A feeding device for moving a sheet of material through a progressive die apparatus which forms holes into the sheet. In one embodiment of the feed device, a feed bar is slidably mounted in the direction of feed and has a plurality of upwardly biased feed fingers which project through the formed holes in the sheet. The bar is pivotally connected to a link which in turn is connected to means for converting the vertical motion of the forming apparatus press into reciprocating horizontal motion of the feed bar. One embodiment of the means includes a rack connected to the press which is engaged with a pinion mounted on a rotatable shaft. A crank is connected to an end of the shaft and is pivotally connected to the link. Another embodiment of the means includes a member projecting downwardly from the press being pivotally connected to an end of the link. A second guide link is connected to the base of the feeding device and is also connected to the downwardly extending member. The feeding device has either a single feed bar for moving the sheet of material during the downward or upward stroke of the press or a pair of feed bars are provided which reciprocate in opposite directions so as to move the sheet during both the downward and upward stroke of the press. A power cylinder is provided in one embodiment to control the stroke of one of the feed bars.

1 Claim, 10 Drawing Figures
FEED DEVICE FOR FORMING APPARATUS
This is a division of application Ser. No. 211,551, filed Dec. 23, 1971, now U.S. Pat. No. 3,780,561.

BACKGROUND OF THE INVENTION
1. Field of the Invention
This invention is in the field of feed devices for advancing a sheet through a forming apparatus.

2. Description of the Prior Art
Punch presses are utilized to form apertures in sheets of metal. In certain instances, progressive dies are utilized when more than a single forming step is required. For example, cooling fins in air conditioning systems have collared holes for receiving the coolant tubes. The progressive die is used to form both the hole in the fin and the collar surrounding the hole. Feeding devices have been provided to move a sheet of material through a progressive die so that the forming apparatus may continuously form the collared holes in the sheet. One such feeding device is disclosed in the U.S. Pat. No. 3,417,596 issued to W. Richter. Another device is disclosed in my U.S. Pat. No. 3,454,205.

A disadvantage of many of the prior art feeding devices is that they will move the sheet of material through the forming apparatus only on the downward or upward stroke of the press. Thus, the output of the forming system is limited since the sheet of material must be precisely registered prior to hole formation thereby limiting the speed of the sheet of material through the system. Disclosed herein is a feeding device which moves a sheet of material through the forming apparatus both during the upward and downward stroke of the press. As a result, the sheet of material may be precisely registered while the output is doubled as compared with the prior art devices.

In many instances, it is desired to form a cooling fin having an odd number of holes therein. For example, if an 11 hole fin were desired then a feeding device is usually used which will feed once per complete opening and closing of the dies. Eleven complete strokes of the press is time consuming and as a result, the device disclosed in the U.S. Pat. No. 3,410,130 issued to L. A. Frank was designed to allow the operator to control the feed of the material via an electrical and mechanical means. Many of these prior art progression feed changers are quite complicated requiring a number of different linkages and electronic controls. Disclosed herein is a new and improved means for controlling the feed device.

Many of the prior art feed devices require mechanical linkages to the press crank shaft. Two prior art devices of interest are disclosed in the U.S. Pat. Nos. 1,626,977 issued to T. Sibley and 2,873,448 issued to O. Berg. The feed devices disclosed herein are controlled by a member mounted to and depending from the press. Thus, the linkages and connections are kept to a minimum so as to insure proper registry of the sheet of material with the die. Considerable time savings occur when changing the dies in one press in that one standard press will operate several dies without costly modification to the press crank shaft eccentricities.

SUMMARY OF THE INVENTION
One embodiment of the present invention is a feed device for moving a sheet of metal through a forming apparatus having a press comprising a first reciprocating feed bar having a first feed finger mounted thereto for projecting through the sheet, first guide means having the bar slidably mounted thereto and extending in the direction of movement of the sheet being operable to guide the bar and, first converting means connected to the bar and connected to the press being operable to cause the bar to reciprocate in response to vertical movement of the press for causing the finger to engage and move the sheet through the forming apparatus. It is an object of the present invention to provide a new and improved feeding device for an apparatus which forms metal.

It is the further object of the present invention to provide a feeding device for a forming apparatus which will feed the material both on the downward and upward stroke of the forming apparatus press. Yet another object of the present invention is to provide a feeding device for a progressive die which operates exclusively off of the progressive die.

Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWING
FIG. 1 is a fragmentary side view of an apparatus for forming metal which has a feed device incorporating the present invention.

FIG. 2 is a fragmentary enlarged cross sectional view of the feed device of FIG. 1 viewed in the direction of arrows 2--2 and rotated 90° clockwise.

FIG. 3 is a fragmentary enlarged end view of the feed device of FIG. 1 viewed in the direction of arrows 3--3.

FIG. 4 is a top view of an alternate embodiment of the feed device shown in FIGS. 1 through 3.

FIG. 5 is a cross section view of a feed finger or hold finger engaged with a collared hole sheet of material.

FIG. 6 is a side view of another alternate embodiment of the feed device of FIGS. 1 through 3.

FIG. 7 is a top view of yet another alternate feed embodiment of the feed device of FIGS. 1 through 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS
For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated herein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring now to FIG. 1, there is shown a fragmentary view of a progressive die apparatus 20 having a double acting scissor feed device 30 incorporating the present invention. A sheet of unformed material 22 is fed into apparatus 20 in the direction of arrow 24. Material 22 may be unrolled off of a coil 21 in the direction of arrow 23 so as to provide a continuous length of material to the apparatus. A top die supporting
structure 28 reciprocates in the vertical direction so as to move the top die shoe 26 mounted thereto towards and away from the bottom die shoe supporting structure 25 thereby forming a plurality of collared holes 29 into the sheet of material 22. Although not shown in FIG. 1, a set of motorized pinch rollers pull the sheet of material 22 from coil 21. The pinch rollers maintain a loop of material in a trough and the feed device 30 advances the material from the trough through a stock lubricator which is important to the die forming, then through the progressive die and through the cut-off. The feed device may be contained within the die and the top die supporting structure is fastened to the press ram.

Referring now to FIGS. 1 through 3, feed device 30 has four actuator arms 32, 33, 39 and 40 pivotally connected to clevis mounting blocks 31 fixedly attached to the top die supporting structure 28. The actuator arms are connected by a plurality of pivot arms to a pair of spaced apart and parallel reciprocating feed bars 34 and 35. Bars 34 and 35 are each slidable on a pair of parallel rods 37 and 38 fixedly connected to a pair of base pivot blocks 41 and 42. Separating plate 60 is secured to structure 25 and supports plate 46.

The connection between actuator arm 33 with bar 34 and block 42 will now be described, it being understood that a similar description applies to the connection between actuator arm 40 with bar 34 and block 42. A pivot arm 45 is pivotally connected by pin 43 to block 42. Actuator arm 33 is pivotally connected to arm 45 by fastening device 50. Thus, as actuator arm 33 moves in the direction of arrow 27 (FIG. 1), pivot arm 45 will pivot about pin 43 in the direction of arrow 52 (FIG. 1). A second pivot arm 46 (FIG. 2) is pivotally mounted to feed bar 34 by pin 44. Actuator arm 33 is positioned between pivot arms 45 and 46 and has its bottom portion pivotally connected to pivot arm 46 by fastening device 51. Thus, as actuator arm 33 moves in the direction of arrow 27 pivot arm 46 will pivot upwardly in the direction of arrow 53 (FIG. 1). Since the distance between fastening devices 50 and 51 is always constant, upward movement of actuator arm 33 will force feed bar 34 in the direction of arrow 48 towards base pivot block 42. Likewise, downward movement of actuator arm 33 will force feed bar 34 in a direction opposite of arrow 48. As previously described, actuator arm 40 is pivotally connected in a similar manner to feed bar 34 and base pivot block 42. Therefore, feed bar 34 is pivotally connected at both of its ends to the actuator arms 33 and 40. Suitable linear ball bearing assemblies 36 are mounted within feed bar 34 so as to allow for relatively frictionless movement between the feed bar and rods 37 and 38.

Actuator arms 32 and 39 are pivotally connected to base pivot block 41 and feed bar 35 in a manner similar to the pivot connection of actuator arms 33 and 40. Likewise, feed bar 35 is provided with bearing assemblies 36 so as to allow the feed bar to move to and from base pivot block 41 in a relative frictionless manner. As structure 28 moves downwardly, the four actuator arms are forced downwardly thereby moving feed bar 34 away from block 42 and simultaneously moving feed bar 35 away from block 41. Likewise, upward movement of structure 28 results in the upward movement of the four actuator arms causing feed bar 34 to move towards block 42 in the direction of arrow 48 and feed bar 35 to move towards block 41 in the direction of arrow 49.

Plate 46 is fixedly connected to blocks 41 and 42 by fastening devices 61. A pressure plate 57 having a forward upward end 56 is fixedly mounted to and beneath rod 52 received by yoke 59 fixedly mounted atop plate 46. Pressure plate 51 is fragmented in area 54 to illustrate that plate 46 is provided with a plurality of fingers 56 which extend upwardly through a plurality of slots 55. Feed fingers 56 are mounted to feed bars 34 and 35 and are biased upwardly to engage the sheet of material 22. Block 42 (FIG. 3) is fragmented in area 63 to illustrate that each finger 56 is hollow so as to receive a helically wound spring 65. The bottom of each spring is positioned within suitably sized holes in each feed bar. Bushings 64 are positioned in the holes to prevent the fingers from disengaging the feed bars. Each feed finger 56 is urged upwardly so as to fit within the collared holes 29 (FIG. 5) formed in the sheet of material 22.

When the actuator arms are moved in the direction of arrow 27 to their most upward position, the feed fingers 56 mounted to feed bar 34 are positioned at the ends of slots 55 closest to block 42. Likewise, the feed fingers mounted to bar 35 are positioned in the ends of the slots closest to block 41. The outer top ends of the feed fingers are beveled with the leading edge portions 67 being located higher than the trailing edge portions 66 (FIG. 5). As a result, when feed bar 34 is moved in the direction of arrow 68 (FIG. 5) portion 67 of the feed fingers will engage the collared holes forcing the sheet of material in the direction of arrow 68. On the other hand, when feed bar 34 moves in a direction opposite of arrow 68, the beveled outer face of fingers 56 will contact the sheet of material thereby forcing the fingers down into the holes and allowing bar 34 to move while the sheet of material remains stationary or moves in the opposite direction.

The embodiment of the apparatus disclosed in FIGS. 1 through 3 will pull the sheet of material through the system during both the downward and upward stroke of structure 28. For example, when structure 28 moves downwardly, the feed fingers mounted to bar 34 will engage the collared holes and pull the sheet of material a distance equal to the length of reciprocation of bar 34. Simultaneously, the feed fingers of bar 35 will move downwardly so as to not engage the collared holes. On the next upward stroke of structure 28, the feed fingers mounted to bar 35 will engage the collared holes and pull the sheet of material a length equal to the length of reciprocation of bar 35. Simultaneously, the feed fingers mounted to bar 34 will move downwardly so as to not engage the sheet of material. Pressure plate 57 forces the sheet of material 22 downwardly to enable the feed fingers to appropriately engage the collared holes. The base pivot blocks 41 and 42 are bolted and doweled to the bottom die shoe for perfect alignment with the working parts of the progressive die apparatus.

An alternate embodiment of the feeding device of FIG. 1 is shown in the top view of FIG. 4. Feed device 80 is a single acting scissor feeding device as contrasted to the double acting feed device of FIGS. 1 through 3. Device 80 has only a single feed bar 86 which is slidably mounted on a pair of rods 85 fixedly mounted to base pivot block 84 and block 83. A pair of actuator arms 81 and 82 are pivotally connected to pivot arms which are in turn pivotally connected to base pivot block 84.
and feed bar 86 in a manner similar to that described for the actuator arms of device 30. For example, actuator arm 82 is pivotally connected to pivot arm 88 which in turn is pivotally connected to base pivot block 84. In addition, actuator arm 82 is pivotally connected to pivot arm 87 which in turn is pivotally connected to bar 86. A plurality of feed fingers 91 are mounted to feed bar 86 and are urged through slots 90 in plate 89 secured to blocks 83 and 84. A pressure plate 92 is mounted in a manner similar to pressure plate 57. Block 83 which is secured to rod 85 has a plurality of upwardly urged hold fingers 94 which extend through holes 93 in plate 89. Holes 93 are slightly larger than the diameter of the hold fingers and are not slotted as are slots 90. The purpose of hold fingers 94 is to hold the sheet of material 22 in position while the feed fingers 91 are being retracted to the next hole in the material.

When the material is moved forward by the feed fingers 91, the sheet of material pushing against the tapered surface of the hold fingers 94 pushes the hold fingers down allowing the sheet of material to pass over the hold fingers. The hold fingers are then pushed back up by their springs into the holes in the sheet of material when the collared holes are positioned over the hold fingers. In operation, downward movement of actuator arms 81 and 82 results in feed bar 86 moving towards block 83 thereby causing feed fingers 91 to engage the collared holes and pull the sheet of material through the system. When the actuator arms move upwardly, the hold fingers 94 are engaged with the collared holes so as to hold the sheet of material 22 in a stationary position with respect to bars 83 and 84. Simultaneously, the feed fingers 91 move with feed bar 86 back toward block 84. Both the embodiments shown in FIGS. 1 through 3 and in FIG. 4 show the actuator arms in the most downward position.

Another alternate embodiment of the feeding device is shown in the side view of FIG. 6. The scissor feed device 100 is provided with a progression changer so as to allow the operator to control the amount of feed. An actuator arm 101 connected to structure 28 (FIG. 1) is pivotally connected by arms 106 and 107 to feed bar 102 and has pivot block 104 in a manner similar to that described for actuator arm 33 previously described and shown. Feed bar 102 is slidably mounted to a pair of rods 103 which are fixedly mounted to blocks 104 and 105. Feed fingers are mounted to bar 102 so as to project upwardly into the collared holes. Thus, downward movement of actuator arm 101 results in the feed fingers of bar 102 engaging the collared holes of the sheet of material so as to move the sheet of material in the direction of arrow 108.

A double acting air cylinder 109 is mounted to structure 28 and has an extendible piston rod 110 connected to a generally triangular shaped plate 111. Plate 111 is pivotally connected and is spaced between pivot arms 112 and 113. Arms 112 and 113 are respectively pivotally mounted to feed bar 114 and base pivot block 105. Bar 114 is provided with a plurality of upwardly urged feed fingers which are similar to the feed fingers mounted to bar 102. As previously mentioned, cylinder 109 is a double acting air cylinder with pressurized air being directable to either side of the piston within the cylinder. With piston rod 110 retracted into cylinder 109 and with air pressure positioned on the side of the piston closest to rod 110 and plate 111, the feed device shown in FIG. 8 will operate identical to that shown in FIGS. 1 through 3. Thus, with air pressure on the rod end of the piston, the result is that the feed fingers on bar 102 will engage and move the sheet of material through the device when structure 28 moves downwardly whereas the feed fingers on bar 114 will engage and move the sheet of material through the device when structure 28 moves upwardly. By placing air pressure on the top end of the piston within cylinder 109, that is, the side of the piston farthest from rod 110 and plate 111 the piston rod 110 will be extended from cylinder 109 to the position shown in FIG. 6. A stop plate 115 is mounted to the bottom die shoe supporting structure and is positioned immediately adjacent to plate 111 thereby preventing movement of plate 111 to a position lower than that shown in FIG. 8. By placing air pressure on the top of the piston within the cylinder, plate 111 will be held immediately adjacent stop plate 115 even though structure 28 moves vertically upward.

Thus, device 100 operates in a manner similar to device 30 operating in a manner identical to the hold fingers 94 of device 80. Thus, the sheet of material will be moved through device 100 only when actuator arm 101 moves downwardly. In this latter case, feed bar 114 would remain stationary with respect to rod 103 even though structure 28 was moving upward and downward.

Feed system 30 will move a length of sheet 22 equaling the distance between each collared hole 29 on both the downward and upward stroke of structure 28.

Feeding system 80 will move a length of sheet 22 through the system equal to the distance between collared holes 29 on a complete cycle consisting of a downward and upward stroke of the structure. Feeding system 100 is particularly useful in that it may be used to move a length of material through the system which has an odd number of collared holes. For example, if it is required to make a sheet metal fin which has 11 collared holes 29 located equidistant along the fin length, then five complete cycles consisting of an upward and downward movement of the upper die structure would be required to pull a length of sheet 22 having ten collared holes. A suitable counter mounted to the apparatus counts the number of strokes made by the top die supporting structure. In the example, the counter at the bottom of the fifth stroke actuates a solenoid air valve which exhausts the air from the rod side of the piston and transfers the pressure to the top end of the piston. Subsequent upward movement of the top die structure results in plate 111 remaining adjacent stop plate 115 and feed bar 114 remains stationary. On the next downward stroke feed bar 102 advances the 11th collared hole. At the bottom of the sixth stroke, the counter resets to zero and the valve returns the pressurized air to the rod side of the piston so that an upward and downward stroke will produce a two hole advance. The material advances through the cutoff at the same rate, therefore cutting off every six strokes would produce 11 hole high fins.

Shown in FIGS. 7 and 8 is a single acting rack and pinion device 120. This device is similar to the single acting scissor feed device 80 shown in FIG. 4 with the exception that the scissor linkage has been replaced by a rack and pinion mechanism. A pair of rods 122 and 123 are fixedly fastened to hold finger block 121 and base pivot block 126 which are secured by fasteners 127 to the lower die shoe. A feed bar 124 is provided with bearings 125 for allowing the feed finger block to
move in a frictionless manner on rods 122 and 123. Feed finger bar 124 is provided with a plurality of upwardly biased feed fingers which project upwardly to engage the collared holes of the sheet of material being formed. A plurality of hold fingers 137 are also upwardly biased being mounted to block 121.

Fixedly mounted to both ends of feed finger block 124 are pivot pin blocks 131 and 132. A pair of feed links 133 and 134 are pivotally mounted respectively to blocks 131 and 132 and are respectively pivotally mounted to eccentric cranks 135 by pins 136. Cranks 135 are rigidly mounted to the ends of cross shaft 128 which is rotatably mounted to blocks 129 and 130 fastened to the lower die shoe. A spur gear 138 is fixedly mounted to shaft 128 and is in meshing engagement with the teeth of rack 139 secured at its upper end to mounting block 141 fastened to the upper die supporting structure (FIG. 8). Bearing block 140 is fastened to the lower die supporting structure and is provided with a groove which bearingly receives rack 139. Device 120 is shown in the position corresponding to when the dies are closed. When the dies open, rack 139 moves downwardly forcing the feed fingers mounted to bar 124 to move towards hold finger bar 121. Simultaneously, the hold fingers 137 hold the sheet of material in a stationary position relative to bar 121. Upon closing of the die, rack 139 moves downwardly causing the feed fingers to engage the collared holes to pull the sheet of material being formed through the apparatus.

A double acting rack and pinion feed device 150 is shown in FIG. 9. Device 150 is identical with device 120 with the exception that a pair of racks 154 and 157 are utilized to engage a pair of spur gears 166 and 173 in lieu of only a single rack and spur gear as used in device 120. Feed bars 158 and 159 are slidably mounted to a pair of rods 152 (only one being shown in FIG. 9) and have upwardly biased feed fingers 160 and 161 to engage the collared holes of the sheet of material. Feed links 163 and 170 are respectively pivotally mounted by pins 169 and 168 to protruding blocks 162 and 167 fixedly secured to feed bars 158 and 159. The opposite ends of feed links 163 and 170 are pivotally mounted by pins 165 and 172 to the eccentric cranks 164 and 171. Cranks 164 and 171 are fixedly fastened to the rotatable shafts having spur gears 166 and 173 secured thereon. The spur gears are in meshing engagement with the teeth of racks 154 and 157 which are slidably mounted in bearing blocks 151 and 153 fastened to the bottom die shoes supporting structure. The top ends of racks 154 and 157 are attached to mounting blocks 155 and 156 which in turn are secured to the top die supporting structure. The racks are shown in FIG. 9 in the position corresponding to the closed die position. As the dies open, racks 154 and 157 move upwardly causing feed bars 158 and 159 to converge. Simultaneously, feed fingers 160 of bar 158 engage the collared holes moving the sheet of material through the feeding device in the direction of arrow 180. Fingers 161 are pushed downwardly by the advancing sheet of material being formed. Next, as the dies are closed and racks 154 and 157 move downwardly, bars 158 and 159 move apart with feed fingers 161 engaging the collared holes of the sheet thereby pulling the material through the device in the direction of arrow 180. Simultaneously, feed fingers 160 are depressed by the sheet.

An alternate embodiment of feed device 150 is shown in FIG. 10. Device 200 is identical with device 150 with the exception that a double acting air cylinder 215 is used to reciprocate feed bar 204 with a rack and pinion arrangement 202 being utilized to reciprocate feed bar 203. The piston rod 214 of cylinder 215 is connected by a coupling 213 to rack 212 slidable in guide 210 and in meshing engagement with the teeth of spur gear 208. Gear 208 is fixedly mounted on a rotatable shaft to which eccentric crank 207 is mounted. Crank link 205 is pivotally mounted to one end of crank 207 by pin 209 and is also pivotally mounted to block 206 secured to bar 204. A stop block 211 is mounted to the bottom die shoe supporting structure and is positioned immediately beneath rack 212 to limit the downward stroke of the rack.

Device 200 operates identically with device 100 with the direction of feed being in the direction of arrow 201. Device 200 is shown corresponding to when the dies are in the open position and pressurized air is on the top side of the piston within cylinder 215. Thus, closure of the dies results in feed bar 203 advancing the sheet in the direction of arrow 201. Subsequent opening of the dies results in the sheet remaining stationary. While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the invention and the scope of the claims are also desired to be protected.

1. In combination with a progressive die press system for forming holes in a sheet of material, a feeding device for moving the sheet through the system comprising:

a) a member connected to the press of the system and extending downwardly therefrom, a first link pivotally connected directly to said member, a frame, a second link pivotally connected to said frame and pivotally connected to said member, a pair of spaced apart and parallel guide tracks fixedly mounted to said frame, a bar slidably mounted to said guide tracks in the direction of feed and pivotally connected directly to said first link, a plurality of spring biased upwardly projecting feed fingers mounted to said bar and engaged with said sheet as said press moves vertically in a given direction and said bar moves in the direction of feed, a second bar fixedly mounted to said guide tracks, and a plurality of spring biased upwardly projecting retaining fingers mounted to said second bar and engaged with said sheet preventing movement of said sheet as said press moves vertically in a direction opposite to said given direction.

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