

Nov. 24, 1953

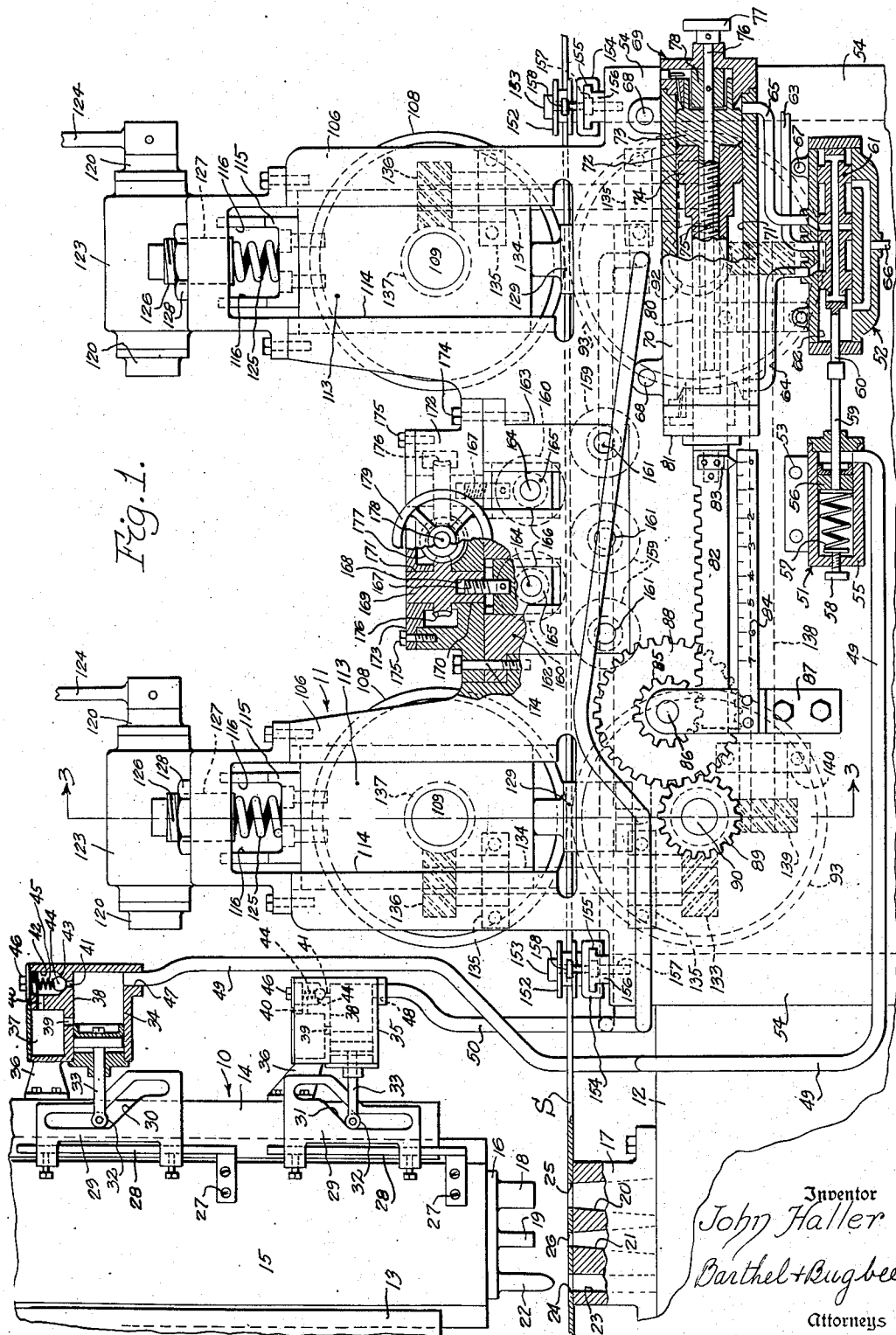
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2,660,427

FEEDING DEVICE FOR SHEET MATERIAL

Filed June 26, 1948

3 Sheets-Sheet 1



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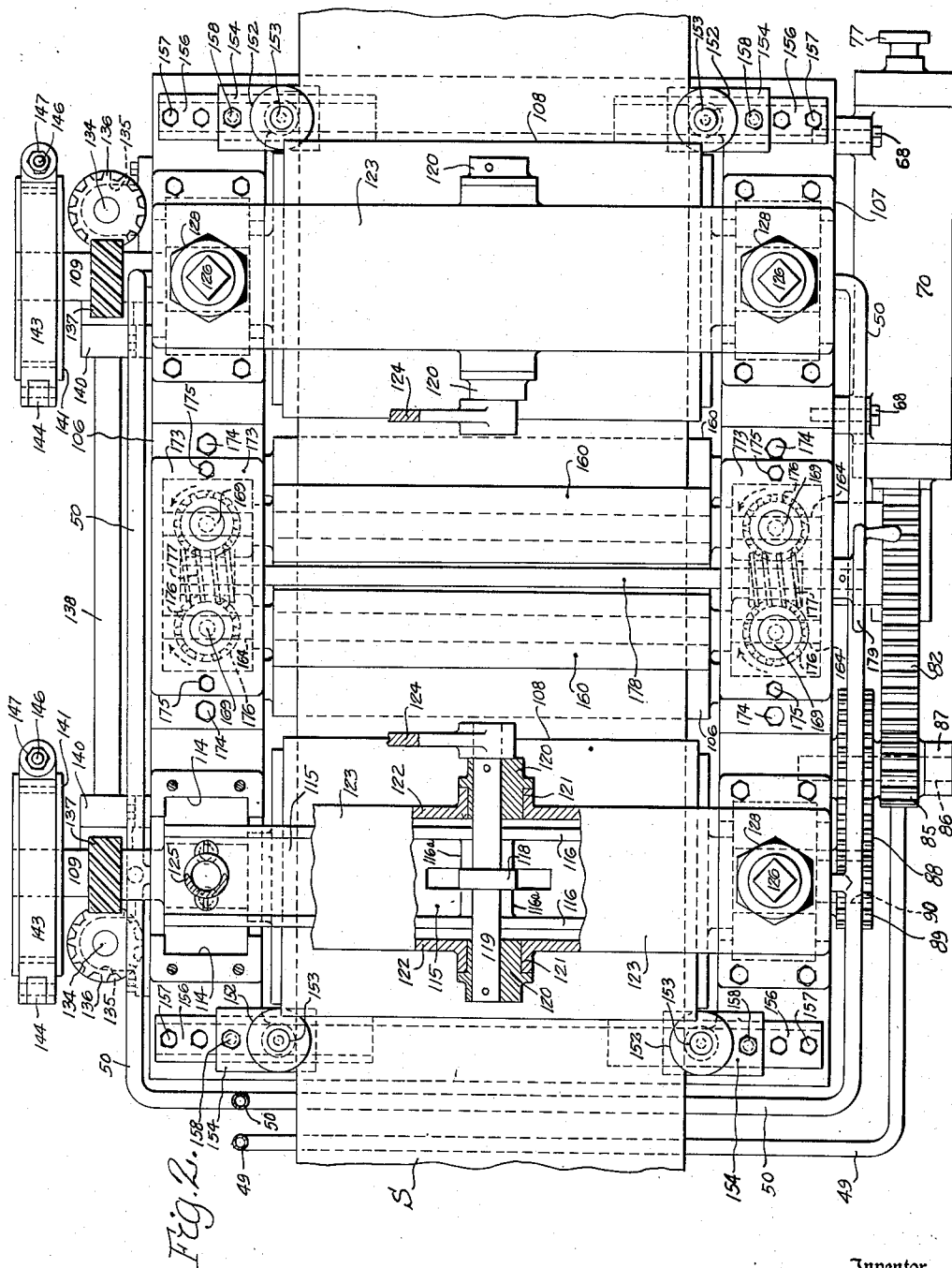
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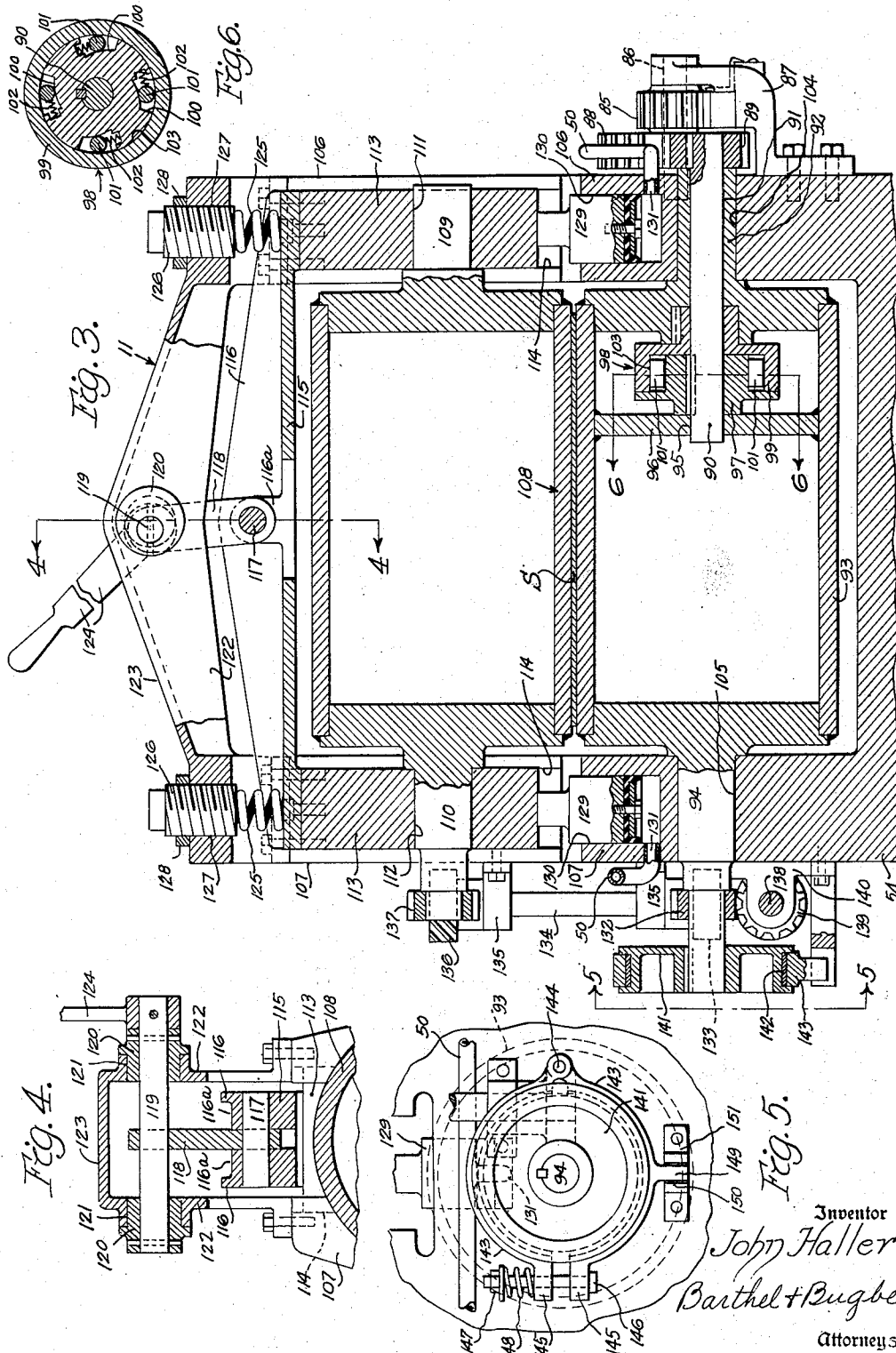
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3 Sheets-Sheet 3



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FEEDING DEVICE FOR SHEET MATERIAL

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This invention relates to feeding devices for feeding sheet material such as sheet steel, to machines utilizing such material, such as punching, stamping or shearing machines.

One object of this invention is to provide a feeding device for sheet material wherein the sheet may be moved unusually large distances between successive operations of the machine being fed, such as in the production of unusually large stampings by a punch press.

Another object is to provide a feeding device for sheet material wherein the sheet material is fed by feeding rolls which are rotated a predetermined circumferential distance to advance the sheet material a similar distance between successive operations of the machine being served, thereby avoiding the difficulties arising in the provision of reciprocating feeding devices for large stampings or the like requiring long distances for the material to be moved between operations of the machine being served.

Another object is to provide a feeding device for sheet material of the foregoing character containing devices for disengaging feeding rolls from gripping engagement with the sheet material at the end of the feeding stroke in order to permit the sheet material to move slightly so as to adjust its position with extreme accuracy by means of a pilot pin on the machine being served entering a pilot hole in the sheet material.

Another object is to provide a feeding device for sheet material of the foregoing character wherein a constant drive is maintained on all sets of rolls regardless of their separation, the rolls on opposite sides of the sheet material being positively driven

Another object is to provide a feeding device for sheet material wherein the actuation of the feeding mechanism is brought about by servo mechanism operated in response to the motion of a part of the machine being served, such as the motion of the platen of a punch press.

Another object is to provide a feeding device for sheet material of the foregoing character, wherein the rolls which feed the sheet material are required to rotate in one direction only, thereby avoiding the shock and vibration of reversing the rotation of mechanisms where large sheets of material are to be handled in order to produce workpieces of unusually large size.

In the drawings:

Figure 1 is a side elevation, partly in section, of a feeding device for sheet material, according to a preferred form of the invention, as attached to and controlled by a stamping press;

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Figure 2 is a top plan view, partly in section, of the feeding device shown in Figure 1;

Figure 3 is a vertical cross-section taken along the line 3-3 in Figure 1, showing the feeding roll operating mechanism;

Figure 4 is a vertical longitudinal section taken along the line 4-4 in Figure 3, showing the mechanism for manually raising and lowering the feeding rolls;

Figure 5 is an enlarged fragmentary end elevation of the braking mechanism for preventing overriding of the feeding rolls, looking in the direction of the line 5-5 in Figure 3; and

Figure 6 is a cross-section through the unidirectional roll driving clutch, taken along the line 6-6 in Figure 3.

Referring to the drawings in detail, Figure 1 shows a sheet metal working machine, generally designated 10, such as a stamping press, arranged to be served by a sheet material feeding device generally designated 11 according to a preferred form of the invention. The sheet metal working machine 10 may be of any type, the stamping press shown being chosen for purposes of illustration and not by way of limitation. The machine 10 which is served by the feeding device 11 is shown diagrammatically as consisting of a bed 12 to which are connected (by means not shown) vertical guide members 13 and 14 in which a platen 15 reciprocates vertically.

Mounted on the platen 15 is a punch unit 16 which is aligned with and cooperates with a corresponding die unit 17 mounted on the bed 12. The punch unit 16 is shown, for purposes of illustration, as having a pair of punches 18 and 19 cooperating with a pair of cavities 20 and 21 respectively in the die unit 17. The punch unit 16 also carries a tapered pilot pin 22 which is adapted to enter a pilot pin cavity 23 in the die unit 17. The pilot pin 22 is for the purpose of entering a pre-formed locating hole or pilot hole 24 in the sheet material S which is to be worked. The punches 18 and 19 subsequently produce the holes 25 and 26 in the sheet material S when they descend and enter the cavities 20 and 21 in the die unit 17. The pilot pin or locating pin 22 serves to move the sheet material S slightly after it has been fed by the feeding device 11 in order that the holes 25 and 26 shall be precisely located relatively to the position of the pilot hole 24.

Secured as at 27 to the platen 15 and movable therewith are two vertically spaced L-shaped brackets 28, to the vertical arms of which are adjustably secured cam plates 29 having upper and lower cam slots 30 and 31 respectively. The

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cam slots 30 and 31 have parallel ends with inclined central portions and engage follower rollers 32 upon the ends of pistons 33 reciprocable in upper and lower hydraulic cylinders 34 and 35 respectively. The cylinders 34 and 35 are of similar construction and are similarly supported on the guide member or press frame 14 by brackets 36 bolted thereto. The cylinders 34 are provided with reservoirs 37 for oil or other suitable fluid communicating with the cylinder bores 38 through ports 39, 40 and 41. The ports 39 open directly into the cylinder bore 38 whereas the ports 40 open into check valve chambers 42 from which the ports 41 open into the cylinder bores 38. The check valve chambers 42 at their lower ends are provided with valve seats 43 engaged by ball relief valve members 44 urged downward by coil springs 45 seated against screw plugs 46 threaded into the upper end of the valve chambers 42.

The upper and lower cylinders 34 and 35 are provided with fluid ports 47 and 48 respectively connected to pipes 49 and 50 leading to certain portions of the feeding device 11 as explained below. Meanwhile, it may be stated that the pipe 49 supplies pressure fluid to actuate a servomotor 51 which operates a control valve 52. The latter, in turn, controls the flow of fluid to a hydraulic motor which operates the feeding rolls. The pipe 50, on the other hand, supplies pressure fluid to hydraulic motors which raise the upper feeding rolls from disengagement with the sheet material S at the end of a feeding stroke, so as to free the sheet material to be capable of moving slightly for re-alignment purposes when the pilot pin 22 descends into the pre-formed locating hole 24 for precisely aligning the punch and die units 16 and 17 relatively to the workpiece S. While the hole 24 may be purely a locating hole pre-formed for that purpose, it may, alternatively, consist of a hole which has been previously formed for other purposes but which may nevertheless be used as a pilot hole or locating hole.

Feed roll operating mechanism

The servomotor 51 is bolted as at 53 to the base or bed 54 of the feeding device 11 and contains a cylinder 55 with a piston 56 reciprocable therein and urged to the right by a coil spring 57, the tension of which may be adjusted by an adjusting screw 58. The piston rod 59 of the servomotor 51 is connected to the valve rod 60 of the control valve 52. Consequently, the pressure fluid entering through the pipe 49 serves to shift the valve rod 60 and valve spool 61 to the left, whereas the spring 57 shifts it to the right into the position shown in Figure 1 when fluid is withdrawn from the pipe 49. The control valve 52 is a conventional four-way valve of a type well-known to hydraulic engineers and hence requires only a superficial description. The three-headed hollow valve spool 61 reciprocates in a valve bore 62 which is provided with spaced ports to which are connected a central pressure fluid supply pipe 63, pressure fluid service pipes 64 and 65 on opposite sides thereof, and a pressure fluid discharge pipe 66. The control valve 52 is bolted as at 67 to the bed 54. The pipe 63 is connected to a suitable pump (not shown) and the pipe 66 to a fluid reservoir connected to the pump.

Bolted as at 68 to the bed 54 is a hydraulic motor generally designated 69 of the variable stroke piston and cylinder type having a cylinder 70 to the opposite ends of which the pressure

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fluid service pipes 64 and 65 lead. Reciprocably mounted in the cylinder bore 71 of the cylinder 70 is an adjustable stroke compound piston 72 having a movable head 73 and a relatively fixed head 74. The latter is internally threaded and threaded upon the threaded stem 75 of the piston head 73, the stem 75 being bored longitudinally with a bore of square cross-section adapted to slidably receive a square shaft 76 carrying a hand wheel 77 at its outer end and a collar 78, these being located on opposite sides of the cylinder head 73. The piston head 74 has a piston rod 80 which, as previously stated, is internally threaded and which passes outward through the opposite cylinder head 81 and is there connected to a toothed rack 82. A pointer 83 is affixed to the side of the rack 82 and indicates the length of stroke of the rack 82 upon a scale 84 secured to the bed 54. As explained below in connection with the operation, the rotation of the hand wheel 77 and squared shaft 76 rotates the threaded stem 75 and thereby causes the piston head 73 to move toward or away from the piston head 72, thereby adjusting the length of the stroke of the piston rod 80 and rack 82, as indicated by the pointer 83 upon the scale 84.

The rack 82 meshes with a pinion 85 (Figures 1, 2 and 3) mounted on a shaft 86, the outer end of which is journaled in a bearing bracket 87 bolted to the bed 54, the inner end being journaled in the bed 54. The shaft 86 also carries a gear 88 which meshes with a pinion 89 upon the shaft 90. The shaft 90 is journaled in the bore 91 (Figure 3) of the hollow lower roll shaft 92 which is connected to the lower feeding roll 93, the opposite end of which is provided with the lower solid roll shaft 94. The inner end of the shaft 90 (Figure 3) is journaled in a bore 95 within a web 96 of the lower feeding roll 93.

Keyed to the inner end of the shaft 90 is the inner clutch member 97 of a unidirectional clutch 98 (Figures 3 and 6) the outer member 99 of which is keyed to the lower feeding roll 93 at the inner end of its hollow shaft 92.

The inner clutch member is provided at intervals around its periphery with arcuately tapered slots or recesses 100 in which are mounted clutch rollers 101 urged toward the converging ends of the recesses 100 by coil springs 102, thereby urging the rollers 101 into clutching engagement with the internal cylindrical surface 103 of the external clutch member 99. By this construction, the rotation of the shaft 90 in a counterclockwise direction drives the outer clutch member 99 but releases it upon rotation in a clockwise direction (Figure 6).

The lower roll shafts 92 and 94 are journaled in aligned bores 104 and 105 in the frame side members 106 and 107 respectively (Figure 3), these rising from the bed 54 of the feeding device 11. Similarly, the hollow upper roll 108 is provided with aligned end shafts 109 and 110 journaled in aligned bores 111 and 112 in the vertically reciprocable blocks 113. The blocks 113 are reciprocably mounted in elongated vertical guideways 114 (Figure 1). The blocks 113 are bolted at their upper ends to cross members 115 (Figures 1 and 3) which at their opposite edges are provided with upstanding webs or flanges 116 (Figure 4) having inwardly extending bosses 116a bored to receive a pivot pin 117 upon which is mounted the lower end of a link 118. The link 118 at its upper end is bored to receive a shaft 119 which at its opposite end has pinned to it a pair of eccentric bushings 120. The eccentric bushings 120 are journaled in

aligned bores 121 in the opposite webs 122 of the frame cross member 123 which interconnects the frame side members 106 and 107 at the upper ends thereof (Figures 2 and 3). Mounted on the outer end of the shaft 119 is a hand lever 124. Thus the cross members 115 and 123 are of approximately U-shaped cross-section but face in opposite directions. Mounted between the outer ends of the cross members 115 and 123 are compression coil springs 125 (Figure 3), the upper ends of which are seated against the lower ends of adjusting screws 126. The screws 126 are threaded through threaded bores 127, carry lock nuts 128, and have squared upper ends for receiving a wrench.

Engaging the lower ends of the blocks 113 are the upper ends of hydraulic plungers 129 which reciprocate in cylinder bores 130 formed in the frame side members 106 and 107 and facing upward. The lower ends of the cylinder bores 130 are provided with ports 131 to which are connected the inner ends of the pipe 50 leading from the lower hydraulic cylinder 35 (Figure 1). By this means, the blocks 113 and consequently the upper rolls 108 are raised and lowered in accordance with the motion of the platen 15. The pipe 50, of course, branches in order to extend to the cylinder bores 130 on opposite sides of the feeding device 11.

In order to provide a driving connection between the upper rolls 108 and lower rolls 93, regardless of their separation, the outer portions of the lower roll shafts 94 carry helical gears 132 (Figure 3) with 45 degree tooth angles. The gears 132 mesh with helical gears 133 (Figures 1 and 3) on the lower ends of vertical shafts 134 journaled in brackets 135 bolted to the frame side members 107. Mounted on the upper ends of the shafts 134 are helical gears 136 meshing with helical gears 137 mounted on the outer end of the upper roll shafts 110. In order to interconnect the two vertical shafts 134, a horizontal shaft 138 is provided at its opposite ends with helical gears 139 meshing with the helical gears 132. The horizontal shaft 138 is journaled at its opposite ends in brackets 140 bolted to the bed 54. In this manner, the rotation of the lower forward roll 93 is transmitted through its shaft 94 to the helical gear 132 and thence through the shafts 138 and 134 to the upper roll shafts 110, positively driving all four of the feed rolls 93 and 108 respectively.

In order to prevent overriding of the feeding rolls 93 and 108, the outer ends of the lower roll shafts 94 are provided with brake drums 141 keyed thereto so as to be rotatable therewith. The brake drums 141 are engaged by the brake linings 142 attached to actuate brake bands 143 which encircle the brake drums 141 (Figures 3 and 5). Each brake band 143 is composed of upper and lower halves hinged together as at 144 and having forwardly projecting arms 145 at their free ends. The arms 145 are bored to receive a retaining pin 146, the upper end of which is threaded to receive a nut 147. Between the nut 147 and one of the arms 145 is mounted a compression coil spring 148 which urges the arms 145 together, causing the brake band 143 to grip the brake drum 141 with a yielding grip, depending upon the adjustment of the nut 147 and the strength of the coil spring 148. In order to prevent the rotation of the brake band 143, the lower half thereof is provided with a downwardly-projecting arm 149 which is anchored in a slot 150 (Figures 3 and 5) formed in a bracket 151 bolted to the bed 54. As a consequence, when

the power is removed from the lower rolls 93 at the end of the feeding stroke, the yielding engagement of the brake linings 142 with the brake drums 141 brings the lower rolls 93 to an abrupt halt, thereby preventing over travel of the sheet material S. The latter is guided in its travel by grooved rollers 152 engaging its opposite edges and mounted on studs or pivot pins 153 carried by slides 154. The slides 154 have T-slots 155 which slidably engage T-section bars 156 bolted as at 157 to the bed 54. In order to lock the slides 154 in their positions of adjustment along the bars 156, each slide 154 is provided with a set screw 158 which engages the T-section bar 156.

Between the two sets of feeding rolls 93, 108 the feeding device 11 is provided with lower and upper straightening rolls 159 and 160 respectively. The lower straightening rolls 159 are mounted on shafts 161 journaled at their opposite ends in the end members 162 inserted in corresponding cut-away portions 163 in the frame side members 106 and 107. The upper straightening rolls 160 are mounted on shafts 164 journaled at their opposite ends in blocks 165 which in turn are slidably mounted in vertical guideways 166 in the end members 162. Pinned or otherwise secured to the blocks 165 are raising and lowering screws 167 which are threaded into threaded bores 168 in vertical shafts 169 having their opposite ends journaled in bores 170 and 171 formed in an upper support 172 in the form of a block having a top member 173 mounted thereon. Each upper support 172 and end member 162 is bolted as at 174 to the side members 106 and 107 (Figure 1) whereas the top member 173 is bolted as at 175 to the upper member 172.

Mounted intermediate the ends of each shaft 169 is a worm gear 176. Each pair of worm gears 176 meshes with a worm 177 on a worm shaft 178 journaled in the upper members 172 and carrying a hand wheel 179 on one end thereof (Figure 2). The adjacent screws 167 on each side of the machine are oppositely threaded, one being a right-hand thread and the other a left-hand thread. Thus, when the hand wheel 179 is turned to rotate the worm gears 176 in opposite directions, as shown by the arrows in the central portion of Figure 2, the screws 167 and blocks 165 will move upward or downward in the same direction. In this manner, the spacing of the lower and upper straightening rolls 159 and 160 can be accurately adjusted. They are so adjusted as to grip the sheet material S with a sufficiently firm grasp to straighten out bent portions thereof but at the same time exert a sufficiently loose grip upon the sheet material S to permit the latter to be shifted slightly to and fro on the downstroke of the platen 15 while the upper feeding rolls 108 have been lifted by the hydraulic plungers 129 (Figure 3) and the pilot pin 22 enters the locating hole 24 to properly and accurately position the material which has already been fed to its approximate position by the feeding rolls 93 and 108.

In the operation of the invention, let it be assumed that the hand levers 124 and hand wheel 179 have been operated manually to lift the upper feed rolls 108 and the upper straightening rolls 160. With the rolls 108 and 160 in their raised positions, the forward end of a sheet of material S is threaded through the space between the upper and lower rolls with its opposite edges passing between the opposite grooved rollers 152. The latter, of course, have been adjusted to and

fro along the T-section bars 156 (Figure 2) so that they are properly adjusted to the width of the sheet S. With these adjustments completed, the hand levers 124 and hand wheel 179 are operated in the opposite direction to lower the upper rolls 108 and 160 into contact with the sheet S resting on the lower rolls 93 and 159. The hand wheel 179 is carefully adjusted so that the upper straightening rolls 160 will perform their function without preventing longitudinal movement of the sheet S.

Let it be assumed that the platen 15 is at the middle of its stroke with the parts of the mechanism in the positions shown in Figure 1, and that the sheet S has been moved forward until the pilot pin 22 is over the locating hole 24. Let it also be assumed that the hand wheel 17 has been adjusted so that the rack 82 attached to the compound piston 72 will reciprocate a sufficient distance, as shown on the scale 34, to advance the sheet material S the proper distance between strokes, of the platen 15, for the particular work pieces to be produced.

The operator now operates the starting switch or starting mechanism of the machine 19 to cause the platen 15 to descend in a working stroke. As the platen 15 descends, the upper cam follower 32 traverses the upper straight portion of the cam groove 30, hence nothing happens within the upper hydraulic cylinder 34 during the downstroke of the platen 15. At the same time, however, the lower cam follower 32 and piston 33 are reciprocated to the right (Figure 1) by the downward motion of the oblique portion of the cam groove 31 in the lower cam plate 29, causing fluid within the lower cylinder 35 to be expelled under pressure through the pipe 53 into the cylinder bores 130 (Figure 3). This pressure fluid, thus produced, acts against the hydraulic plungers 129 to raise them and the blocks 113 against the downward force of the springs 125, thereby raising both of the upper feeding rolls 103. When this occurs, the sheet S is free to move to or fro. As the platen 15 continues its downward stroke, the pilot pin 22 enters the locating hole 24 in the sheet S (Figure 1) and shifts the sheet S to or fro until it is properly located, whereupon the continued downward travel of this platen 15 causes the punches 18 and 19 to pass through the sheet S into the cavities 20 and 21, punching out the holes 25 and 26.

The platen 15 is then reversed and moves upward. As it does so, the lower cam follower 32 and lower piston 33 are subjected to the action of the oblique portion of the lower cam groove 31, causing a suction in the lower cylinder 35 which withdraws fluid from the cylinder bores 130 (Figure 3) by way of the pipe 50 and thus permits the upper feeding rolls 103 to descend into engagement with the sheet material S, urged by the coil springs 25 and the force of gravity. At the same time, the upper cam follower 32 and upper piston 33 are reciprocated to the right, expelling fluid under pressure from the cylinder 34 through the pipe 49 into the servo-motor 51, causing the piston 56 and valve rod 60 of the valve 52 to shift to the left. When this occurs, fluid is free to flow from the pressure fluid line 63 into the service line 65 and thence into the right-hand end of the hydraulic motor 59 (Figure 1) shifting the compound piston 72, piston rod 80 and rack 82 to the left. This action rotates the pinion 85, shaft 86 and gear 88, consequently rotating the pinion 89, shaft 90 and inner clutch member 97 of the unidirectional clutch 98. This causes the

inner clutch member 97 to move in a counter-clockwise direction (Figure 6), forcing the clutch rollers 101 into the smaller ends of the recesses 100 and jamming the rollers 101 tightly against the internal surface 103 of the outer clutch member 99, rotating the latter and consequently rotating the lower feed roll 93 in a counterclockwise direction.

The rotation of the lower feed roll 93 is transmitted through the helical gears 132, 139, 133, 136, 137 and shafts 134 and 133 to the other lower feed roll 93 and to both upper feed rolls 108, causing the lower feed rolls 93 to rotate in a counterclockwise direction and the upper feed rolls 108 to rotate in a clockwise direction, advancing the strip of sheet material S the proper distance to present a fresh portion of stock to the action of the punches 18 and 19. When the platen 15 reaches the top of its stroke, it again reverses and makes a downward stroke in the manner previously described. During this downward stroke, and in every subsequent downward stroke, the upper feed rolls 108 are again raised by the action of the pressure fluid from the lower cylinders 35 passing through the pipes 59 into the cylinder bores 130 so that when the pilot pin 22 enters the next locating hole 24, it can shift the sheet material S freely to enter the hole and cause the punches 18 and 19 to punch the next set of holes 25, 26 in the proper positions.

During the downstroke of the platen 15, the upper piston 33 is reciprocated to the left by the engagement of the cam follower 32 with the oblique portion of the cam groove 30, causing the fluid to be withdrawn from the right-hand end of the servomotor 51. The coil spring 57 then shifts the piston 56 and valve spool 61 of the control valve 52 to the right into the position shown at the lower right-hand corner of Figure 1. In this position, pressure fluid from the supply pipe 63 passes into the service pipe 64 and thence into the left-hand end of the cylinder bore 71, moving the compound piston 72 and rack 82 to the right into the position shown in Figure 1. This action rotates the shaft 90 in a clockwise direction, through the gear 85, shaft 86 and gears 88 and 89. The lower roll shaft 92, and the lower feeding roll 93, however, remain stationary because of the action of the unidirectional clutch 98. The clockwise rotation of the inner clutch member 97 (Figure 6) moves the wider portion of the recesses 100 toward the clutch rollers 101, releasing their grip upon the internal surface 103 of the outer clutch member 99, and hence causing the latter to slip relatively to the inner clutch member 97.

During each forward stroke of each piston 33 of the cylinders 34 and 35, the excess fluid beyond that required for operating the respective plungers 56 and 129 is expelled through the port 41, raising the ball relief valve members 44 and permitting the excess fluid to escape into the reservoir 37 through the ports 41 and 40. On the return stroke of the pistons 33, the additional fluid required to fill the cylinder bore 34 enters from the reservoir 37 through the port 39. The cylinders 34 and 35 are purposely made of larger volume than the servo-cylinder 55 and roll lifting cylinder 130 in order to provide a quick response.

Thus, the feeding device 11 automatically advances the strip of sheet material S the proper distance after each working stroke of the platen 15, then releases the grip of the feeding rolls upon the material S so as to permit the latter to be properly lined up with the punches 18 and 19 by

the pilot pin 22 entering the locating hole 24. The helical gear drive of the rearward lower feeding roll 93 and of both upper feeding rolls 108, causes these to rotate properly without any interruption or change in speed, regardless of the varying thicknesses of material S being handled, since the centers of the meshing helical gears remain spaced at constant distances as the upper rolls 108 rise or fall. The present invention enables the sheet material for large stampings to be handled more conveniently than where a straight reciprocating feed is used, and the speed of feeding is increased and the feeding time shortened, since the feeding rolls operate in only one direction. In the reverse direction, during the working or downward stroke of the platen 15, the feeding rolls remain stationary due to the action of the unidirectional clutch 98. The freeing of the feeding rolls during the downward stroke of the platen 15 insures that the punches will punch their holes in the proper locations because the locating plunger or pilot pin 22 can freely enter the locating hole 24 and shift the sheet materials S in the proper direction to line it up accurately.

What I claim is:

1. A sheet stock feeding apparatus for sheet metal working machines with reciprocating platens comprising a frame, a pair of feeding rolls rotatably mounted one above the other on said frame, a fluid pressure piston and cylinder mounted on said frame, motion-converting mechanism drivingly connecting said piston to one of said rolls, a pressure, fluid control valve having an inlet adapted to be connected to a source of pressure fluid and an outlet connected to said cylinder, a servo-motor operably connected to said valve to shift said valve, and a fluid pressure pump drivingly connected to said platen of said machine and responsive to the motion thereof to generate and transmit pressure fluid to said servo-motor to shift said valve.

2. A sheet stock feeding apparatus for sheet metal working machines with reciprocating platens comprising a frame, a pair of feeding rolls rotatably mounted one above the other on said frame, a fluid pressure piston and cylinder mounted on said frame, motion-converting mechanism drivingly connecting said piston to one of said rolls, a pressure fluid control valve having an inlet adapted to be connected to a source of pressure fluid and an outlet connected to said cylinder, a servo-motor operably connected to said valve to shift said valve, a cam connected to said platen of said machine, and a fluid pressure pump operably engageable with said cam to generate and transmit pressure fluid to said servo-motor to shift said valve in response to the motion of said cam.

3. A sheet stock feeding apparatus for sheet metal working machines comprising a frame, a pair of vertically-spaced parallel horizontal feeding roll shafts rotatably mounted on said frame, a feeding roll mounted on each shaft, one of said roll shafts being adjustably movable toward and away from the other roll shaft, mechanism for rotating one of said roll shafts, a helical gear of 45° tooth angle connected to each roll shaft, a pair of helical gears of 45° tooth angles meshing with said roll-shaft-connected gears, said gears being fixedly secured against axial motion to their respective rolls and shafts, and an approximately vertical rotary shaft carrying and drivingly interconnecting said pair of helical gears.

4. A sheet stock feeding apparatus for sheet

metal working machines comprising a frame, two spaced pairs of vertically-spaced parallel upper and lower opposed feeding roll shafts rotatably mounted on said frame, a feeding roll mounted on each shaft, two of said roll shafts being adjustably movable in substantially vertical directions toward and away from the other two roll shafts, a helical gear of 45° tooth angles connected to each roll shaft, upper and lower helical gears meshing with each pair of roll-shaft-connected gears approximately vertical, said gears being fixedly secured against axial motion to their respective rolls and shafts, rotary shafts carrying and drivingly interconnecting the upper and lower helical gears, and mechanism drivingly interconnecting the lower helical gears.

5. A sheet stock feeding apparatus for sheet metal working machines comprising a frame, two spaced pairs of vertically-spaced parallel upper and lower opposed feeding roll shafts rotatably mounted on said frame, a feeding roll mounted on each shaft, two of said roll shafts being adjustably movable in substantially vertical directions toward and away from the other two roll shafts, a helical gear of 45° tooth angles connected to each roll shaft, upper and lower helical gears meshing with each pair of roll-connected gears, approximately vertical rotary shafts carrying and drivingly interconnecting the upper and lower helical gears, an additional pair of helical gears of 45° tooth angles meshing with the lower roll-shaft-connected helical gears, and an additional rotary shaft carrying and interconnecting said additional pair of gears, said gears being fixedly secured against axial motion to their respective rolls and shafts.

6. A sheet stock feeding apparatus for a sheet metal working machine having a reciprocable member, said apparatus comprising a frame, a pair of feeding rolls rotatably mounted on said frame, one of said rolls being adjustably movable toward and away from the other roll, a reciprocatory fluid pressure motor having a piston therein operatively connected to each end of said adjustably movable roll, a cam connected to said reciprocable member of said machine, and a fluid pressure pump hydraulically connected to said motor, said pump being operably engageable with said cam to generate and transmit pressure fluid to said motor to shift said roll in response to the motion of said cam resulting from the reciprocation of said reciprocable member.

7. A sheet stock feeding apparatus for sheet metal working machines comprising a frame, a pair of feeding rolls rotatably mounted on said frame, a fluid pressure piston and cylinder mounted on said frame, a rack connected to said piston, motion-converting mechanism drivingly connecting said rack to one of said rolls, one of said rolls being adjustably movable toward and away from the other roll, a pressure fluid control valve having an inlet adapted to be connected to a source of pressure fluid and an outlet connected to said cylinder, a servo-motor operably connected to said valve to shift said valve, a reciprocatory fluid pressure motor connected to said adjustably movable roll, and fluid pressure pumping mechanism hydraulically connected to said motor and servo-motor and drivingly connected to a moving part of said machine, said pumping mechanism being responsive to the motion of said machine part in one direction to generate and transmit pressure fluid to said servo-motor to shift said valve, and responsive to the motion of said machine part in the opposite direction

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to generate and transmit pressure fluid to said motor to shift said motor-connected roll.

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