizontal shearing edge 48*a* and terminates at the end adjacent pivot 34 in an end portion 48*b*. This end portion 48*b* has a vertical cutting edge 48*c* which is inclined at a slight angle (approximately 4°) to the vertical portion 1*b* of the panel strip. In other words, the upper extremity of the vertical cutting edge 48*c* of end portion 48*b* is initially slightly closer to the vertical panel portion 1*b* than the lower extremity thereof. The upper surface of end portion 48*b* has a configuration which corresponds to the lower surface of the bent-back portion 1*c*, 1*d* of the strip. The shear blade 47 has—at the end remote from the pivot axis 34—a horizontal projecting portion 47*a* which extends beneath the depression 1*e* of the panel strip. As is apparent in FIG. 2, this horizontal portion 47*a* terminates in a vertical portion 47*b* having a lip extending back over the angularly-arranged depression 1*e*. The configuration of the cutting edge surface of the portion 47*b* corresponds to the configuration of the depression 1*e*. At the other end (adjacent the pivot axis 34) the upper shear blade 47 has a recess 47*c* for receiving the bent-back portion 1*c*, 1*d* of the panel strip, the cutting edge of the recess being of a configuration corresponding to the upper surface of said bent-back portion 1*c*, 1*d*.

The continuous uniform shearing action of the sheet metal panel strip may now be described. As the carriage 3 moves in the direction of travel of the strip (and at the same speed thereof) the upper arm 22 will be progressively pivoted downwardly about pivot axis 34 due to the action of cam 21 upon the cam follower 26. The horizontally-projecting upper portion of the slightly inclined vertical cutting edge 48*c* of end portion 48*b* will penetrate the panel strip vertical portion 1*b* just below the connection thereto of the bent-back portion 1*c*, 1*d*, and the vertical portion 1*b* will be progressively cut downwardly during the clockwise pivotal movement of the upper arm 22 due to the shearing cooperation between the inclined verti-

cal cutting edge 48*c* of end portion 48*b* and the vertical cutting edge 42*b* of the stationary blade part 42. The shearing of the reversely bent-back panel strip portion (1*c*, 1*d*) will be effected by the shearing cooperation between the recess cutting edge 47*c* and the curved upper cutting edge of the horizontal portion 43*a* of the insert 43. The transverse shearing of the horizontal portion 1*a* of the panel strip then proceeds progressively from left to right in FIG. 2 (in the direction away from the pivot axis 34) due to the cooperation between (and relative inclination of) shear edge 48*a* of the upper arm and the corresponding shear edge 42*c* of the lower arm. As the upper arm 22 is pivoting downwardly, the bent lower portion of depression 1*e* will be at least partially severed by the cooperation between the cutting edge of the reverse end portion 47*b* of the upper shear blade 47 and the corresponding shear edge walls of the opening 42*a*. Further downward pivotal movement of the upper arm 22 will effect complete shearing of the depression 1*e* (by the horizontal edge 48*a*) as well as progressive shearing of the second horizontal portion 1*f*.

It is important to note that by shearing the vertical section of the panel (1*b*, 1*c*, 1*d*) adjacent the pivot axis 34, a relatively large shearing force is developed due to the mechanical advantage of the length of upper arm 22 which is moved downwardly at its free extremity by the cam bar 21 and the cam follower means (26, 25, 24). Furthermore, due to the pivotal movement of the upper arm 22 and due to the location of the vertical portion 1*b* adjacent the pivot axis 34, the shearing action will proceed smoothly and continuously without crushing or otherwise deforming the vertical section of the panel (1*b*, 1*c*, 1*d*).

Thus it is apparent that by means of the shearing apparatus illustrated in FIG. 2, continuous uniform shearing transversely of a non-planar panel sheet having a vertical portion adjacent the pivot axis may be easily accomplished. Due to the location of the pivot axis 34, the upper blade is in effect caused to move during its cutting operation both vertically and horizontally with respect to the lower blade.

Referring now to FIG. 4, it will be seen that the shafts (8*a*, 7*a*) of the carriage drive sprocket gear 8 and the motor driven sprocket gear 7 are connected to each other through the electrically-operated clutch 5. The shafts are journalled in fixed bearing means 50 secured to lower bed rails 51 of the frame. The shaft 52 on which the idler sprocket gear 13 is rotatably mounted is also secured to the lower bed rails 51. The clutch means 5 is of the known multi-disc type having induction-coil electrically-energized control means.

The dimensions of the panel strip and the location of the pivot axis 34 relative to the panel strip projecting portions are specifically selected and are somewhat critical. In one working embodiment using panels having a nominal width of eight inches, the dimension A of FIG. 2 was selected to be one and five-eighths inches, the dimension B was one and seven-eighths inches, the dimension D was 8.0625 plus or minus .010 inch, the dimension E (FIG. 3) was on the order of one half an inch, the dimension F was 0.500 plus or minus .010 inch, and the dimensions G and H were three-sixteenths and one-eighth inch, respectively. The angle of inclination C of the depression 1*e* was 30 degrees.

The aluminum panels so formed are adapted for use as exterior siding in the building construction trade. Two of such panels may be easily interconnected as shown in FIG. 5 by inserting the reversely bent-back portion 1*c*, 1*d* of one panel beneath the angular depression 1*e* formed in the other panel. The aluminum panels may be secured to a supporting structure in a known manner.

While the apparatus has been described primarily for the shearing of a continuously running strip of metal such as aluminum, it is apparent that the principles of the invention are also applicable to the shearing of strips of similar configuration formed from other materials, such as synthetic plastics, for example.

In view of the removability of the shear blades 41 and 46, shear blades of various configurations may be substituted as desired in accordance with the cross-sectional configuration of the strip to be cut. Depending on the dimensions of the panel strip to be cut, the dimensions A and B (FIG. 2) of the pivot axis 34 relative to the vertical portion of the panel sheet may be varied in accordance with the nature and configuration of the shear blades which are connected to the arms 22 and 23.

While in accordance with the provisions of the patent statutes we have illustrated and described the best forms and embodiments of our invention now known to us, it will be apparent to those skilled in the art that other changes and modifications may be made in the apparatus described without deviating from the invention as set forth in the following claims.

We claim:

1. An apparatus for severing uniform lengths from a continuously running panel strip having in cross-section a generally L-shaped configuration, the shorter leg of which extends vertically upwardly from one side of the longer leg constituting a horizontal panel portion, said apparatus comprising a frame, a carriage slidably connected to said frame for horizontal reciprocatory movement parallel to the direction of feed of said strip, means moving said carriage in the direction of feed of the strip at the same speed of travel thereof, a stationary cutter arm secured to said carriage transversely of the strip, said stationary cutter arm including a lower shear blade having a horizontal upper edge below the horizontal leg portion of the panel strip and a vertical edge adjacent and parallel to the outer surface of the vertical leg portion of the panel strip, a transversely arranged movable cutter arm pivotally connected at one end to said stationary cutter arm by a pivot which lies at a higher elevation than the upper extremity of the vertical leg portion of the panel strip, said movable cutter arm including an upper shear blade having a generally horizontal lower edge above the horizontal leg portion of the panel strip and a generally vertical slightly inclined edge adjacent the inner surface of the vertical leg portion of the panel strip, the upper portion of said slightly inclined edge being closer to the vertical leg portion of the panel strip than the lower portion thereof whereby pivotal movement of said movable arm in the cutting direction relative to said stationary arm will progressively downwardly sever the vertical leg portion of the panel strip and progressively transversely sever the horizontal leg portion of the panel strip in a direction away from the pivot axis of said movable arm, stationary cam means arranged adjacent the other end of the movable cutter arm remote from the pivot axis and secured to said frame parallel to the direction of travel of the panel strip, and cam follower means connected to said movable arm for cooperation with said cam means to effect pivotal movement of said movable cutter arm in the cutting direction relative to said stationary cutter arm as said carriage moves in the direction of travel of said strip.

2. Apparatus as defined in claim 1 for severing uniform lengths from a continuously running panel strip wherein the vertical leg portion of the L-shaped panel strip terminates in a longitudinally extending horizontal extremity which is bent back partially over the horizontal leg portion of the panel strip, and further wherein said lower shear blade on said stationary cutter arm includes an L-shaped insert having a horizontal portion extending intermediate said horizontal bent-back extremity and the horizontal leg portion of the panel strip, said upper shear blade on said movable cutter arm having a cutting edge portion above said bent back extremity to cooperate with the horizontal portion of said L-shaped insert

to sever said horizontal extremity upon pivotal movement of said movable arm in the cutting direction.

3. Apparatus as defined in claim 1 for severing uniform lengths from a continuously running panel strip wherein the horizontal leg portion of the panel strip includes an angularly inclined longitudinally extending depression therein adjacent the side of the panel strip which is remote from the pivot axis between said stationary and movable cutter arms, said depression extending toward the pivot axis side of the panel strip at an acute angle relative to the horizontal leg portion of the panel strip, said lower shear blade on said stationary cutter arm being provided with a recess receiving said panel depression, and further wherein said upper shear blade on said movable cutter arm is provided with a horizontal lip portion extending intermediate said depression and the horizontal leg portion of the panel strip to cooperate with the walls of said recess in said lower shear blade to at least partially shear said depressions upon pivotal movement of said movable cutter arm in the cutting direction.

4. Apparatus as defined in claim 1 for severing uniform lengths from a continuously running panel strip wherein said shear blades are constituted by a plurality of blade edge sections which together establish the overall blade edge contour.

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