Jan. 26, 1960 E. R. BEEBE 2,922,459

MATERIAL HANDLING MEANS

Filed Nov. 27, 1956 4 Sheets-Sheet 1

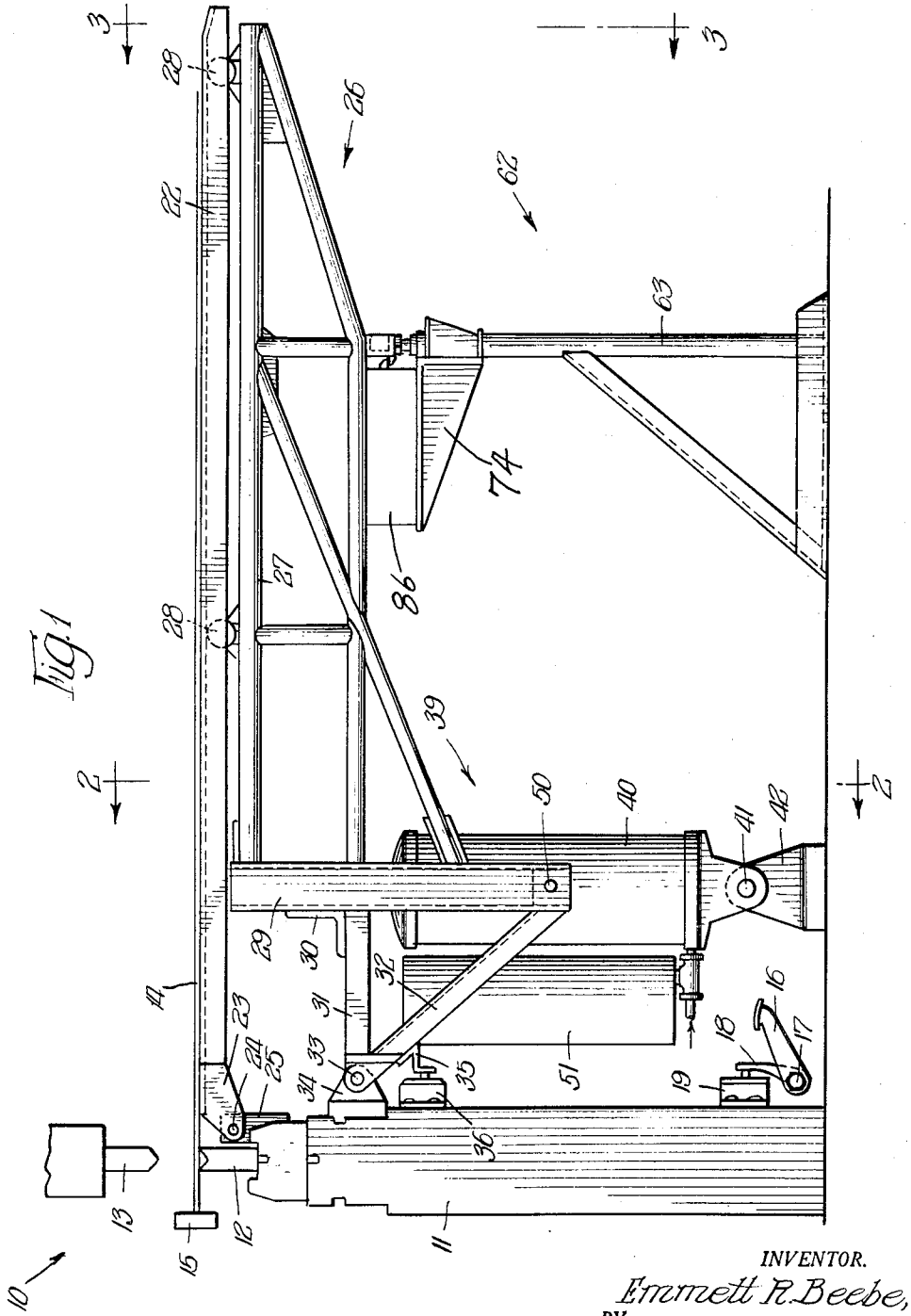


Fig. 1

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MATERIAL HANDLING MEANS

Filed Nov. 27. 1956 4 Sheets-Sheet 2

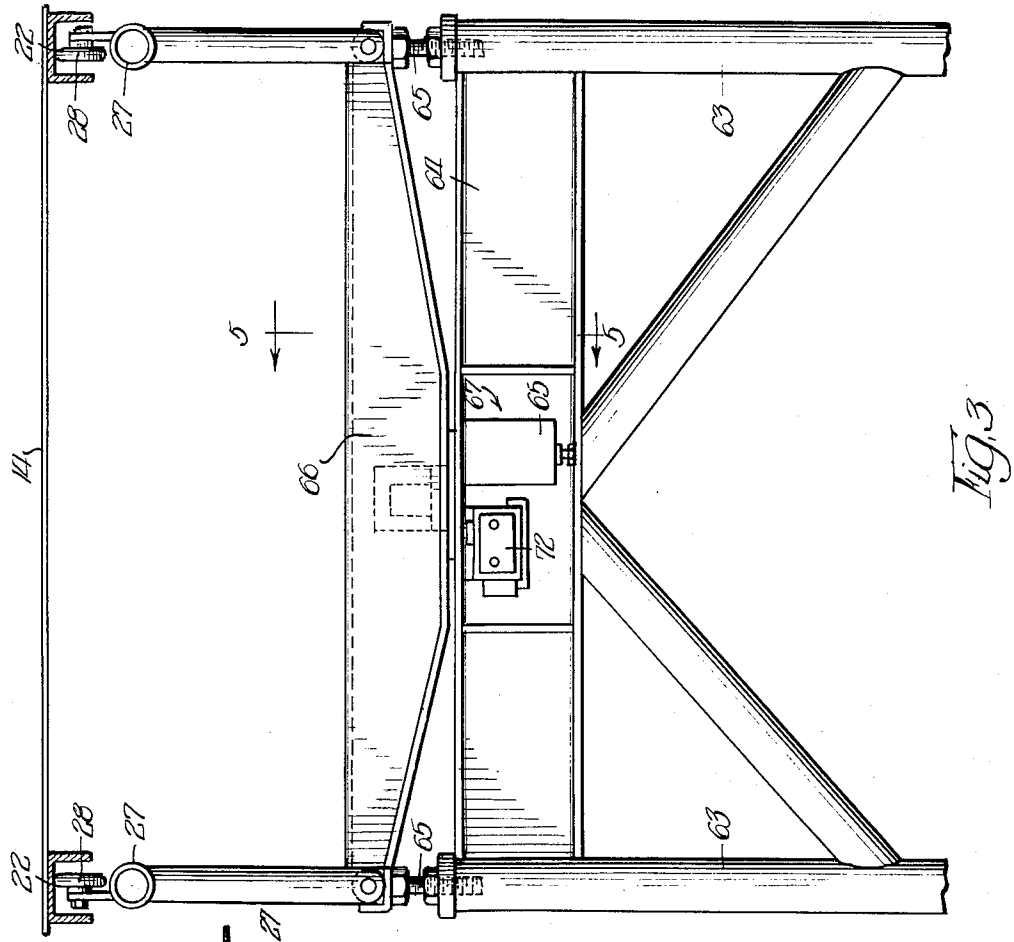


Fig. 3

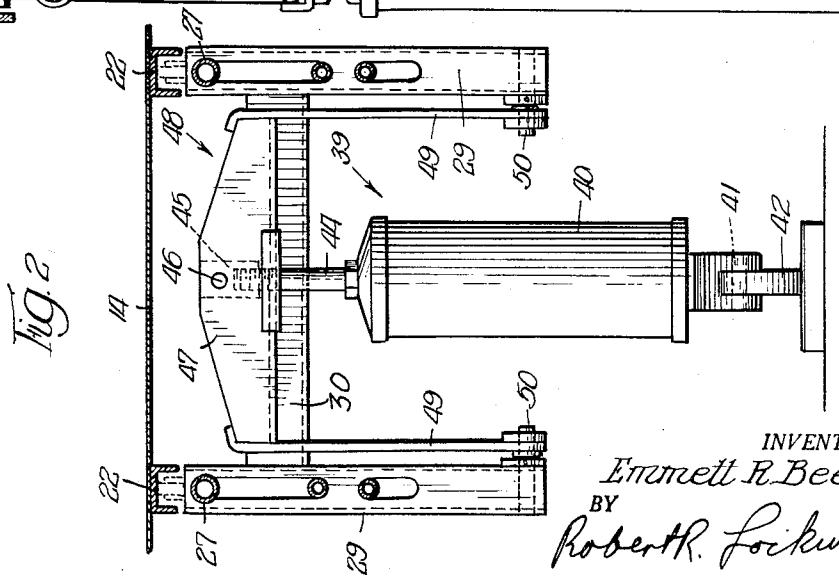


Fig. 2

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MATERIAL HANDLING MEANS

Filed Nov. 27, 1956 4 Sheets-Sheet 3

Fig. 5

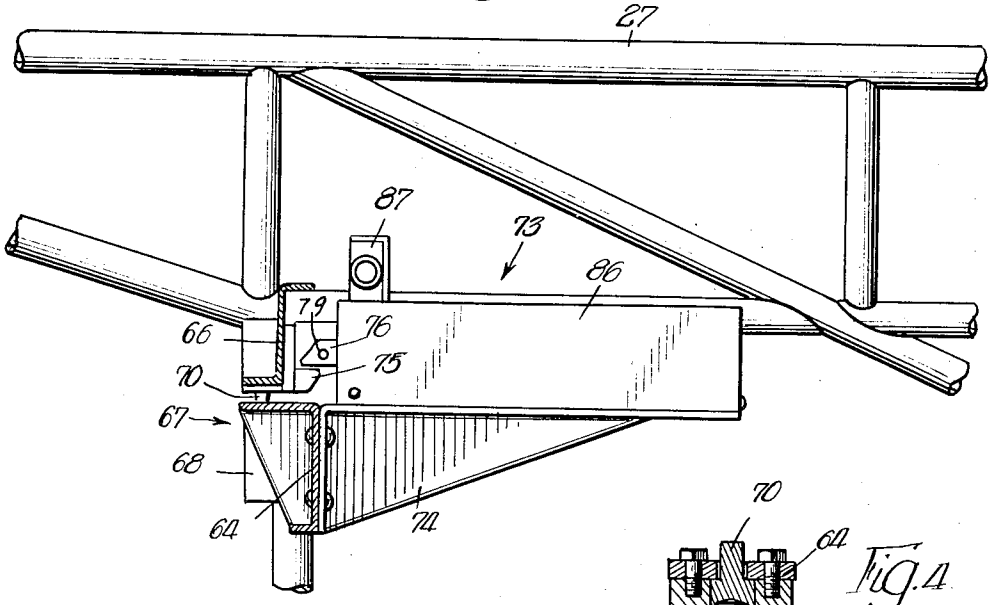


Fig. 4

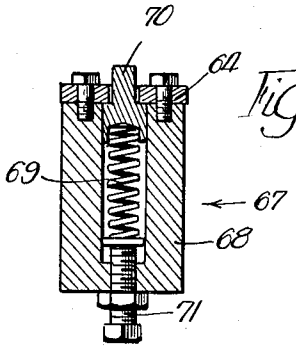
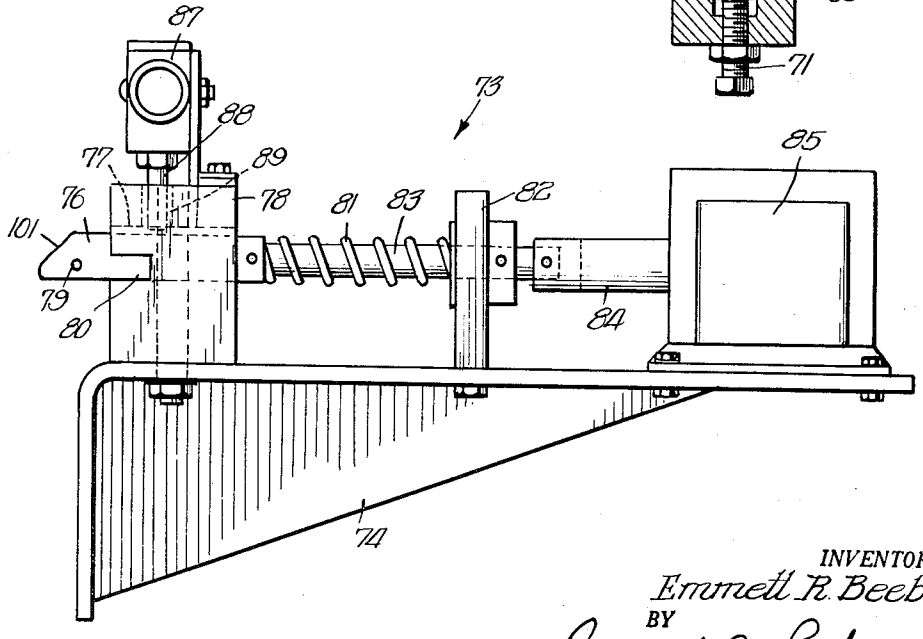


Fig. 6



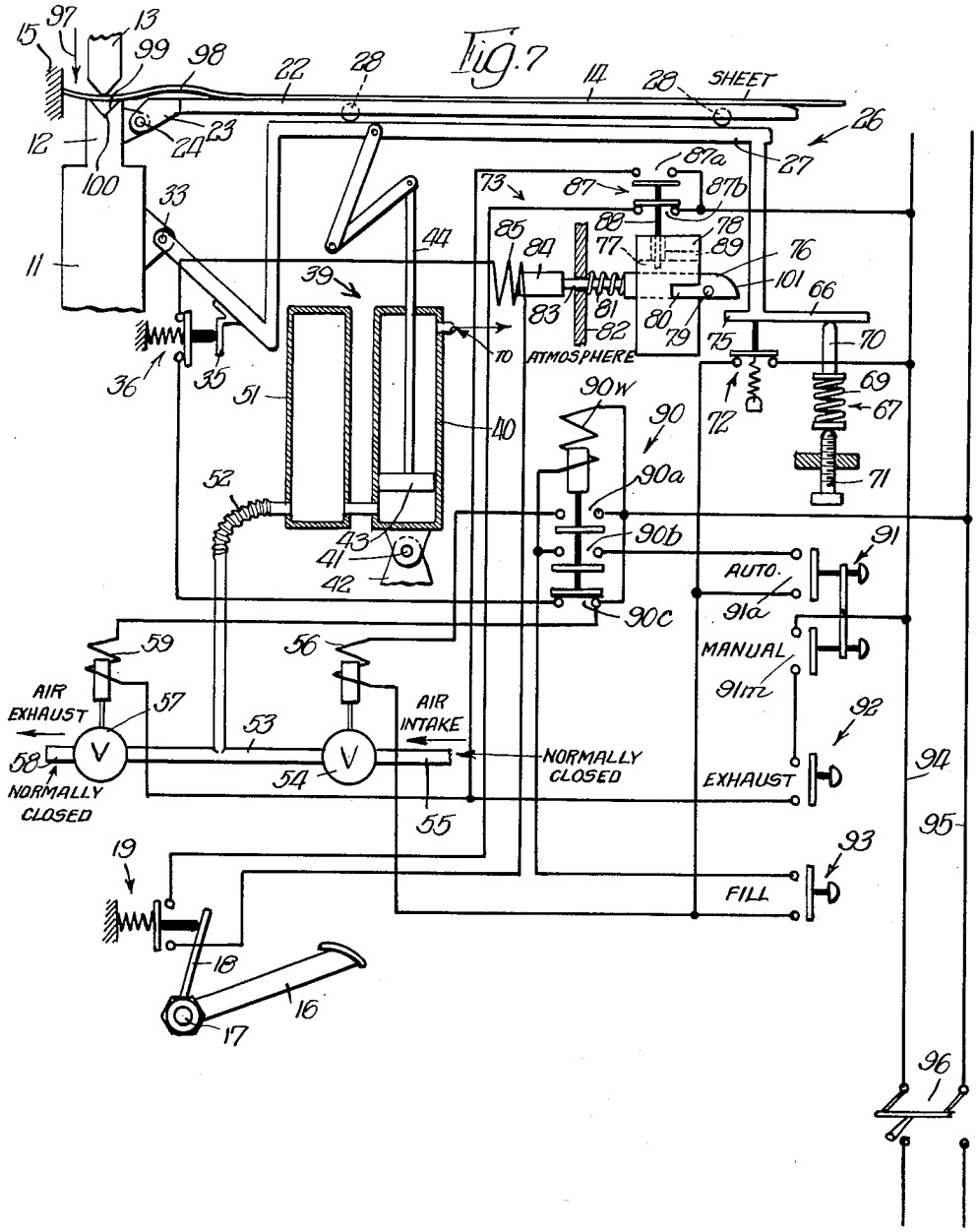
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MATERIAL HANDLING MEANS

Filed Nov. 27. 1956 4 Sheets-Sheet 4

Fig. 7



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United States Patent Office 2,922,459 Patented Jan. 26, 1960

2,922,459

MATERIAL HANDLING MEANS

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Application November 27, 1956, Serial No. 624,682

16 Claims. (Cl. 153—21)

The invention relates, generally, to material handling means and it has particular relation to such means for use with mechanical presses employed for forming a flange along one edge of a metallic sheet.

Among the objects of this invention are: To provide for raising the unformed portion of a metallic sheet in a new and improved manner as a flange is formed along one edge; to provide for substantially balancing the sheet and support therefor in any position to which they may be raised; to cushion the return of the sheet and support by the same means used to elevate them; to determine automatically the force that must be exerted to balance the sheet and support; to provide for adjusting the balancing force; to employ the force applied to the sheet during the forming operation tending to raise the unformed portion thereof as a control for both the raising and the lowering of the sheet and its support; to prevent the raising of the sheet and support except on intended operation of the elevating mechanism; to employ air pressure means for raising and lowering the sheet and support; to provide such a ratio between the total volume of the space occupied by the compressed air and the volume of the space through which a piston connected to the sheet support moves that the force exerted on the support varies as a function of the angle to which the support is swung; to exhaust the air from the air pressure means when it exceeds a predetermined pressure; and to provide for supporting the sheet and swinging the same about an axis close to the bending axis and additional support means movable with respect to the sheet support and swinging about an axis below the bending axis.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts that will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a view, in side elevation, of a portion of the material handling means in which this invention is incorporated and showing somewhat diagrammatically the application thereof to a conventional mechanical press;

Figure 2 is a vertical sectional view taken generally along the line 2—2 of Figure 1;

Figure 3 is a vertical sectional view taken generally along the line 3—3 of Figure 1 and at an enlarged scale;

Figure 4 is a vertical sectional view of the balance adjusting means;

Figure 5 is a sectional view taken generally along the

line 5—5 of Figure 3 and showing the general arrangement of the latch mechanism;

Figure 6 is a view, in side elevation and at an enlarged scale, of the latch mechanism shown in Figure 5, the cover being removed in order to show the details of construction; and

Figure 7 illustrates diagrammatically certain of the mechanical and electrical features embodied in this invention.

Referring now to particularly Figure 1 of the drawings, it will be observed that the reference character 10 designates, generally, a mechanical press of conventional construction and which is identified in the art as a press brake. The press 10 is employed for applying a substantial bending force to sheets of metal, such as sheet steel, having a thickness of from ⅛" to ¼" and greater for bending the same, particularly for bending a flange along one edge. For this purpose the press 10 includes an apron 11 which is arranged to be mounted on a suitable foundation, such as a block of concrete embedded in the ground. Mounted on the apron 11 is a stationary or lower die 12 arranged underneath a movable or upper die 13 which is arranged to engage a sheet 14 for bending a flange along one edge thereof. It will be observed that the mating faces of the dies 12 and 13 generally form right angles so that the flange along one edge of the sheet 14 is arranged to be bent at right angles thereto. Other angularities can be formed by suitable configuration of the mating surfaces of the dies 12 and 13.

When the sheet 14 is of relatively short length, it is a simple matter to bend the flange. When this takes place and the movable or upper die 13 performs the bending operation, the flange which is to be bent is swung upwardly through an angle of 45°, for example, and the remaining portion of the sheet likewise is swung through a similar angle since the flange is assumed to be formed at a 90° angle. When the sheet 14 is relatively long, for example is 6 to 8 or 10 feet long, the remaining portion of it must be swung upwardly through the required angle in order to maintain the proper relationship between the flange and the remaining portion of the sheet. Although some attempts have been made in the past to provide a solution to the problem of handling the remaining portion of the sheet under these circumstances when it is relatively long, the principal method employed has been to use the services of two or three human operators who manually lift the remaining portion of the sheet through the required angle and lower it after the bending operation has been completed. This has been costly in time of the operators required and has been more or less dangerous. The present invention is addressed particularly to the provision of means for mechanically handling the remaining portion of the sheet during and after the bending operation. It will be understood that the sheet 14 is variable in size and in so characterizing it it is intended to refer to not only to the dimensions but also to the weight of the sheet.

Associated with the mechanical press 10 in a suitable manner (not shown) is a stop 15 which limits the position of the sheet 14 between the dies 12 and 13 and determines the width of the flange to be bent as will be understood readily. The upper die 13 is moved downwardly in response to the operation of a suitable manual control, such as the depression of a foot pedal 16 which is mounted on a shaft 17 that rotates to effect the desired control operation. Associated wtih the foot pedal 16 is an arm 18 which controls the operation of a pedal switch 19 the function of which will be set forth hereinafter.

It is desirable that the sheet 14 be supported for move-

ment about the axis of bending and that there be a minimum of movement between the sheet and its support in order to avoid injury to its surface. For this purpose a pair of rider members **22** are provided. As shown more clearly in Figures 2 and 3 of the drawings the rider members **22** may be in the form of channels with the side flanges extending downwardly. At their forward ends the rider members **22** are provided with ears **23** which are pivoted at **24** about a horizontal axis that is located adjacent the bending axis of the sheet **14** as determined by the cooperating dies **12** and **13**. The pivot axis **24** is provided on fulcrum blocks **25** which are securely mounted on the apron **11** adjacent the stationary or lower die **12**.

Provision is made for swinging the rider members **22** upwardly and controlling the return movement thereof to the horizontal position shown in Figure 1 of the drawings through the agency of a main frame that is indicated, generally, at **26**. The frame **26** is formed of a combination of tubular construction and rolled structural members. It will be understood that other members can be employed as may be desired, the particular construction being for illustrative purposes. The main frame **26** may include tubular frame members **27** which extend horizontally when the frame **26** is in the lowermost position. The frame members **27** carry rollers **28** which readily permit relative movement between the main frame **26** and the rider members **22** as the combination is swung upwardly by means to be described in order to permit the remaining portion of the sheet **14** to follow the bending operation. Depending from the forward ends of the tubular frame members **27** are channel frame members **29** that are interconnected by an angle cross member **30**. The various frame members are secured together preferably by welding. Extending forwardly from the frame members **29** are horizontal frame members **31** and inclined frame members **32**. It will be observed that the frame members **31** and **32** are pivoted at **33** about a horizontal axis on fulcrum blocks **34**. The horizontal axis through the pivots **33** is positioned laterally of and below the bending axis between the dies **12** and **13**. An arm **35** is carried by one of the frame members **32** for controlling the operation of a lock disconnect switch **36** the function of which will be described hereinafter.

Provision is made for swinging the remaining portion of the sheet **14** upwardly through a corresponding movement of the rider members **22** and main frame **26**. In accordance with this invention air pressure means, shown generally at **39** in Figures 1, 2 and 7 of the drawings, is employed. The air pressure means **39** includes an air cylinder **40** which is pivotally mounted at its lower end about a horizontal axis **41** on a suitable ear **42** that is supported on the same foundation that supports the mechanical press **10**. A piston **43** is slidable within the cylinder **40** and a piston rod **44** is connected thereto and extends out of the upper end for connection to the main frame **26**.

The details of the connection of the piston rod **44** to the main frame **26** are illustrated more clearly in Figure 2. There it will be observed that a fitting **45** is threaded on the upper end of the piston rod **44** and is secured by a transverse pin **46** to a central portion **47** of a lift yoke as indicated, generally, at **48**. The yoke **48** includes a pair of depending arms **49** which are pivotally connected at **50** near their lower ends to the lower ends of the channel frame members **29**. It will be understood that, as air pressure is applied to the piston **43**, the piston rod moves upwardly and carries with it the yoke **48**. The upward thrust is applied through the channel frame members **29** to the main frame **26** which swings around the axis through the pivots **33** and causes the rider members **22** to swing conjointly therewith about the horizontal axis through the pivots **24**. As this conjoint movement takes place, because of the spacing of the axes through the pivots **24** and **33**, the rider members **22** move outwardly along the rollers **28** during the upward movement and move inwardly during the downward movement. During such operation the air pressure means **39** pivots about the axis **41** to the extent required to permit the movement of the main frame **26**, rider members **22** and sheet **14**.

It is desirable that the volume of the air pressure means **39** be relatively large as compared to the volume in the air cylinder **40** through which the piston **43** moves. The reason for this is to permit a reduction in the thrust applied to the main frame **26** as it swings upwardly with the reduction varying as the cosine of the angle through which the main frame **26** is swung. This makes it possible to substantially balance the main frame **26**, rider members **22** and the sheet **14** carried thereby in any position between the horizontal position and the fully raised position without varying the amount of air initially measured into the air pressure means **39** by the automatic loading feature described hereinafter. For this purpose, instead of employing a long cylinder **40**, an accumulator cylinder **51** is provided and is connected, as shown in Figure 7, to the air cylinder **40**. The accumulator cylinder **51** preferably is mounted to move conjointly with the air cylinder **40**.

Air under pressure is supplied to the accumulator chamber **51** through a flexible connection **52** from a conduit **53** and the supply is controlled by an air intake valve **54** from an air supply pipe **55**. It will be understood that the pipe or conduit **55** is connected to a suitable source of air under pressure. The operation of the air intake valve **54** is controlled by an operating solenoid **56** in a manner to be described hereinafter. The air is exhausted from the accumulator cylinder **51** and air cylinder **40** through an air exhaust valve **57** to a discharge conduit **58**. An operating solenoid **59** controls the operation of the air exhaust valve **57** and the operation thereof will be set forth hereinafter.

It is desirable that the outer end of the main frame **26** be supported in the horizontal position. For this purpose a support frame or stand, shown generally at **62** in Figure 1, is provided. The support frame or stand **62** may include frame uprights **63** in the form of tubular members interconnected, as shown in Figure 3, by a cross member **64**. Adjustable supports **65** carried by the upper ends of the frame uprights **63** and cooperating with the ends of a cross member **66**, forming a part of the main frame **26**, serve to limit the downward movement of the latter as desired.

It is desirable to provide an adjustment for the balance of the main frame **26** and rider members **22** in accordance with the size of the sheet **14** that is to be operated on. For this purpose balance adjusting means, shown generally at **67**, is mounted on the cross member **64**. The details of construction of the balance adjusting means **67** are shown more clearly in Figure 4 of the drawings.

The balance adjusting means **67** includes a housing **68** that is carried by the cross member **64** of the support frame or stand **62**. Within the housing **68** is a coil compression spring **69** that reacts against a plunger **70** at its upper end which, in turn, bears against the underside of the cross member **66** of the main frame **26**. The tension of the spring **69** can be adjusted by an adjusting screw **71**. By varying the tension on the spring **69**, the upward thrust exerted by the plunger **70** on the main frame **26** can be varied to effect a corresponding variation in the upward thrust required to be applied by the air pressure means **39** thereby providing the required amount of force to balance the force of gravity exerted downwardly on the main frame **26**, rider members **22** and sheet **14** carried thereby which varies as the cosine of the angle through which the main frame **26** moves from the horizontal position.

In order to limit the air pressure applied to the air

pressure means 39 provision is made for controlling the energization of the operating solenoid 56 associated with the air intake valve 54. For this purpose a down limit switch 72 is mounted on the cross member 64 of the support frame or stand 62. It is arranged to be operated by the main frame 26, particularly by the cross member 66 thereof engaging the switch, as shown in Figure 3, to hold the contacts thereof in the closed position. As soon as sufficient air pressure is applied to the air pressure means 39 to lift the main frame 26 slightly with the aid of the spring 69 in the balance adjusting means 67 and reacting against the force of gravity, the contacts of this switch are opened and the circuit to the operating solenoid 56 is opened, as will be set forth hereinafter, to permit the valve 54 to close and prevent further application of air to the air pressure means 39.

It is desirable that means be provided for preventing the upward swinging movement of the sheet 14, rider members 22 and main frame 26. A mechanical latch mechanism, shown generally at 73, in Figures 5, 6 and 7, is provided for this purpose. The latch mechanism 73 is mounted on a support member 74 which is carried by the cross member 64 forming a part of the support frame or stand 62. It cooperates with a detent 75 which is carried by the cross member 66 that forms a part of the main frame 26. Cooperating with the detent 75 is a movable latch 76 which, as shown more clearly in Figure 6, is slidably mounted in an opening 77 in a block 78 which is carried by the support member 74. The fit of the latch 76 in the opening 77 is relatively loose for the purpose of permitting the former to move upwardly in the latter to effect a control function which will be described presently. A transversely extending pin 79 is carried by the latch 76 and, when the latch 76 is withdrawn under normal operating conditions, the pin 79 interfits with a slot 80 in the block 78. However, should the latch 76 be raised upwardly as permitted by the loose fit in the opening 77, the pin 79 will not register with the slot 80 and thus will prevent movement of the latch 76 to the unlatched position.

The latch 76 is biased to the latched position by a coil compression spring 81 which reacts between it and a stationary plate 82 that is carried by the support member 74. A shaft 83 is connected to the latch 76 and extends through the spring 81 and through the plate 82 for connection to an armature 84 which is arranged to be attracted by a solenoid 85 which is illustrated as a winding in Figure 7 of the drawings. A suitable cover 86 is provided, as shown in Figure 5, for enclosing the latch mechanism 73.

It has been pointed out hereinbefore that the air exhaust valve 57 is opened under certain circumstances. For this purpose an up limit switch, shown generally at 87, is provided. As shown in Figure 7 the up limit switch 87 is provided with normally open contacts 87*a* and normally closed contacts 87*b*. These contacts are operated by a plunger 88 which extends through an opening 89 in the block 78, Figure 6, where its lower end is positioned in the path of upward movement of the latch 76. In the event that the air pressure rises to such an extent in the air pressure means 39 that the main frame 26 is lifted sufficiently far to cause the detent 75 to lift the latch 76, then the up limit switch 87 is operated from one position to an alternate position for effecting the energization of the operating solenoid 59 associated with the air exhaust valve 57.

The several switches previously referred to are connected in an electrical system as shown in Figure 7. This system also includes a control relay that is indicated, generally, at 90 and is provided with an operating winding 90*w*, normally open contacts 90*a* and 90*b* and normally closed contacts 90*c*. The system also includes a transfer switch, shown generally at 91, which includes contacts 91*a* and 91*m* for either automatic or manual operation as will appear hereinafter. In addition there is an exhaust switch 92 that is arranged to be manually operated and a fill switch 93 that likewise is arranged to be manually operated. The electrical system can be energized from any suitable source of current such as 110 volt 60 cycle source which may be applied across conductors 94 and 95 through a suitable switch 96.

In describing the operation of the material handling means disclosed herein, it will be assumed that the switch 96 is closed to energize conductors 94 and 95 and that the transfer switch 91 is in the automatic position with contacts 91*a* closed. Further it will be assumed that a sheet 14 has been placed on the rider members 22 as shown in Figure 1 with the left hand end abutting the stop 15.

The fill switch 92 is depressed momentarily to effect the operation of the control relay 90. The circuit for accomplishing this can be traced from energized conductor 94 through the normally closed contacts of the down limit switch 72, contacts of the fill switch 93, operating winding 90*w* to energized conductor 95. As a result of the energization of winding 90*w* a holding circuit is completed at contacts 90*b* through contacts 91*a* and the fill switch 93 need be held in the depressed condition no longer.

As a result of the operation of the control relay 90 a circuit is completed for energizing the operating solenoid 56 of the air intake valve 54. This circuit can be traced from energized conductor 94 through the normally closed contacts of the down limit switch 72, solenoid 56, contacts 90*a* to energized conductor 95.

As a result of the opening of the air intake valve 54, air under pressure is applied to the accumulator cylinder 51 and air cylinder 40. When sufficient air pressure is developed within the air cylinder 40, the piston 43 is moved upwardly to lift the sheet 14, rider members 22 and main frame 26. Only a slight upward movement of the main frame 26 takes place until the contacts of the down limit switch 72 are opened. As a result the holding circuit for the winding 90*w* is opened and the control relay 90 is deenergized. Contacts 90*a* open and the solenoid 56 is deenergized resulting in closure of the air intake valve 54.

It will be understood that the amount of air pressure admitted into the air cylinder 40 for lifting the main frame 26 sufficiently to open the contacts of the down limit switch 72 can be adjusted by the balance adjusting means 67. This is accomplished by varying the tension in the spring 69 by the adjusting screw 71.

The system now is in condition for performing the bending operation on the sheet 14. For this purpose the operator depresses the foot pedal 16. One result of this operation is to operate the mechanical press 10 and cause the movable or upper die 13 to move downwardly as indicated by the arrow 97 in Figure 7. Such operation is conventional and need not be described further. At the time that the foot pedal 16 is depressed the contacts of pedal switch 19 are closed to complete a circuit for energizing the solenoid 85 associated with the latch mechanism 73. This circuit can be traced from the energized conductor 94 through normally closed contacts 87*b*, contacts of the pedal switch 19, solenoid 85, normally closed contacts of lock disconnect switch 36, normally closed contacts 90*c* to conductor 95. As a result the latch 76 is withdrawn from the path of the detent 75 and the main frame 26 then is free to swing upwardly.

As the movable or upper die 13 moves downwardly to engage the sheet 14 for performing the bending operation, a portion indicated at 98 of the sheet 14 tends to be raised so that the portion of the sheet adjacent the stationary or lower die 12 can conform to the shape of the bending surface 99 about the axis of the bend which is indicated at 100 at the nadir of this surface. It will be understood that the upward force applied to the sheet 14 as indicated at 98 reduces the downward force ex-

erted by the sheet 14 against the piston 43. As a result, the air pressure which is trapped in the air cylinder 40 and accumulator cylinder 51 is permitted to raise the frame 26. Previously the upward force exerted by the air pressure within the air cylinder 40 had been balanced by the force of gravity acting on the sheet 14, rider members 22 and main frame 26. Some of that force is decreased, as described, by the upward thrust applied to the portion 98 of the sheet 14 as the bending operation progresses. Consequently the remaining portion of the sheet 14, rider members 22 and main frame 26, are swung upwardly as the air in the air cylinder 40 and accumulator cylinder 51 expands. The upward force exerted by the air pressure decreases as the air expands. However, the downward force of gravity applied to the sheet 14, rider members 22 and main frame 26 varies as the cosine of the angle through which they are swung so that the system generally remains in balance except as unbalanced by the upward thrust applied to the portion 98 of the sheet 14. The upward movement of the remaining portion of the sheet 14, rider members 22 and main frame 26 continues until they occupy a position parallel to the right hand side of the bending surface 99 of the stationary or lower die 12. Where a 90° bend is formed in the sheet 14, this corresponds to a movement through about 45° for the remaining portion of the sheet 14, rider members 22 and main frame 26.

As soon as the bending operation is completed, no further upward thrust is applied to the portion 98 of the sheet 14. Consequently, the only forces acting are the force of gravity acting downwardly on the sheet 14, rider members 22 and main frame 26 and the force exerted by the air pressure in the air pressure means 39 acting upwardly. The relationship is such that the downwardly acting force exceeds the upwardly acting force, and, as a result, the sheet 14, rider members 22 and main frame 26 are biased downwardly by a force equal to the difference between the oppositely acting forces after the upper die 13 has been retracted to a position completely out of engagement with the sheet 14. The aforementioned difference is adjustable by the previously described adjustment means 67. The return of these parts to the horizontal position is cushioned by the air pressure means 39.

It is pointed out that, as the main frame 26 is swung upwardly the contacts of the lock disconnect switch 36 are opened and the previously traced circuit for energizing the solenoid 85 of the latch mechanism 73 is opened. The spring 81 then returns the latch 76 to the position shown in Figure 7 so that, when the detent 75 is moved downwardly, it rides over the inclined latching surface 101 to displace the latch and permit the return of the main frame 26 to the horizontal position. As soon as the latch 76 is disengaged by the detent 75, the former is urged to the latching position by the spring 81.

As long as the same sheet 14 remains on the rider members 22, it is unnecessary to provide additional air under pressure to the air pressure means 39. All that is required is for the successive operation and release of the foot pedal 16 to cause the mechanical press 10 to go through a complete stroke and for the remaining portion of the sheet 14 to be raised and lowered during and after the bending operation, respectively, as described.

After all of the bending operations have been performed on the sheet 14, it is removed from the rider members 22. The downwardly exerted force is reduced to an extent equal to the mass of the sheet and, as a result, the air pressure in the air pressure means 39 tends to swing the main frame 22 upwardly. The detent 75 then engages the under side of the latch 76 and moves it upwardly. This movement is transmitted through the plunger 88 to the upper limit switch 87. Contact members 87*b* are opened to open any possible energizing circuit to the solenoid 85. As a further precaution, as pointed out hereinbefore, the pin 79 is provided on the latch 76 so that, when it is raised, as just described, the latch 76 could not be withdrawn to the unlatched position even if the solenoid 85 might inadvertently be energized.

A further result of the operation of the up limit switch 87 is to close contacts 87*a* and complete a circuit for energizing the operating solenoid 59 of the air exhaust valve 57. This circuit can be traced from the energized conductor 94 through contacts 87*a*, solenoid 59, to energized conductor 95. On opening of the air exhaust valve 57, the air pressure applied to the air pressure means 39 is released through the discharge conduit 58 to the atmosphere. The air pressure is not discharged fully but only to an extent sufficient to permit the force of gravity to overcome the force exerted on the piston 43. Under these circumstances the detent 75 no longer holds the latch 76 in the elevated position and contacts 87*a* are opened to open the previously traced energized circuit for the solenoid 59.

On the application of another sheet 14 to the rider members 22, the fill switch 93 is again depressed and the foregoing cycle of operation is repeated.

In the event that it is desired to operate the system manually, the transfer switch 91 is operated to close contacts 91*m*. Under these conditions, it is necessary to hold the fill switch 93 in the closed position until sufficient air pressure is developed in the air pressure means 39 to open the contacts of the down limit switch 72. In other words, the control relay 90 is not automatically held energized since it is not possible to complete the holding circuit to the contacts 90*b* for the reason that the contacts 91*a* are open.

The air pressure means 39 can be exhausted completely by depressing the exhaust switch 92 under the assumed conditions and holding the same closed. The circuit for energizing the operating solenoid 59 of the air exhaust valve 57 by operation of the exhaust switch 92 can be traced from the energized conductor 94 through contacts 91*m*, contacts of exhaust switch 92, solenoid 59 to the energized conductor 95.

Since certain changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, frame means pivotally supported to swing about a horizontal axis below the bending surface of said stationary die, sheet support means movably carried by said frame means and pivotally supported to swing about a horizontal axis in close proximity to said bending surface of said stationary die, and means for conjointly moving said frame means and said sheet support means upwardly as the bending operation is performed to support the unbent portion of the sheet during such operation.

2. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, frame means pivotally supported to swing about a horizontal axis below the bending surface of said stationary die, sheet support means movably carried by said frame means and pivotally supported to swing about a horizontal axis in close proximity to said bending surface of said stationary die, and means for conjointly moving said frame means and said sheet support means upwardly as the bending operation is per-

formed with a force varying as the cosine of the angle through which said frame means is moved and less than that required to overcome the force of gravity acting thereon and on said sheet support means and said sheet whereby, when the bending operation is completed and the first mentioned force is no longer applied, the return to the initial position under the force of gravity of said frame means, sheet support means and sheet is cushioned by the second mentioned force.

3. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, and means for moving said supporting means upwardly as the bending operation is performed with a constantly applied force which is less than that required to overcome the force of gravity acting on said supporting means and sheet whereby, when the bending operation is completed and the first mentioned force is no longer applied, the return to the initial position under the force of gravity of said supporting means and sheet is cushioned by the second mentioned force.

4. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, means for moving said supporting means upwardly as the bending operation is performed with a constantly applied force which varies as the cosine of the angle through which the same is swung and which is less than that required to overcome the force of gravity acting on said supporting means and sheet whereby, when the bending operation is completed and the first mentioned force is no longer applied, the return to the initial position under the force of gravity of said supporting means and sheet is cushioned by the second mentioned force, and means independent of the means for applying said second mentioned force for varying the initial amount thereof required to function as aforesaid.

5. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, and air pressure operating means disposed below said sheet and reacting upwardly against said supporting means for moving the same upwardly as the bending operation is performed with a constantly applied force which cushions the return of said supporting means and sheet to said initial position under the influence of gravity after the bending operation has been completed and the first mentioned force is no longer applied.

6. The invention as set forth in claim 5 wherein the air pressure operating means comprises an air cylinder and a piston slidable therein with the volume of the former being substantially greater than the volume of the space therein through which said piston moves.

7. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, air pressure operating means disposed below said sheet and reacting upwardly against said supporting means for moving the same upwardly as the bending operation is performed with a constantly applied force which varies as the cosine of the angular displacement of said supporting means from its initial position and which cushions the return of said supporting means and sheet to said initial position under the influence of gravity after the bending operation has been completed and the first mentioned force is no longer applied, and means independent of said air pressure operating means for varying the initial amount of force required to be exerted thereby to function as aforesaid.

8. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, air pressure operating means disposed below said sheet and reacting upwardly against said supporting means for moving the same upwardly as the bending operation is performed with a constantly applied force which varies as the cosine of the angular displacement of said supporting means from its initial position and which cushions the return of said supporting means and sheet to said initial position under the influence of gravity after the bending operation has been completed and the first mentioned force is no longer applied, and means cooperating with said air pressure operating means for limiting the initial value of the force exerted thereby when the same reaches a value determined principally by the force of gravity acting on said supporting means and sheet.

9. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, means for moving said supporting means upwardly as the bending operation is performed with a constantly applied force which is less than that required to overcome the force of gravity acting on said supporting means and sheet whereby, when the bending operation is completed and the first mentioned force is no longer applied, the return to the initial position under the force of gravity of said supporting means and sheet is cushioned by the second mentioned force.

10. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, means for supporting said sheet to swing the same upwardly generally about the bending axis thereof, means for moving said supporting means upwardly as the bending operation is performed with a constantly applied force which varies as the cosine of the angle through which the same is swung and which is less than that required to overcome the force of gravity acting on said supporting means and sheet whereby, when the bending operation is completed and the first mentioned force is no longer applied, the return to the initial position under the force of gravity of said supporting means and sheet is cushioned by the second mentioned force, and locking means cooperating with said supporting means for preventing upward movement thereof in the event that said second mentioned force exceeds a predetermined value.

11. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet, sheet hoisting means comprising, means for supporting said sheet independently of said die, means for

pivotally mounting said sheet supporting means to swing about a horizontal axis in close proximity to said bending surface of said stationary die, air pressure operating means connected to said sheet supporting means, and means connected to said air cylinder for controlling the supply of air under pressure thereto and the discharge of air therefrom.

12. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet, sheet hoisting means comprising, means for supporting said sheet, means for pivotally mounting said sheet supporting means to swing about a horizontal axis in close proximity to said bending surface of said stationary die, air pressure operating means connected to said sheet supporting means, means connected to said air cylinder for controlling the supply of air under pressure thereto and the discharge of air therefrom, and adjustable means cooperating with said sheet supporting means to apply a variable upward thrust thereto to accommodate sheets of different size.

13. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet, sheet hoisting means comprising, means for supporting said sheet, means for pivotally mounting said sheet supporting means to swing about a horizontal axis in close proximity to said bending surface of said stationary die, air pressure operating means connected to said sheet supporting means, means connected to said air cylinder for controlling the supply of air under pressure thereto and the discharge of air therefrom, and means cooperating with said air cylinder control means for limiting the air pressure applied thereto to a value determined principally by the force of gravity acting on said sheet supporting means and sheet.

14. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet, sheet hoisting means comprising, a main frame, means for pivotally supporting said main frame to swing about a horizontal axis below the bending surface of said stationary die, means for supporting said sheet movably supported on said main frame, means for pivotally supporting said sheet supporting means to swing about a horizontal axis in close proximity to said bending surface of said stationary die, air pressure operating means including an air cylinder having a piston slidable therein and operatively connected to said main frame, and means connected to said air cylinder for controlling the supply of air under pressure thereto and the discharge of air therefrom.

15. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet, sheet hoisting means comprising, a main frame, means for pivotally supporting said main frame to swing about a horizontal axis below the bending surface of said stationary die, means movably supported on said main frame for supporting said sheet, means for pivotally supporting said rider means to swing about a horizontal axis in close proximity to said bending surface of said stationary die; air pressure operating means including an air cylinder having a piston slidable therein and operatively connected to said main frame, and an electrically operated air intake valve connected to said air cylinder for controlling the supply of air under pressure thereto; fill switch means connected to effect the operation of said air intake valve to apply an upward thrust to said main frame and said rider means and sheet carried thereby, down limit switch means connected to effect closure of said air intake valve on predetermined upward movement of said main frame, and frame balance adjusting means including a coil compression spring reacting at one end against a plunger engaging said main frame in its lowermost position and having an adjusting screw reacting against the other end.

16. In combination with a mechanical press having a downwardly movable die and a cooperating stationary die for forming a flange along one edge of a metallic sheet accompanied by application of force tending to raise the remaining portion of the sheet, sheet hoisting means comprising, a main frame, means for pivotally supporting said main frame to swing about a horizontal axis below the bending surface of said stationary die, rider means movably supported on said main frame for supporting said sheet, means for pivotally supporting said rider means to swing about a horizontal axis in close proximity to said bending surface of said stationary die, air pressure operating means including an air cylinder having a piston slidable therein and operatively connected to said main frame, and an electrically operated air intake valve connected to said air cylinder for controlling the supply of air under pressure thereto; fill switch means connected to effect the operation of said air intake valve to apply an upward thrust to said main frame and said rider means and sheet carried thereby, and down limit switch means connected to effect closure of said air intake valve on predetermined upward movement of said main frame.

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