

[54] **ROTATING ARM SHEET UNLOADER-STACKER**

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[51] Int. Cl. **B65h 29/10**

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271/84, 14, 42, 68; 214/6 DK, 6 D, 1 BB;
83/71, 153

[56] **References Cited**

UNITED STATES PATENTS

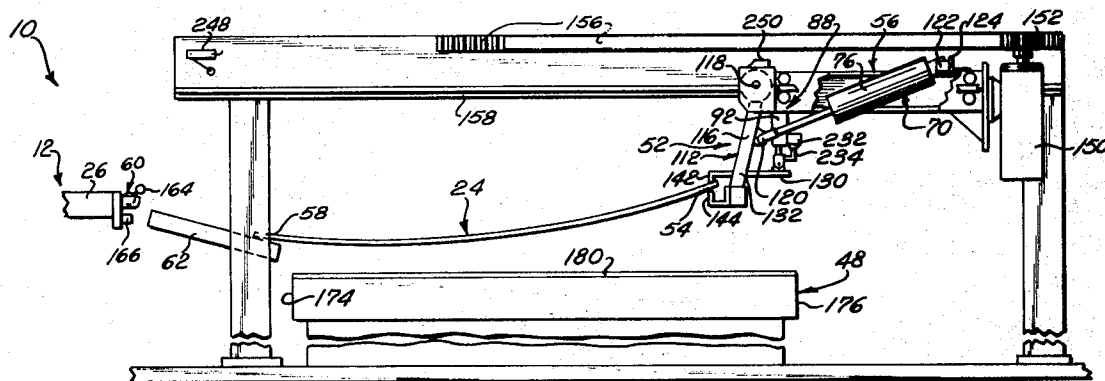
3,370,492	2/1968	Treff	83/71
1,598,381	8/1926	Makowski.....	214/6 DK
3,583,562	6/1971	Yock et al.	271/68
2,890,675	6/1959	Cheever	271/85 X
3,603,187	9/1971	Bredow	83/71 X

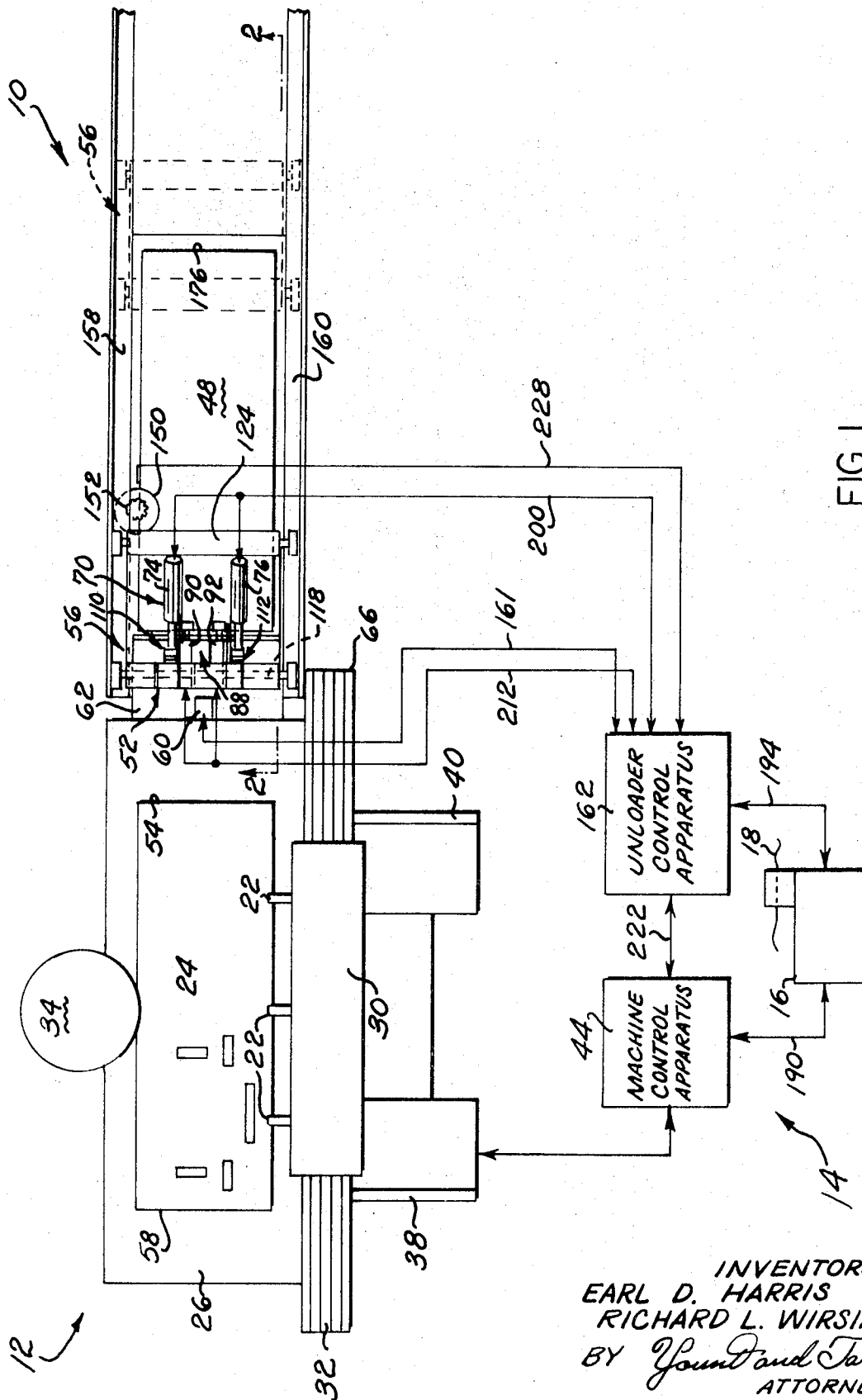
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[57] **ABSTRACT**

An improved apparatus for operating on sheets of material includes an unloader assembly which engages the leading end portion of a sheet and pulls it from a punch press table onto a pile of sheets. This unloader assembly includes a trolley mounted clamp assembly which is movable between a retracted or raised position and an extended or lowered position. In the retracted position the clamp assembly is clear of an area through which the punch press table moves during a punching operation. In the extended position the clamp assembly projects into the area through which the table moves during operation of the punch press. After the clamp assembly has been extended and closed to grip the leading end portion of a sheet, the trolley is moved along a path extending over the pile to pull the sheet gripped by the clamp assembly from the punch press. During at least a portion of this movement of the trolley, a trailing portion of the sheet engages a support chute to maintain the sheet suspended above the pile. The sheet is deposited on the pile without unnecessarily disturbing the uppermost sheet on the pile by retracting and opening the clamp assembly to release the leading end portion of the sheet as the trailing end portion of the sheet moves clear of the support chute and onto the pile.

19 Claims, 9 Drawing Figures





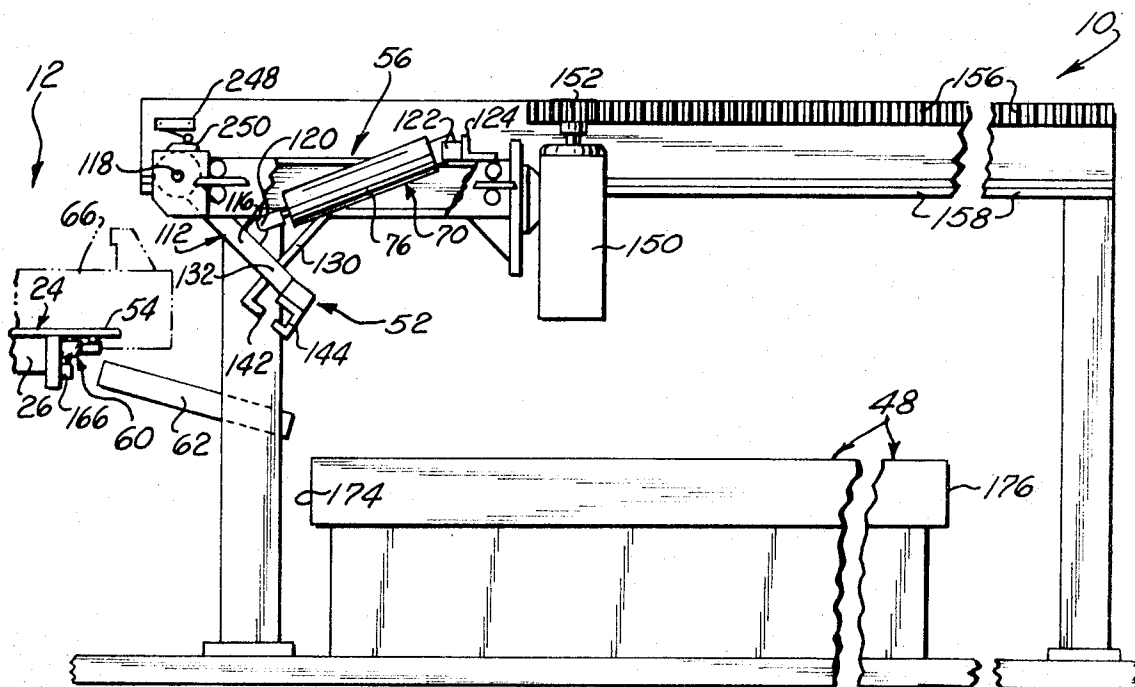


FIG. 2

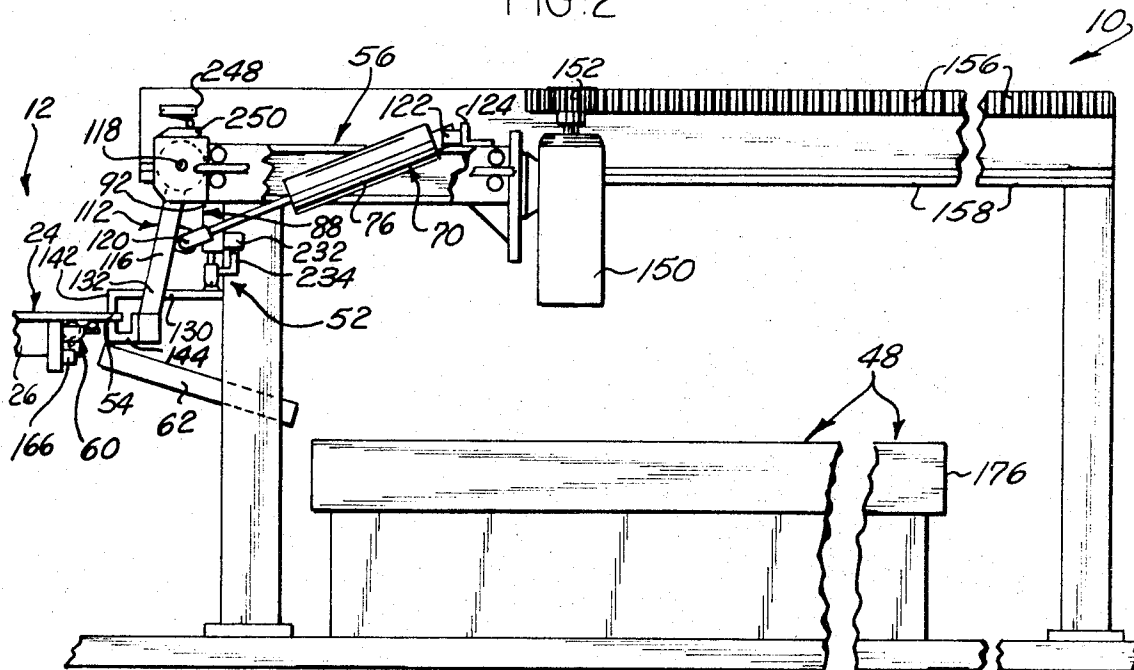


FIG. 3

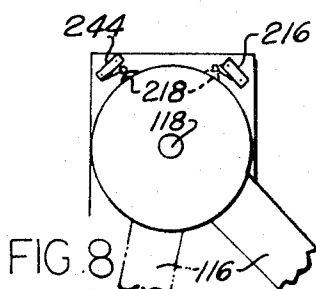


FIG. 8

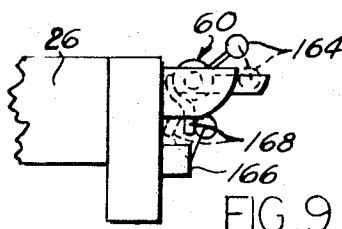
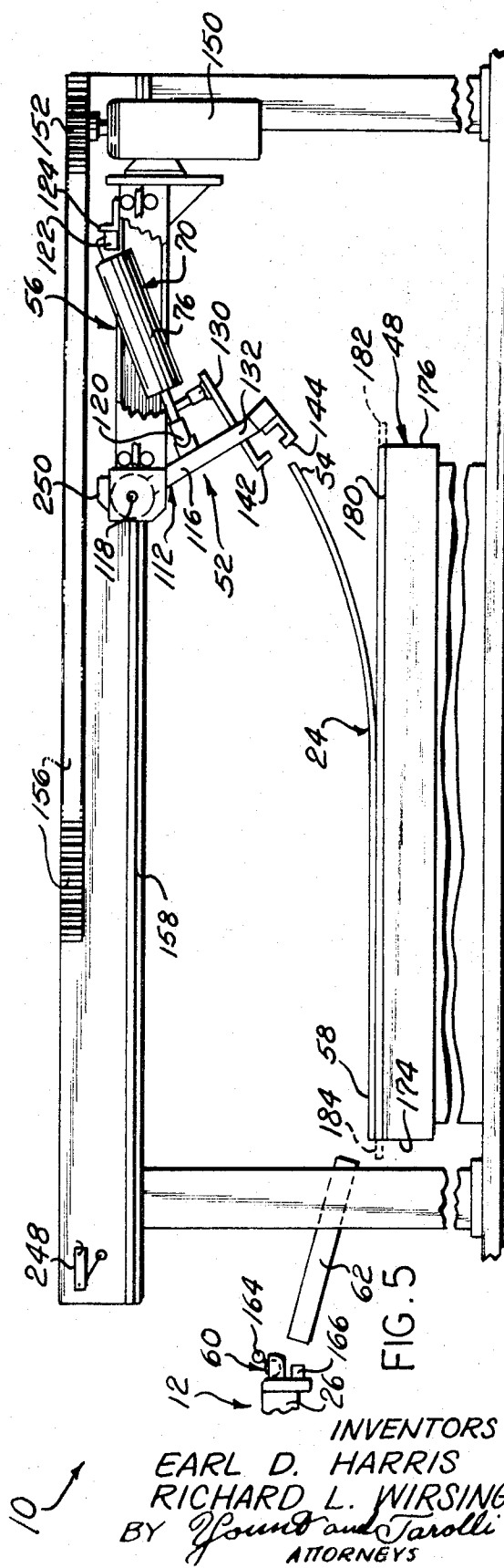
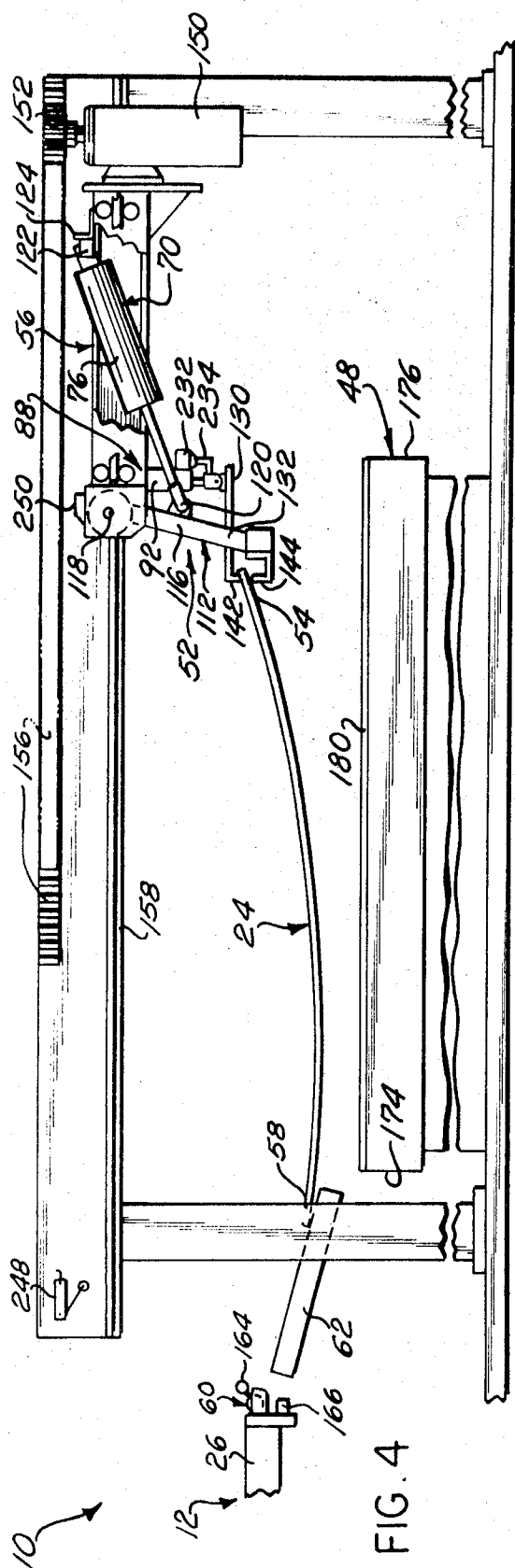
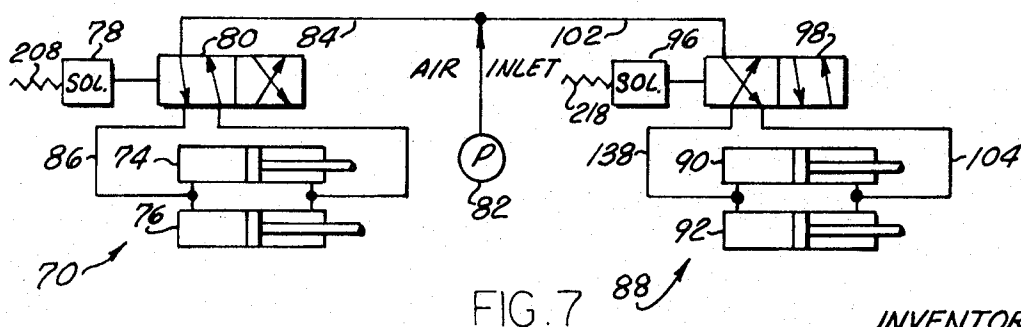
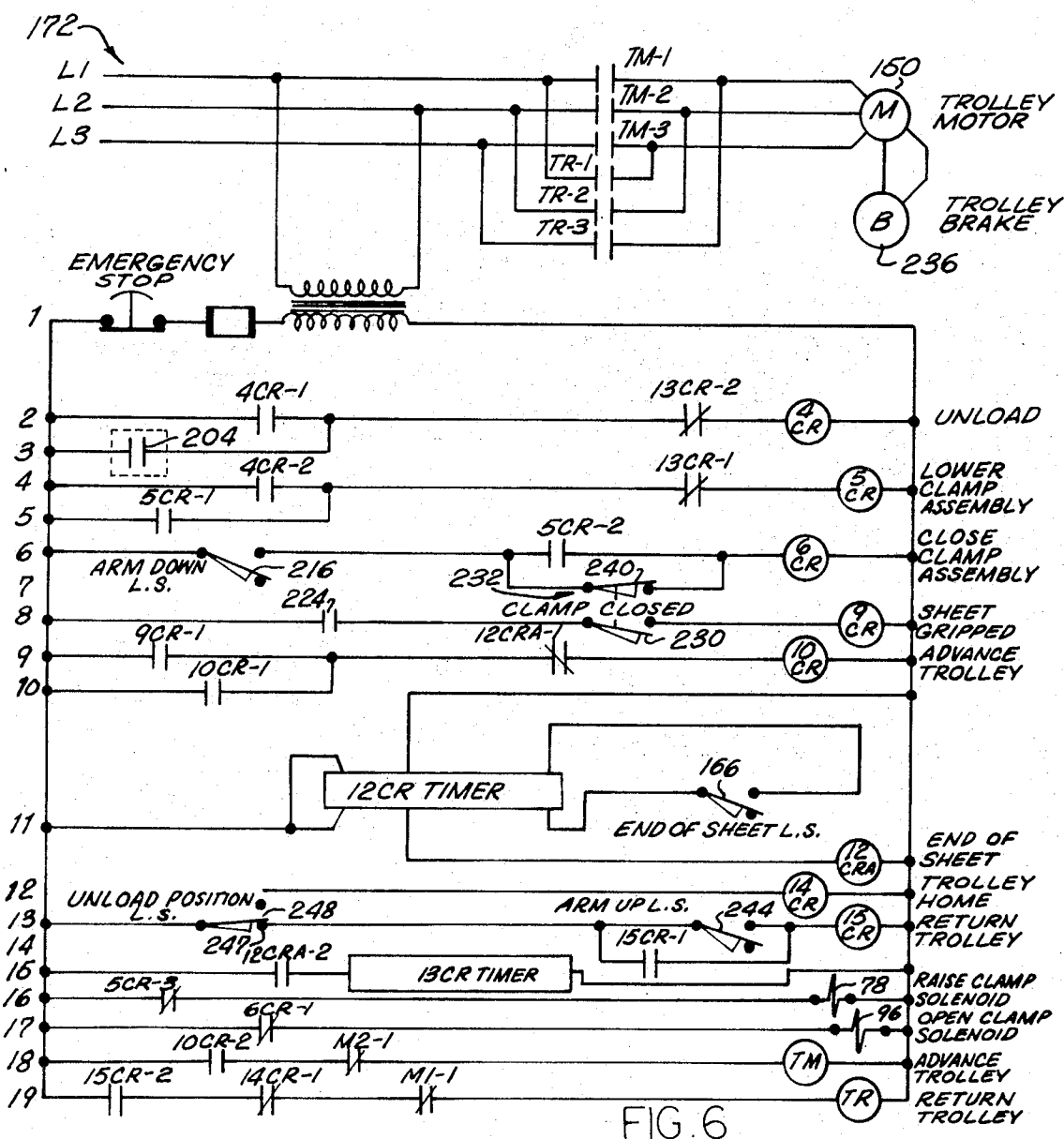


FIG. 9

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ROTATING ARM SHEET UNLOADER-STACKER

This invention relates generally to an apparatus for operating on sheet material and more particularly to an apparatus which includes an unloader assembly for transferring a sheet from a machine to a pile of sheets.

Sheet material has heretofore been unloaded from punch presses and other machines manually or by operation of an unloader assembly, such as the one disclosed and claimed in application Ser. No. 133,873, filed on Apr. 14, 1971 by Joseph R. Linkus and entitled "Unloader Assembly" (File No. WS-5223, Project No. 1200-2). While this unloader assembly greatly facilitates the unloading of a punch press or other machine, the time required for this unloader assembly to remove a sheet from a punch press is contributed to by the fact that an unloader trolley and clamp assembly are moved from an unloading position spaced a substantial distance from the punch press to a loading position adjacent to the punch press upon completion of each punching cycle. This movement of the trolley is necessary to keep the trolley and clamp assembly clear of an area through which a punch press table moves during the punching cycle.

During operation of an unloader assembly the sheets should be stacked in a pile with their ends in alignment. If the ends of the sheets are misaligned, subsequent handling of the pile of sheets is made unnecessarily difficult. During operation of a known unloader assembly, a sheet is pulled or dragged across the uppermost sheet on the pile of sheets as the sheet is removed from a machine. Of course, this dragging action tends to move or displace the uppermost sheet relative to the other sheets on the pile.

The present invention provides an improved sheet processing apparatus which includes an unloader having a trolley which is maintained at an unloading position during operation of an associated punch press. A clamp assembly mounted on the trolley is movable relative to the trolley from a retracted position in which the clamp assembly is clear of the punch press to an extended position. In the extended position, the clamp assembly projects into an area of movement of the punch press table to grip the leading end portion of a sheet. The trolley then pulls the gripped sheet from the punch press to a position in which the sheet is suspended over the pile. The sheet is deposited on the pile, without unnecessarily disturbing an uppermost sheet, by retracting and opening the clamp assembly to release a leading end portion of the sheet as a trailing portion of the sheet drops onto the pile. Of course, an unloader constructed in accordance with the present invention can be utilized in association with machines other than punch presses.

Accordingly, it is an object of this invention to provide a new and improved apparatus for operating on sheet material and which includes an unloader assembly having a clamp assembly which is movable relative to a trolley between a raised or retracted position in which the clamp assembly is clear of an area of movement of operating components of an associated machine and an extended or lowered position in which the clamp assembly is disposed within the area of movement of a component of the machine to engage the leading end portion of a sheet to be removed from the machine.

Another object of this invention is to provide a new and improved apparatus for operating on sheet material and which includes an unloader assembly having a clamp assembly which is opened as it is moved from a lowered or extended position to a raised or retracted position to release the leading end portion of a sheet and deposit it on a pile of sheets.

Another object of this invention is to provide a new and improved apparatus for operating on sheets of material and which includes a machine for performing work operations on a sheet and positioning it at a loading location and an unloader assembly which is operable to engage the leading end portion of the sheet and pull it from the machine onto a pile of sheets, and wherein the unloader assembly includes a clamp assembly mounted on a trolley which is movable from a loading position adjacent to the machine to an unloading position adjacent to a furthestmost end portion of the pile of sheets to pull a sheet from the machine and a control apparatus which effects operation of the clamp assembly to an open condition while simultaneously therewith effecting movement of the clamp assembly to a raised position to thereby release the leading end portion of the sheet and deposit it on the pile.

Another object of this invention is to provide a new and improved apparatus in accordance with the next preceding object and wherein the control apparatus includes means for effecting movement of the trolley to the loading position in response to a releasing of a leading end portion of a sheet of material by the clamp assembly.

Another object of this invention is to provide a new and improved apparatus for operating on sheets of material and which includes an unloader having a trolley mounted clamp assembly which is movable over a pile of sheets to pull a sheet from an associated machine and wherein unnecessary disturbance of the sheets on the pile is prevented by suspending the sheet over the pile as it is pulled from the machine and opening the clamp assembly to release a leading end portion of the sheet as a trailing end portion of the sheet moves onto the pile.

These and other objects and features of the present invention will become more apparent upon a consideration of the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a schematic illustration depicting the relationship between a punch press and unloader assembly constructed in accordance with the present invention;

FIG. 2 is a partially broken away elevational view, taken generally along the line 2-2 of FIG. 1, depicting the relationship between an unloader trolley and an open clamp assembly mounted on the trolley, the clamp assembly being shown in a raised or retracted position in which it is clear of the punch press;

FIG. 3 is a fragmentary elevational view, generally similar to FIG. 2, illustrating the clamp assembly in a closed and lowered or extended position in which work clamp assembly projects into an operating area of a component of the punch press and grips the leading end portion of a sheet;

FIG. 4 is a fragmentary elevational view, generally similar to FIGS. 2 and 3, illustrating the trolley at an unloading position immediately before depositing of a sheet onto a pile of sheets;

FIG. 5 is a fragmentary elevational view, generally similar to FIG. 4, illustrating the disengagement of the leading end portion of a sheet from the clamp assembly as it is swung upwardly away from the punch press and opened;

FIG. 6 is a schematic illustration of electrical control circuitry for controlling the operation of the unloader assembly;

FIG. 7 is a schematic illustration of pneumatic control circuitry for controlling the operation of the unloader assembly;

FIG. 8 is an enlarged fragmentary view illustrating the relationship between a clamp arm and a pair of limit switches which are actuated upon movement of the clamp arm; and

FIG. 9 is a schematic illustration depicting the construction of an end of sheet detector assembly.

An unloader assembly 10 constructed in accordance with the present invention is illustrated in FIGS. 1 and 2 in association with a tape controlled punch press 12 of a known construction. A control assembly 14 for controlling the operation of both the punch press 12 and unloader assembly 10 is illustrated schematically in FIG. 1. The control assembly 14 includes a known reader 16 which effects operation of the punch press 12 and unloader assembly 10 in accordance with a program punched in a tape 18. Although the unloader assembly 10 and control assembly 14 are shown herein in association with a turret type punch press 12, it should be understood that the unloader and control assemblies could be associated with many different types of machines.

The punch press 12 includes a plurality of workholders 22 which grippingly engage a piece of sheet metal 24 which is supported on a work table 26. The workholders 22 are of a known pneumatically actuated type and are mounted on a cross slide 30. The cross slide 30 is movable back and forth along ways 32 to position the sheet 24 along a first or X axis relative to a turret 34 which holds a plurality of tools for punching holes in the sheet. The cross slide 30 and table 26 are movable along cross ways 38 and 40 to position the sheet 24 along a second or Y axis relative to the turret 34.

Movement of the sheet 24 by the cross slide 30 and table 26 is effected by machine control apparatus 44 and tape reader 16 in accordance with a program punched into the tape 18. In addition, the control apparatus 44 indexes the turret 34 to work on the sheet 24 with tools selected in accordance with the program punched into the tape 18. Once work operations have been completed on the sheet 24, the tape reader 16 signals the control apparatus 44 to effect operation of the table 26 and cross slide 30 to move the sheet to an unloading location. Since the operation of tape controlled turret punch presses and similar machines is well-known, a further description of the specific operation of the punch press 12 will not be included herein to avoid prolixity of description.

Upon completion of punching operations and movement of the sheet 24 to the unloading location, the unloader assembly 10 removes the sheet from the punch press 12 and deposits it on the pile 48. Upon initiation of an unloading cycle, an open sheet clamp assembly 52 is swung downwardly and rearwardly from the raised or retracted position of FIG. 2 to the lowered or

extended position of FIG. 3 and closed to grip a leading end portion 54 of the sheet 24. A trolley 56, on which the clamp assembly 52 is mounted, is then moved away from the punch press 12 to pull the sheet 24 over the pile 48. During a latter part of this movement of the trolley 56, a trailing end portion 58 of the sheet moves past an end of sheet detector assembly 60. Shortly thereafter, the trolley 56 is stopped with the sheet 24 suspended over the pile 48 (FIG. 4) between the trolley 56 and a support chute 62.

The sheet 24 is then deposited on the pile 48 by opening the clamp assembly 52 as it is moved upwardly and forwardly toward the retracted position (see FIG. 5). Movement of the clamp assembly 52 toward the retracted position pulls the trailing end portion 58 of the sheet from the chute 62. As the trailing end portion 58 of the sheet 62 is moving clear of the chute 62 and onto the pile 48, the clamp assembly 52 is opened to release the leading end portion 54 of the sheet. In this manner, the sheet 24 is transferred from the punch press 12 to the pile 48 without disturbing the other sheets on the pile. The trolley 56 is then moved from the unloading position of FIG. 5 back to the loading position of FIG. 2 with the clamp assembly 52 opened and raised so that it is clear of the punch press table 26 and ready to move into engagement with the leading end portion of a next succeeding sheet.

When the trolley 56 is in the loading position with the clamp assembly 52 raised or retracted (as shown in FIG. 2), the clamp assembly is clear of a projecting end portion 66 of the table 26. Therefore, the table 26 can be moved along the cross ways 38 and 40 toward and away from the turret 34 (FIG. 1) without interfering with the clamp assembly 52 even though the end portion 66 of the table 26 is moved in an operating area which extends into the unloader assembly 10 (FIG. 2). The capability of the clamp assembly 52 for movement between the raised or retracted position (FIG. 2) and the extended or lowered position (FIG. 3) enables the trolley 56 to be maintained in the loading position while the punch press 12 is operating on the sheet 24 without restricting the range of operation of the punch press. By maintaining the trolley 56 in the loading position during operation of the punch press 12, the time required to unload the sheet 24 from the punch press 12 tends to be minimized. This is because the leading end portion 54 of the sheet 24 can be engaged upon initiation of an unloading cycle by merely swinging the clamp assembly 52 downwardly and rearwardly (that is, toward the left as viewed in FIG. 2) from the retracted position to the extended position without moving the trolley 56 relative to the punch press 12.

The clamp assembly 52 is moved from the retracted or raised position to the lowered or extended position by extending an operator assembly 70. The operator assembly 70 includes a pair of piston and cylinder assemblies 74 and 76 (see FIGS. 1 and 7) which are extended by de-energizing a solenoid 78 so that a control valve 80 directs high pressure air from a source 82 through conduits 84 and 86 to the head ends of the cylinders 74 and 76. This causes the cylinders 74 and 76 to swing the clamp assembly 52 downwardly and rearwardly to the extended or lowered position of FIG. 3. Thus, upon completion of punching operations on the sheet 24, the clamp assembly 52 is moved into position to grip the

leading end portion 54 of the sheet 24 by merely extending the piston and cylinder assemblies 74 and 76 without moving the trolley 56. This enables the sheet 24 to be gripped quickly after punching operations have been completed by the press 12 and pulled from the press by continued operation of the unloader assembly 10.

The clamp assembly 52 is maintained in the open condition of FIG. 2 as it is moved from the retracted position to the extended position. Once the clamp assembly 52 has been extended, it is closed by an actuator assembly 88 to tightly grip the leading end portion 54 of the sheet 24. Accordingly, the actuator assembly 88 includes a pair of piston and cylinder assemblies 90 and 92 (FIGS. 1 and 7) which are retracted to close the clamp assembly 52 by de-energizing a solenoid 96 (FIG. 7) to effect operation of a control valve 98 to its normal condition. This enables high pressure air to be conducted from the source 82 through conduits 102 and 104 to the rod ends of the cylinders 90 and 92 to thereby retract the cylinders. Operation of the cylinders 90 and 92 to the retracted condition operates the clamp assembly 52 from the open condition of FIG. 2 to the closed condition of FIG. 3 to grip the leading end portion 54 of the sheet 24.

The clamp assembly 52 includes a pair of grippers 110 and 112 (FIG. 1) which are mounted on the trolley 56. The grippers 110 and 112 are substantially identical in construction, the gripper 110 being moved between the retracted and extended positions by the piston and cylinder assembly 74 and actuated between the open and closed conditions by the piston and cylinder assembly 90. Similarly, the gripper 112 is moved between the extended and retracted positions by the piston and cylinder assembly 76 and is opened and closed by operation of the piston and cylinder assembly 92. The gripper 112 includes a main clamp arm 116 (FIG. 2) which is pivotally mounted on a horizontal support shaft 118 extending across the trolley 56. The clamp arm 116 is pivotal about the support shaft 118 by extending and retracting the piston and cylinder assembly 76. The piston and cylinder assembly 76 has a rod end 120 connected to the main clamp arm 116 and a cylinder end connected at 122 to a cross-frame member 124 on the trolley 56. Thus, when the piston and cylinder assembly 76 is extended, the main clamp arm 116 is pivoted about the support shaft 118 relative to the trolley 56 from the retracted position of FIG. 2 to the extended position of FIG. 3.

During this movement of the main clamp arm 116 from the retracted position to the extended position, the gripper 112 is maintained in the opened condition of FIG. 2. Once the gripper 112 has been lowered, it is closed to clampingly engage the leading end portion 54 of sheet 24 (FIG. 3). The gripper 112 includes a secondary clamp arm 130 which is pivotally connected at 132 to the main clamp arm 116. To operate the gripper 112 from the open condition to the closed condition, the piston and cylinder assembly 92 is retracted to pivot the secondary clamp arm 130 in a counter-clockwise direction (as viewed in FIG. 2) about the connection 132.

The piston and cylinder assembly 92 is connected at its head or cylinder end with the shaft 118 so that it pivots about the shaft with the main clamp arm 116 and

secondary clamp arm 130 when the operator assembly 70 is extended or retracted. Therefore, the gripper 112 remains in the open condition of FIG. 2 as it is lowered to the active position of FIG. 3 by extension of the operator piston and cylinder assembly 76. Accordingly, the solenoid 96 (FIG. 7) is maintained energized so that the valve 98 directs air under pressure from the conduit 102 to the conduit 138 and the head end of the cylinder 92. Once the gripper 112 has been moved to the lowered position of FIG. 3, the solenoid 96 is de-energized to move the valve 98 to the normal position of FIG. 7 and direct air under pressure to the rod end of the cylinder 92. Of course, this retracts the cylinder 92 and pivots the secondary clamp arm 130 in a counter-clockwise direction (as viewed in FIGS. 2 and 3) about the pivot connection 132 to move a jaw element 142 on the secondary clamp arm 130 into engagement with an upper surface of the sheet 24. The air pressure in the cylinder 92 urges or biases the jaw element 142 toward a lower jaw element 144 to tightly grip the sheet 24 (see FIG. 3).

Since the gripper 110 is of the same construction as the gripper 112 and cooperates with the piston and cylinder assemblies 74 and 90 in the same manner as in which the gripper 112 cooperates with the piston and cylinders 76 and 92, it is believed that the construction of operation of the gripper 110 will be apparent without a further description. Moreover, it should be understood that the gripper 110 is operated by the piston and cylinder assemblies 74 and 90 in unison with operation of the gripper 112 by the piston and cylinder assemblies 76 and 92. Thus, when the valve 80 is operated to extend or retract the piston and cylinder assembly 76, the piston and cylinder assembly 74 is extended and retracted at the same time to thereby swing both the grippers 110 and 112 about the support shaft 118 between the raised and lowered positions. Similarly operation of the valve 98 opens or closes both of the grippers 110 and 112 at the same time.

After the leading end portion 54 of the sheet 24 has been clampingly engaged by both of the grippers 110 and 112 (see FIG. 3), a motor 150 on the carriage 56 is energized to rotate a pinion gear 152 in a counter-clockwise direction (as viewed in FIG. 1) to move the trolley 56 from the loading position of FIG. 3 toward the unloading position of FIG. 4 by driving engagement between the pinion 152 and a rack gear 156. This causes the trolley 56 to move along support tracks or rails 158 and 160 (see FIG. 1) to pull the sheet 24 out of the punch press 12. As the trolley 56 moves along the tracks 158 and 160, the trailing end portion 58 of the sheet 24 is pulled past the end of sheet detector assembly 60 and onto the inclined guide chute or ramp 62.

In response to movement of the trailing end portion 58 of the sheet 24 past the detector assembly 60, the detector assembly provides a signal over a control path 161 to unloader control apparatus 162 (see FIG. 1). To effect the generation of this signal, a detector roller 164 is pivoted upwardly from a detecting position (shown in dashed lines in FIG. 9) to an actuated position (shown in solid lines in FIG. 9) by a suitable biasing device, such as a spring or pneumatic cylinder (not shown). When the detector roller 164 moves to the actuated position shown in solid lines in FIG. 9, an end of sheet

limit switch 166 is actuated by an arm 168 to signal the unloader control apparatus 162 (FIG. 1). The end of sheet detector assembly 60 can have many different constructions, such as the one disclosed and claimed in copending application Ser. No. 133,822, filed by Earl D. Harris on Apr. 14, 1971 and entitled "Detector Assembly" (File No. WS-5224, Project No. 1200-7) and assigned to the same assignee as the present application.

After the trailing end portion 58 of the sheet 24 has cleared the end of sheet detector assembly 60, the trolley 56 continues to move away from the punch press 12 along the tracks 158 and 160 to pull the sheet 24 over the pile 48. However, when the trailing end portion 58 of the sheet 24 is adjacent to the bottom of the chute 62 (see FIG. 4) operation of the motor 150 is interrupted by electrical control circuitry 172 (FIG. 6) in the unloader control apparatus 162 (FIG. 1). It should be noted that the portion of the sheet 24 trailing behind the trolley 56 has not yet moved onto the pile 48 and that the sheet is suspended over the pile 48 between the chute 62 and trolley (see FIG. 4). Therefore, the sheet 24 must be advanced still further in order to bring it into alignment with the near and far ends 174 and 176 of the pile 48.

To complete the movement of the sheet 24 onto the pile 48, the clamp assembly 52 is moved upwardly and forwardly from the extended position of FIG. 4 toward the retracted position (FIG. 5). This movement of clamp assembly 52 pulls the sheet forwardly so that the trailing end portion 58 of the sheet moves down the chute 62 onto the pile 48. As the trailing end portion 58 of the sheet 24 moves clear of the chute 62 and onto the pile 48, the clamp assembly 52 is opened (see FIG. 5) to release the leading end portion 54 of the sheet. The leading end portion 54 of the sheet then drops onto the pile 48 in alignment with the far end 176 of the pile.

It should be noted that the sheet 24 is not dragged or pulled across an uppermost sheet 180 on the pile 48 as the trolley 56 moves from the loading position of FIG. 3 to the unloading position of FIGS. 4 and 5. This minimizes any tendency for the uppermost sheet 180 to be moved or displaced forwardly toward the dashed line position 182 (FIG. 5) to thereby maintain the leading or far end 176 of the pile 48 uniform or straight. Similarly, it should be noted that when the clamp assembly 52 is operated to the open condition by extending the piston and cylinder assemblies 90 and 92, the leading end portion 54 of the sheet is disengaged from the clamping jaws 142 and 144 without moving the trailing end portion 58 of the sheet 24 rearwardly on the pile 48. This prevents the uppermost sheet 180 from being moved or slid rearwardly toward the position illustrated in dashed lines at 184 in FIG. 5 to promote the uniformity of stacking of sheets on the pile 48. Thus, the sheet 24 is suspended over the pile 48 between the chute 62 and trolley 56 until both end portions of the sheet are to be dropped onto the pile. Therefore, the sheet 24 is deposited on the pile 48 without unnecessarily disturbing the uppermost sheet 180 on the pile.

The control assembly 14 (FIG. 1) coordinates the operations of the unloader assembly 10 and punch press 12 to quickly remove each of the sheets 24 from the punch press 12 in response to the completion of a

punching cycle. Thus, upon completion of a punching cycle, the reader 16 indexes the tape 18. The program punched in the tape 18 causes a signal to be transmitted over the control path 190 to the machine control apparatus 44 which effects movement of the table 26 to the illustrated unloading position. In addition, the machine control apparatus 44 causes the cross slide 30 to move the sheet 24 to the right (as viewed in FIG. 1) relative to the table 26 so that the sheet 24 is positioned at the unloading location with its leading end portion 54 extending past the end of sheet detector assembly 60. In response to movement of the sheet 24 to the unloading position, the machine control apparatus 44 transmits a signal over the control path 190 to the reader 16 to again effect an indexing of the tape 18. A signal is then transmitted over control path 194 to the unloader control apparatus 162 to initiate an unloading cycle.

Upon initiation of an unloading cycle, the unloader control apparatus 162 (FIG. 1) activates the operator assembly 70 over a control path 200 to move the clamp assembly 52 from the retracted position of FIG. 2 to the extended position of FIG. 3. Accordingly, when the tape 18 is indexed in response to movement of the sheet 24 to the unloading position, a signal is transmitted from the reader 16 to close contacts 204 (see FIG. 6, line 3) in the electrical circuitry 172. Closing of the contacts 204 energizes a 4CR relay (FIG. 6, line 2) which is then held up over its own normally open contacts 4CR-1. Energization of the 4CR relay also closes normally open contacts 4CR-2 (FIG. 6, line 4) to energize a 5CR relay which is then held up over a circuit which includes its own normally open contacts 5CR-1 (FIG. 6, line 5).

Prior to initiation of the unloading cycle, the solenoid 78 was in an energized condition to maintain the control valve 80 (FIG. 7) operated and the piston and cylinder assemblies 74 and 76 retracted. This was necessary to hold the clamp assembly 52 in the raised position of FIG. 2 out of way of movement of the punch press table 26. However, upon movement of a sheet 24 to the unloading position and energization of the 5CR relay, the solenoid 78 is de-energized so that the return spring 208 moves the valve 80 to the normally open position of FIG. 7 to thereby extend the piston and cylinder assemblies 74 and 76 and lower the clamp assembly 52. Thus, energization of the 5CR relay opens its normally closed contacts 5CR-3 (FIG. 6, line 16) to de-energize the solenoid 78. When the valve 80 is returned to the normal position of FIG. 7 by the return spring 208, air is conducted to the head ends of the piston and cylinder assemblies 74 and 76 to swing the clamp assembly 52 rearwardly from the raised position of FIG. 2 to the lowered or extended position of FIG. 3.

After the clamp assembly 52 has been moved to the extend position, a signal is transmitted from the unloader control apparatus 162 (FIG. 1) over a path indicated schematically at 212 to initiate operation of the clamp assembly to the closed condition of FIG. 3. Thus as the clamp assembly 52 is extended, an arm-down limit switch 216 (FIG. 8) is closed by a cam 218 on the main clamp arm 116. Closing of the arm-down limit switch 216 (FIG. 6, line 6) completes a circuit to energize a 6CR relay over a circuit including the normally open contacts 5CR-2 of the now energized 5CR relay.

Energization of the 6CR relay opens its normally closed contacts 6CR-1 (FIG. 6, line 17) to de-energize the solenoid 96 so that the valve 98 (FIG. 7) is moved to its normal position by a return spring 218. The valve 98 then conducts fluid under pressure to the rod ends of the cylinders 90,92 so that they are retracted to close the clamp assembly 52 by pivoting the secondary clamp arm 130 about the pivot connection 132 (see FIG. 3).

The clamp assembly 52 has now gripped the leading end portion 54 of the sheet 24 and is ready to be moved by the trolley 56 to pull the sheet from the punch press 12. However, before the unloader assembly 10 can pull the sheet 24 from the punch press 12, the sheet must be released from the punch press workholders 22 (see FIG. 1). Accordingly, the trolley 56 remains in the loading position of FIGS. 2 and 3 until the machine control apparatus 44 transmits a signal, over a path indicated schematically at 222 in FIG. 1, to the unloader control apparatus 162 indicating that the workholders 22 have been opened to release the sheet 24.

Upon receipt of the signal indicating that the sheet 24 has been released by the punch press 12, the trolley 56 is moved from the loading position (shown in solid lines in FIG. 1) to the unloading position (shown in dashed lines in FIG. 1). To this end, the unloader control apparatus 162 initiates operation of the reversible motor 150, over a control path indicated at 228 in FIG. 1, to move the carriage 56 toward the unloading position.

Accordingly, when the sheet 24 is released from the workholders 22, contacts 224 (FIG. 6, line 8) are closed by the machine control apparatus 44. Upon a closing of the contacts 224 a 9CR relay is energized. It should be noted that the normally open contacts 230 of a clamp closed limit switch 232 were closed by an actuator arm 234 upon operation of the clamp assembly 52 to the closed condition (see FIG. 3). Energization of the 9CR relay closes its normally open contacts 9CR-1 (FIG. 6, line 9) to energize a 10CR relay. Energization of the 10CR relay closes its normally open contacts 10CR-2 (FIG. 6, line 18) to energize a trolley motor relay TM to close contacts TM-1, TM-2 and TM-3 to thereby release a trolley brake 236 and energize the trolley motor 150 to drive the trolley 56 away from the punch press 12.

As the carriage 56 is moved from the loading position toward the unloading position, the trailing end portion 58 of the sheet 24 moves past the end of sheet detector assembly 60 and down onto the chute 62. As the sheet clears the detector assembly 60, the roller 164 is swung upwardly (FIG. 9) by an associated biasing assembly (not shown). When this occurs, the arm 168 actuates the normally open end of sheet limit switch 166 (see FIG. 6, line 11) to activate a 12CR timer.

The 12CR timer is adjusted so that when a trailing end portion 58 of the sheet 24 has moved almost to the end of the chute 62, the timer opens the circuit for energizing the drive motor 150 to stop the trolley 56 in the unloading position. Thus at the end of a predetermined time period necessary for the trailing end portion 58 of the sheet 24 to travel from the detector assembly 60 to the position shown in FIG. 4, the 12CR timer energizes a 12CRA relay (FIG. 6, line 11). Energization of the 12CRA relay opens its normally closed contacts 12CRA-1 (FIG. 6, line 9) to effect a stopping

of the trolley 56 by de-energizing the 10CR relay. De-energizing the 10CR relay opens contacts 10CR-2 (FIG. 6, line 18) and de-energizes the TM relay. Of course, de-energization of the TM relay opens the contacts TM-1, TM-2 and TM-3 to de-energize the trolley motor 150 and re-engage the brake 236 to stop the trolley 56 in the unloading position of FIG. 4 with the trailing end portion 58 of the sheet 24 resting on the lower end portion of the chute 62.

Once the trolley 56 has been stopped at the unloading position (FIG. 4), the suspended sheet 24 is deposited onto the pile 48 without unnecessarily disturbing the position of the uppermost sheet 180 on the pile by opening the clamp assembly 52 as it is moved toward the retracted position (FIG. 5). Thus, energization of the 12CRA relay to stop the trolley 56 closes its normally open contacts 12CRA-2 to energize the 13CR timer (FIG. 6, line 15). After a predetermined time period in which the trolley 56 comes to a complete stop, the 13CR timer momentarily opens its normally closed contacts 13CR-1 and 13CR-2 (FIG. 6, lines 2 and 4) to de-energize the 4CR and 5CR relays. De-energization of the 5CR relay closes the contacts 5CR-3 (FIG. 6, line 16) so that the solenoid 78 is energized to operate the valve 80 (FIG. 7) and retract the piston and cylinder assemblies 74 and 76. As the piston and cylinder assemblies 74 and 76 are retracted, the clamp assembly 52 is moved upwardly and forwardly from the extended position (FIG. 4) through an intermediate position shown in FIG. 5 to the retracted position (FIG. 2).

During this upward and forward movement of the clamp assembly 52 toward the retracted position, the trailing end portion 58 of the sheet 24 moves clear of the support chute 62 and drops onto the pile 48. As the trailing end portion 58 of the sheet 24 is clearing the chute 62 and dropping onto the pile 48, the clamp assembly 52 is opened to release the leading end portion 54 of the sheet. Thus, de-energization of the 5CR relay (FIG. 6, line 4) also effects a de-energization of the 6CR relay (FIG. 6, line 6) by an opening of the 5CR-2 contacts. It should be noted that the clamp closed limit switch contacts 240 are opened since the piston and cylinder assembly 92 is retracted and the actuator arm 234 is holding the limit switch 232 actuated. Upon de-energization of the 6CR relay, the 6CR-1 contacts (FIG. 6, line 17) are closed to energize the solenoid 96. Energization of the solenoid 96 operates the valve 98 (FIG. 7) to extend the piston and cylinder assemblies 90 and 92 and open the clamp assembly 52 as it is being moved upwardly by the contracting piston and cylinder assemblies 74 and 76. As the clamp assembly 52 is opened, the leading end portion of the sheet 54 is released and falls downwardly onto the pile 48.

By opening the clamp assembly 52 to release the leading end portion 54 of the sheet 24 as the trailing end portion 58 of the sheet moves clear of the chute 62, the sheet is dropped onto the pile 48 without being dragged along the uppermost sheet 180. Since the sheet 24 is suspended above the pile 48 between the chute 62 and trolley 56 until it is dropped onto the pile, the edges of the sheets on the pile are maintained in alignment so that the pile has substantially uniform ends 174 and 176.

After the sheet 24 has been deposited on the pile 48, the trolley 56 is returned to the loading position (FIG. 2) with the clamp assembly 52 open and in the retracted position. Accordingly, when the main clamp arm 116 is fully raised, the cam element 218 (see FIG. 8) closes an arm-up limit switch 244 to thereby energize a 15CR relay (FIG. 6, line 13) over the normally closed contacts 247 of the unload or home position limit switch 248 (see FIG. 6, line 13 and FIG. 5). The 15CR relay is then held up by its own 15CR-1 contacts (FIG. 6, line 14) to maintain 15CR-2 contacts (FIGS. 6, line 19) closed. Closing of the 15CR-2 contacts energizes trolley return relay TR (FIG. 6, line 19) to close TR-1, TR-2 and TR-3 contacts in the control circuit for the motor 150. Closing of these contacts energizes the motor 150 and releases the brake 236 to drive the trolley back toward the loading position of FIG. 2.

When the trolley 56 reaches the loading position of FIG. 2, a cam 250 on the trolley 56 actuates the unload position limit switch 248 (see FIG. 2) to interrupt movement of the trolley 56. Thus, actuation of the unload position limit switch 248 energizes a 14CR relay (FIG. 6, line 12) to open normally closed 14CR-1 contacts (FIG. 6, line 19) to thereby de-energize the TR relay and the trolley motor 150. Therefore, the trolley 56 remains in the loading position with the clamp assembly 52 retracted and opened until a next succeeding cycle of operation of the unloader assembly 10. Upon initiation of the next succeeding unloading cycle, the clamp assembly 52 can be moved into position to grip a sheet by merely extending the operator assembly 70.

From the foregoing description, it can be seen that the unloader assembly 10 includes a clamp assembly 52 which is mounted on a trolley 56 and is movable between the retracted position of FIG. 2 and the extended position of FIG. 3. When the clamp assembly 52 is in the retracted position of FIG. 2, it is clear of the area through which the table 26 of the punch press 12 is moved as the punch press is operated to position a sheet relative to the turret 34. When the clamp assembly 52 is in the extended position of FIG. 3, the clamp assembly extends into the area through which the projecting end portion 66 of the punch press table 26 is moved during operation of the punch press to enable the clamp assembly 52 to grip the leading end portion 54 of the sheet 24. Therefore, the trolley 56 can remain in the loading position of FIG. 2 with the clamp assembly 52 retracted while the punch press 12 is being operated to thereby tend to minimize the time required to remove a sheet from the punch press after initiation of an unloading cycle.

After a sheet has been gripped by the clamp assembly 52, the trolley 56 is moved to the unloading position of FIG. 4. When the trolley 56 reaches the unloading position, the sheet 24 is still suspended above the pile 48 between the trolley 56 and support chute 62. To deposit the sheet 24 on the pile 48, the clamp assembly 52 is moved upwardly and forwardly to pull the trailing end 58 of the sheet clear of the chute 62 and onto the pile 48. At the same time, the leading end portion is released by opening the clamp assembly 52 so that there is little or no sliding movement of the sheet 24 along the surface of the uppermost sheet 180 on the pile 48. This promotes a uniformity of stacking of the sheets on the pile 48 since the stacking of a sheet does

not tend to move the immediately preceding sheet relative to the pile.

Having described a specific preferred embodiment of the invention, the following is claimed:

1. An apparatus for operating on sheets of material, said apparatus comprising a machine for performing work operations on a sheet of material and positioning it at an unloading location, and unloader means for engaging a leading end portion of a sheet of material at the unloading location, for pulling the engaged sheet of material from said machine, and for depositing the sheet of material on a pile of sheets, said unloader means including a trolley movable along a predetermined path extending away from said machine and over the pile of sheets, drive means for moving said trolley between a first position adjacent to said machine and a second position adjacent to an end portion of the pile which is farthest from said machine, clamp means mounted on said trolley and operable between a closed condition grippingly engaging a leading end portion of a sheet of material and an open condition releasing the leading end portion of the sheet of material, actuator means mounted on said trolley for operating said clamp means between the open and closed conditions, operator means mounted on said trolley for moving said clamp means between a lowered position and a raised position, said drive means being operable to move said trolley from the first position to the second position with said clamp means in the closed condition and the lowered position to pull a sheet of material gripped by said clamp means from said machine, and control means for effecting operation of said actuator means to operate said clamp means from the closed condition to the open condition and for effecting operation of said operator means to raise said clamp means from the lowered position to the raised position upon movement of said trolley to the second position to release the leading end portion of the sheet of material and deposit it on the pile.

2. An apparatus as set forth in claim 1 wherein said clamp means includes first and second jaw elements, a first clamp arm pivotally mounted on said trolley and operatively connected to said first jaw element and said operator means, and a second clamp arm pivotally mounted on said first clamp arm and operatively connected with said second jaw element and said actuator means, said operator means including first piston and cylinder means for pivoting said first clamp arm relative to said trolley to move said clamp means between the raised and lowered positions, said actuator means including second piston and cylinder means for pivoting said second clamp arm relative to said first clamp arm to operate said clamp means between the open and closed conditions.

3. An apparatus as set forth in claim 1 wherein said control means includes detector means for detecting when a trailing end portion of a sheet of material is pulled from the machine by operation of said unloader means and means for initiating operation of said actuator means to operate said clamp means from the closed condition to the open condition and for initiating operation of said operator means to raise said clamp means from the lowered position to the raised position in response to detection of the trailing end portion of a sheet of material by said detector means.

4. An apparatus as set forth in claim 1 wherein said control means includes means for initiating operation of said drive means to move said trolley from the second position to the first position with said clamp means in the raised position in response to the releasing of a leading end portion of a sheet of material by said clamp means when said trolley is in the second position.

5. Apparatus as set forth in claim 4 wherein said control means for initiating operation of said actuator means to move said clamp means from the raised position to the lowered position in response to a positioning of a sheet of material at the unloading location by said machine.

6. An apparatus for operating on sheets of material, said apparatus comprising a machine for performing work operations on each of the sheets of material in turn, said machine including tool means for working on a sheet of material, carrier means movable within a predetermined area for positioning a sheet of material relative to said tool means to enable said tool means to work on various portions of the sheet of material and for positioning the sheet of material at an unloading location upon completion of work operations on the sheet of material, unloader means for engaging a sheet of material at the unloading location and transferring the sheet of material from said machine to a pile of sheets, said unloader means including a trolley movable between a first position adjacent to said machine and a second position adjacent to an end portion of the pile which is furthest from said machine, drive means for moving said trolley between said first and second positions, clamp means mounted on said trolley for engaging a leading end portion of a sheet to pull the sheet from said machine upon movement of said trolley from said first position to said second position, said clamp means including first and second clamp members for gripping a sheet, operator means for moving said clamp members relative to said trolley between an extended position in which said clamp members extend into the area of movement of said carrier means when said trolley is in the first position to engage a sheet of material at the unloading location and a retracted position in which said clamp members are spaced from the area of movement of said carrier means when said trolley is in said first position, and actuator means for moving said clamp members between an open condition and a closed condition in which said clamp members are effective to grip the leading end portion of a sheet of material, and control means for activating said operator means to move said clamp members from the extended position to the retracted position upon movement of said trolley to the second position and for simultaneously therewith activating said actuator means to move said clamp members from the closed condition to the open condition to release the leading end portion of a sheet of material pulled from said machine by movement of said trolley to the second position.

7. Apparatus as set forth in claim 6 wherein said one of said clamp members is pivotally mounted on said trolley for movement between the extended and retracted positions and another of said clamp members is mounted on said one clamp member for movement therewith between the extended and retracted positions.

8. Apparatus as set forth in claim 7 wherein said operator means includes first piston and cylinder means which is connected with said one clamp member and is operable to pivot said one clamp member relative to said trolley, said clamp means further including second piston and cylinder means connected with said other clamp member for pivoting said other clamp member relative to one clamp member between an open position and a closed position in which said clamp members are effective to grip the leading end portion of a sheet of material.

9. An apparatus as set forth in claim 6 wherein said control means includes detector means for detecting when a trailing end portion of a sheet of material is pulled from the machine by operation of said unloader means and means for initiating operation of said actuator means to operate said clamp means from the closed condition to the open condition and for initiating operation of said operator means to raise said clamp means from the extended position to the retracted position in response to detection of the trailing end portion of a sheet of material by said detector means.

10. An apparatus as set forth in claim 6 wherein said control means includes means for initiating operation of said drive means to move said trolley from the second position to the first position with said clamp means in the retracted position in response to the releasing of a leading end portion of a sheet of material by said clamp means when said trolley is in the second position.

11. An apparatus for operating on sheets of material, said apparatus comprising a machine for performing work operations on a sheet of material and positioning it at an unloading location, and unloader means for depositing the sheet on an uppermost sheet on a pile of sheets in such a manner as to tend to minimize movement of the uppermost sheet relative to the pile of sheets, said unloader means including a trolley which is movable along a predetermined path extending over the pile of sheets, drive means for moving said trolley between a first position adjacent to said machine and a second position adjacent to an end portion of the pile which is furthest from said machine, clamp means mounted on said trolley for gripping the leading end portion of a sheet of material to pull it from said machine during movement of said trolley in a direction away from said machine, support means disposed adjacent to an end portion of the pile which is nearest to said machine for supporting a trailing portion of a sheet to maintain the sheet suspended above the pile as the sheet is pulled from said machine by movement of said trolley and clamp means in a direction away from said machine, operator means for moving said clamp means and the leading end portion of a sheet of material gripped by said clamp means upwardly away from the pile of sheets immediately prior to disengagement of the trailing end portion of a sheet from said support means, and control means for effecting operation of said clamp means to release the leading end portion of a sheet as the trailing end portion of the sheet moves out of engagement with said support means and onto the pile of sheets.

12. An apparatus for operating on sheets of material, said apparatus comprising a machine for performing work operations on a sheet of material and positioning it at an unloading location, and unloader means for

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depositing the sheet on an uppermost sheet on a pile of sheets in such a manner as to tend to minimize movement of the uppermost sheet relative to the pile of sheets, said unloader means including a trolley which is movable along a predetermined path extending over the pile of sheets, drive means for moving said trolley between a first position adjacent to said machine and a second position adjacent to an end portion of the pile which is furthest from said machine, clamp means mounted on said trolley for gripping the leading end portion of a sheet of material to pull it from said machine during movement of said trolley in a direction away from said machine, support means disposed adjacent to an end portion of the pile which is nearest to said machine for supporting a trailing portion of a sheet to maintain the sheet suspended above the pile as the sheet is pulled from said machine by movement of said trolley and clamp means in a direction away from said machine, control means for effecting operation of said clamp means to release the leading end portion of a sheet as the trailing end portion of the sheet moves out of engagement with said support means and onto the pile of sheets, said clamp means being operable between a closed condition grippingly gripping the leading end portion of a sheet of material and an open condition releasing the leading end portion of the sheet of material, said unloader means further including actuator means for effecting operation of said clamp means between the open and closed conditions, said control means including means for effecting activation of said actuator means to operate said clamp means to the open condition immediately after a trailing end portion of a sheet gripped by said clamp means is disengaged from said support means.

13. An apparatus for operating on sheets of material, said apparatus comprising a machine for performing work operations on a sheet of material and positioning it at an unloading location, and unloader means for depositing the sheet on an uppermost sheet on a pile of sheets in such a manner as to tend to minimize movement of the uppermost sheet relative to the pile of sheets, said unloader means including a trolley which is movable along a predetermined path extending over the pile of sheets, drive means for moving said trolley between a first position adjacent to said machine and a second position adjacent to an end portion of the pile which is furthest from said machine, clamp means mounted on said trolley for gripping the leading end portion of a sheet of material to pull it from said machine during movement of said trolley in a direction away from said machine, support means disposed adjacent to an end portion of the pile which is nearest to said machine for supporting a trailing portion of a sheet to maintain the sheet suspended above the pile as the sheet is pulled from said machine by movement of said trolley and clamp means in a direction away from said machine, and control means for effecting operation of said clamp means to release the leading end portion of a sheet as the trailing end portion of the sheet moves out of engagement with said support means and onto the pile of sheets, said control means including detector means for detecting when the trailing end portion of a sheet of material is in a predetermined position relative to said support means and means for initiating operation of said clamp means to release the leading end por-

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tion of the sheet in response to detection of the trailing end portion of the sheet by said detector means.

14. An apparatus for operating on sheets of material, said apparatus comprising machine means for performing work operations on each of the sheets of material in turn and for positioning the sheet of material at an unloading location upon completion of work operations on the sheet of material, unloader means for engaging a sheet of material at the unloading location and transferring the sheet of material from said machine means to a pile of sheets, said unloader means including a trolley movable between a forward position adjacent to said machine means and a rearward position adjacent to an end portion of the pile which is furthest from said machine means, drive means for moving said trolley between said first and second positions, and clamp means mounted on said trolley for engaging a leading end portion of a sheet to pull the sheet from said machine means upon movement of said trolley from said forward position to said rearward position, said clamp means including first and second clamp members for gripping a sheet and operator means for moving said clamp members downwardly and forwardly along an arcuate path relative to said trolley when said trolley is in said forward position to move said clamp members from a retracted position in which said clamp members are disposed above and rearwardly of the unloading location to an extended position in which said clamp members extend into the unloading location.

15. An apparatus as set forth in claim 14 wherein said clamp means includes actuator means for moving said clamp members between an open condition and a closed condition in which said clamp members are effective to grip the leading end portion of a sheet of material.

16. Apparatus as set forth in claim 14 wherein said unloader means further includes control means for activating said operator means to move said clamp members upwardly and rearwardly along the arcuate path from the extended position to the retracted position upon movement of said trolley to the rearward position.

17. Apparatus as set forth in claim 14 wherein one of said clamp members is pivotally mounted on said trolley for movement between the extended and retracted positions and another of said clamp members is mounted on said one clamp member for movement therewith between the extended and retracted positions.

18. Apparatus as set forth in claim 17 wherein said operator means includes first piston and cylinder means which is connected with said one clamp member and is operable to pivot said one clamp member relative to said trolley, said clamp means further including second piston and cylinder means connected with said other clamp member for pivoting said other clamp member relative to one clamp member between an open position and a closed position in which said clamp members are effective to grip the leading end portion of a sheet of material.

19. An apparatus for operating on sheets of material, said apparatus comprising machine means for performing work operations on each of the sheets of material in turn and for positioning the sheet of material at an unloading location upon completion of work operations

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on the sheet of material, unloader means for engaging a sheet of material at the unloading location and transferring the sheet of material from said machine means to a pile of sheets, said unloader means including a trolley movable between a first position adjacent to said machine means and a second position adjacent to an end portion of the pile which is furthest from said machine means, drive means for moving said trolley between said first and second positions, a clamp assembly mounted on said trolley, said clamp assembly being operable from an open condition to a closed condition to engage a leading end portion of a sheet and pull the engaged sheet from said machine means upon movement of said trolley from said first position to said second position, said clamp assembly being movable

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relative to said trolley between an extended position in which said clamp assembly extends into the unloading location when said trolley is in the first position to engage a sheet of material at the unloading location and a retracted position in which said clamp assembly is spaced from the unloading location when said trolley is in said first position, detector means for detecting when a trailing end portion of a sheet of material is pulled from said machine means by operation of said unloader means, and means for initiating operation of said clamp assembly from the closed condition to the open condition in response to detection of the trailing end portion of a sheet of material by said detector means.

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