Sept. 12, 1950 E. K. JOHANSEN 2,522,451

PRESSURE OR LOAD CONTROL DEVICE FOR LINKAGE OF METALWORKING PRESSES

Filed June 12, 1950 2 Sheets-Sheet 1

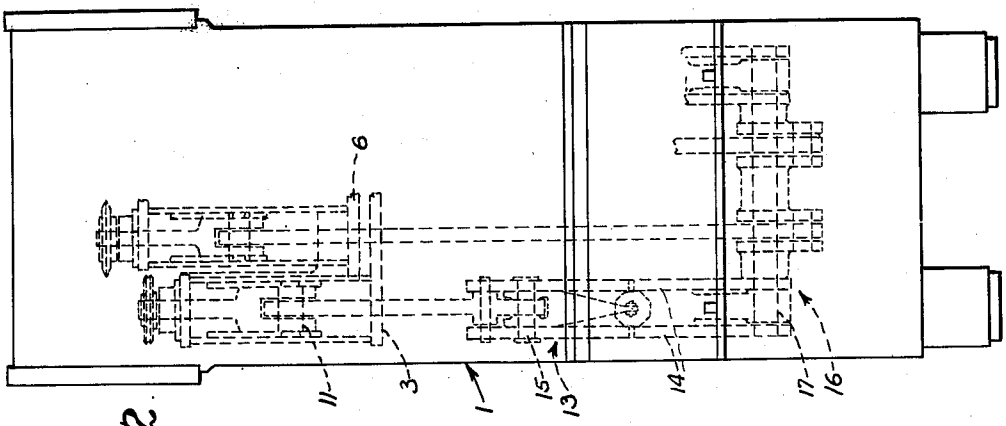


FIG. 2

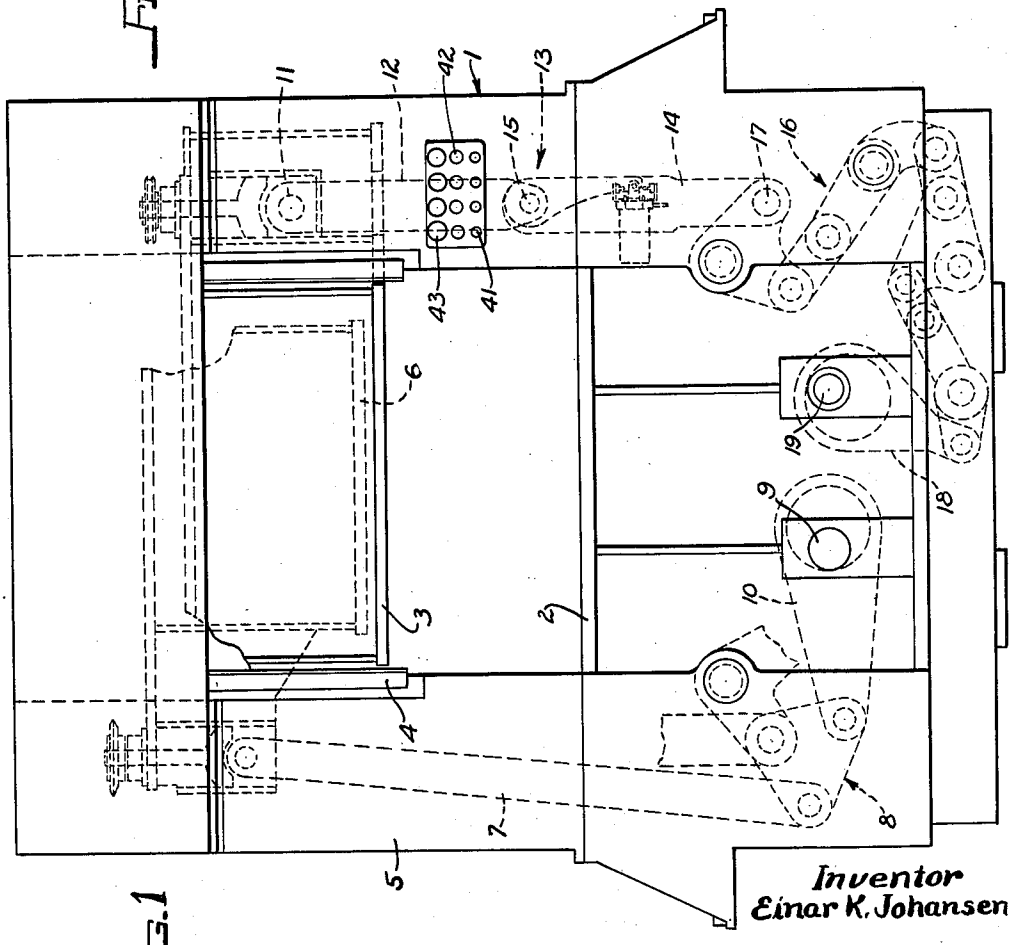


FIG. 1

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FIG. 3

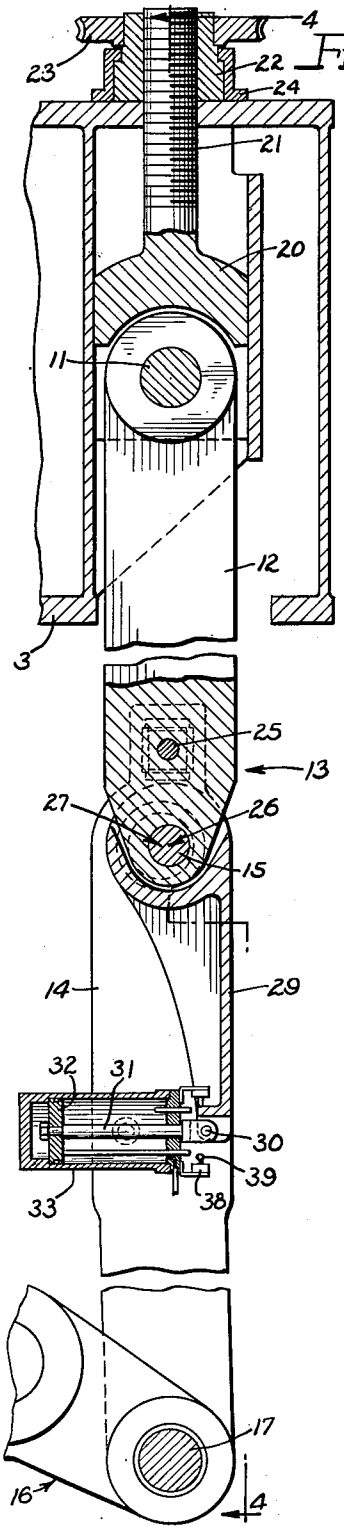


FIG. 4

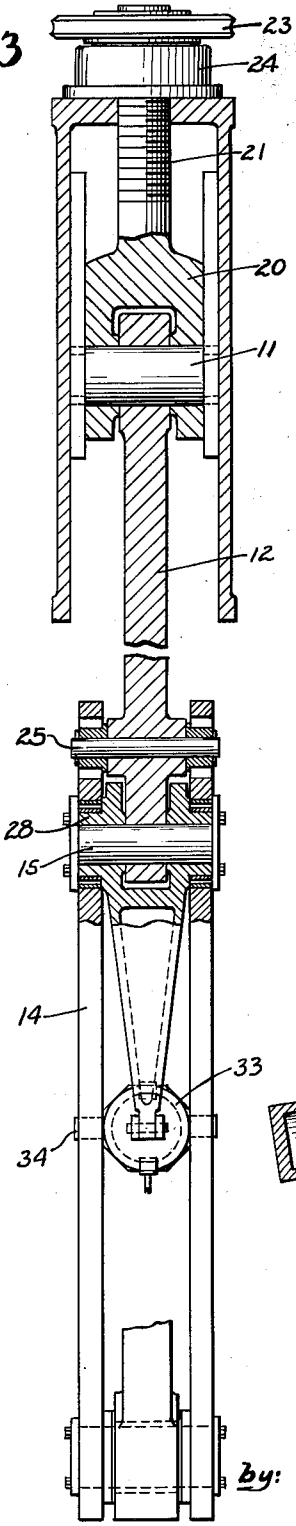
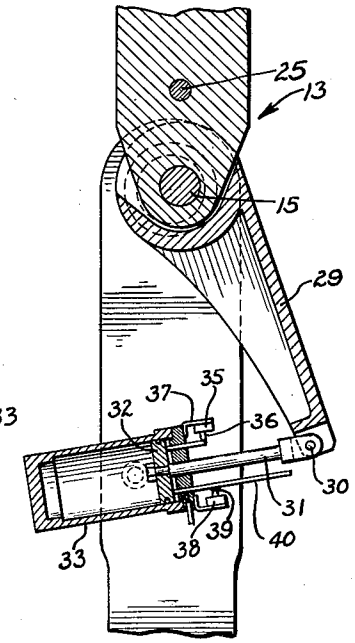


FIG. 5



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2,522,451

PRESSURE OR LOAD CONTROL DEVICE FOR LINKAGE OF METALWORKING PRESSES

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Application June 12, 1950, Serial No. 167,500

4 Claims. (Cl. 113—38)

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This invention relates in general to metal working and forming presses of the mechanical type and is particularly directed to a novel form of pressure or load control device which prevents an overload from occurring on certain parts of the press and which may also be used for adjusting and regulating the pressure exerted between certain parts of the press.

The pressure or load control device embodying the present invention is applicable to metal working presses which are mechanically operated and may be applied to different parts of the press to accomplish various specific results, all of which will be clearly set forth hereinafter.

Many metal working presses are so constructed as to consist of a pair of uprights having a crown at one end thereof and a bed at the other end thereof held together by a plurality of tie rods. One form of a pressure or load control device embodying the present invention has heretofore been applied to the tie rods in such a press, and this feature has been disclosed and claimed in my earlier filed copending application bearing Serial No. 154,699, filed April 7, 1950. Also, a further form of pressure or load control device embodying the present invention has been applied to one or more of the slides of the press, and this feature has been disclosed and claimed in my copending application Serial No. 167,501, filed June 12, 1950.

Metal working and forming presses, however, differ as to their specific details of construction. Some such presses may have a solid frame without any tie rods to hold the crown and bed together. There are also single action presses wherein an upper slide having a die affixed thereto is caused to come against a metal work piece between the upper die and the lower die located on the bed of the press. Another form of metal working press is known as the double action type wherein a blank holder is first caused to move in a direction to hold the metal blank in place while a second slide, having a die affixed thereto, moves to perform a forming operation. Larger presses may have what is known as a triple action which may be similar to the double action with the addition of a third action slide moving against the blank to cause a further forming operation on the metal blank or work piece. Some of these presses may be operated by driving mechanism located at the top of the press, and others may have the driving mechanism in the lower portion of the press. When the driving mechanism is located in the bottom of the press the frame is not necessarily held together by tie rods, nor is it necessarily a solid frame type.

One difficulty which has always been present in metal working presses of the mechanical type is

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the possibility of stalling or breaking certain parts of the press due to an overload. The overload may be caused by the die setter during the preliminary steps of die setting, if he should set the die in the movable slide too near the opposite die. On the other hand, an operator of the press may occasionally move two blanks instead of one into position on the die which would also cause an overload in the press and either cause some part of the press to break, or may cause the clutch to slip resulting in the press stalling at the end of its normal stroke. It is evident that when press breakage occurs, not only costly repairs are incurred, but also a lengthy delay in production may result during the necessary time for repair.

The pressure or load control device of the present invention is adaptable to presses of the tie rod construction, the solid frame construction, as well as the type of press wherein the drive is located in either the upper or lower portion of the press. The present form of the invention illustrates the applicability thereof to either the blank holder slide or to the slide or slides carrying the forming dies when the mechanism for driving the slide or slides is located in the lower portion of the press. More particularly, the invention is illustrated herein as applied to the linkage connected between the blank holder slide and the mechanism in the lower portion of the press for reciprocating the blank holder slide.

In most instances the various slides of a metal working press have adjusting means associated therewith in order to adjust the blank holder slide or the draw slides either toward or away from the opposite die to compensate for different pressures, as well as different thicknesses of blanks on which work is to be performed, and varying die heights. In some cases these adjusting means may be adjusted manually, and in larger presses these adjusting means may be operated mechanically.

Heretofore, the variation in thickness of a blank on which the forming operation is to be performed has been a serious problem, because if the blank holder slide or forming slide has been finely adjusted for a particular thickness of stock or blank and then a blank of greater thickness is placed in the press, an overload will occur. The device of the present invention compensates for this variation in thickness of the blank, thus eliminating the necessity for a fine selection in stock thickness or adjusting the press for each variation. This, in turn, results in great economy because of the reduction in the number of worked pieces or products which must be discarded.

With the foregoing considerations in mind, it

is a principal object of the present invention to provide a pressure or load control device which is associated with one or more of the linkage means connected between the driving mechanism and a slide of a metal working press of the mechanical type.

Another object of the invention is to provide a pressure or load control device which is associated and connected with one or more of the slide operating links in a metal working press and which compensates for the inaccuracies of a die setter during the preliminary steps of die setting as well as for the variations in blank thicknesses to prevent an overload in the press from stalling the press or causing breakage to occur therein.

A further object of the invention is to provide a novel form of pressure or load control device connected with the link which operates the blank holder slide of a metal working press wherein the mechanism for driving the blank holder slide is located in the lower portion of the press.

A still further object of the invention is to provide a pressure or load control device connected with one or more of the links for operating either the forming slides or the blank holder slide in a metal working press, wherein the mechanism for driving the slide is located in the lower portion of the press to protect the press against overload.

Still another object of the invention is to provide a novel pressure or load control device connected with at least one of the links which operates a slide in a metal working press, wherein the mechanism for reciprocating the slide and actuating the link is located in the lower portion of the press and wherein a yieldable force will be caused to yield when the pressure created by the slide against the work reaches a predetermined amount. Thus, the pressure against the blank may be regulated if the device is connected with one or more of the links which operates the blank holder slide, or the press will be protected against overload if the device is associated with one or more of the links connected with either a blank holder slide or the forming slide or slides of the press.

Another object of the invention is to provide a pressure or load control device for metal working presses of the mechanical type wherein a yieldable member is mounted on one of the links which drives one of the slides in the press, and a lever arm is connected at one end thereof to the yieldable means, and at the other end thereof to an eccentrically mounted pivot pin connecting two sections of the link together, whereby the eccentrically mounted pivot pin will cause the yieldable means to operate when a predetermined pressure or load is reached on the slide driven by the link with which the device is associated.

Still another and more specific object of the invention is to provide a pressure or load control device for a metal working press of the mechanical type wherein a yieldable force such as air or other fluid is exerted against one end of an eccentrically mounted lever arm, thereby to rotate the lever arm in one direction when the fluid cylinder to which it is attached is charged, thereby setting up an initial stress. A pivot pin connects two sections of a link together which link is caused to reciprocate a slide driven by mechanism located in that portion of the press toward which the slide moves for its operating stroke. The other end of the lever arm is then connected eccentrically to the said pivot pin so

that when a predetermined pressure or load is reached, such load will tend to elongate the link made up of the two link sections thereupon rotating the lever arm in the opposite direction to that in which it was rotated during the charging of the cylinder, thereby to prevent the occurrence of any excessive pressure or overload.

Other objects and advantages of the invention will become apparent upon reading the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is an elevational view of one form of double action press somewhat diagrammatically illustrated, and wherein the blank holder slide and forming slide move downwardly on the working stroke thereof, and wherein the mechanisms for driving the slides are located in the lower portion of the press.

Fig. 2 is a side elevational view of the machine shown in Fig. 1.

Fig. 3 is an enlarged detailed vertical sectional view through one of the linkage means to which the device of the present invention has been applied.

Fig. 4 is a vertical sectional view taken along the plane of line 4—4 of Fig. 3; and

Fig. 5 is a fragmentary view of the link and device as shown in Fig. 3 but illustrating the position of the various parts when the sections of the link are under tension.

In the case of double and triple action presses, the first action slide is sometimes referred to as a blank holder slide which, during the initial cycle of the press, is the first to move against the work or blank to hold it in position while the metal blank is being operated upon by the forming slide or slides.

In a double action press the second action slide is the forming slide which has a die affixed thereto. This forming slide is sometimes mounted within the blank holder slide and is caused to reciprocate vertically. It may also be mounted so as to reciprocate in a direction opposite to that of the blank holder. It is called a second action slide because of the fact that it is operated to cause a forming operation on the blank after the blank holder has come against the blank and during the dwell of the blank holder while it is holding the blank in position. This second slide or forming slide performs its forming operation and then returns to its initial position after which the blank holder returns to its initial position and the product is removed from the press.

For purposes of illustration only, the invention is shown in the drawings as applied to the links connected between the driving mechanism and the blank holder slide wherein the mechanism is located in the lower portion of the press. Inasmuch as presses of this general construction are well-known, the details thereof have not been shown except in a general way. For details of operation of the press, reference may be made to the copending application of Rudolph W. Glasner and Einar K. Johansen, filed October 19, 1949, bearing Ser. No. 122,208. It is sufficient for present purposes to state that the press as illustrated comprises a main supporting structure or frame 1 including a base or bed 2 and a blank holder slide 3 mounted for reciprocation in guideways 4 provided in the uprights or separating members 5.

A forming slide 6 is illustrated as being located within the blank holder slide 3 and is caused to reciprocate therein to perform a forming operation on the metal work piece or blank. The

forming slide 6 has a plurality of links 7 connected at one end therewith and at the other ends to a suitable linkage arrangement generally indicated at 8. A rotating shaft 9 has eccentric straps 10 thereon connected to the linkage mechanism for operating the links 7 and reciprocating the forming slide.

The blank holder slide 3 has connected therewith by means of a pin 11 one section 12 of a link generally indicated at 13. The other section 14 of link 13 is connected to section 12 by means of a pivot pin 15 and at its other end to an operating linkage mechanism 16 by means of pivot pin 17. The linkage mechanism 16 is operated by means of an eccentric strap 18 mounted on shaft 19 and is caused to be actuated in timed relation with the movement of linkage 8 so that the blank holder slide and forming slide will be reciprocated at proper times with respect to each other.

It is customary to provide some adjusting means for adjustment of the blank holder slide toward and away from the work. In some presses this adjustment is arranged to be made manually and in other presses such as, for example, the one illustrated herein, the adjustment may be made mechanically. In the particular arrangement shown in Figs. 3 and 4 of the drawings, the pivot pin 11 passes through the upper end of link section 12, and through the bifurcated end of a connecting member 20. The member 20 extends upwardly through the upper part of the blank holder slide and is screw threaded as at 21. An adjusting nut 22 has fixed thereto a worm gear 23 adapted to be rotated by mechanical means. The nut 22 is fixed to the top of the blank holder slide by means of the retaining member 24. When worm gear 23 and nut 22 are rotated, the blank holder will be raised or lowered with respect to the bed of the press. Suitable interconnecting means are provided for rotating all of the gears 23 and nut 22 simultaneously and at the same rate of speed so that all points of the blank holder slide will be moved simultaneously.

The link section 12 extends downwardly and terminates between the spaced sides of link section 14. A pin 25 passes through both link sections 12 and 14 above the pivot pin 15, whereby the two link sections constituting link 13 will be prevented from collapsing or rotating with respect to each other. The pivot pin 15 constitutes an eccentric connection between the link sections 12 and 14. It will be noted in Fig. 3 in the embodiment of the invention specifically shown herein that the vertical center line of link section 12 also passes through the center or axis 26 of pivot pin 15. This pin, however, is mounted in link section 14 eccentrically so that a vertical plane passing through the center of link section 14 will be offset from the central plane passing vertically through link section 12. The intersection of a horizontal plane through the axis 26 of pin 15 with the vertical plane through the center of link section 14 will constitute an eccentric axis as indicated at 27.

Pivot pin 15 also passes through side members 28 at one end of a lever arm 29. The end portions 28 are preferably circular and the openings therein which receive pivot pin 15 are also eccentric with respect to the axis of pin 15 so that the eccentric axis 27 will be the axis about which lever arm 29 may rotate.

Lever arm 29 is disposed between the spaced sides of link section 14 and has its lower or opposite end pivotally connected as at 30 to the

outer end of a piston rod 31. The inner end of piston rod 31 has secured thereto a piston 32 adapted to reciprocate within the cylinder 33. This cylinder 33 is mounted for pivotal movement between the spaced sides of link section 14 on trunnions 34.

Air, or other fluid under pressure is admitted to cylinder 33 against one side of piston 32 to place the device consisting of lever arm 29, piston 32 and cylinder 33 under a yieldable stress, whereby the normal position of the various parts just enumerated during the normal operation of the press will be as shown in Fig. 3.

It will be evident that during the operation of the press, or during the preliminary die setting operation, if the slide is being adjusted or has been adjusted so that in the lowermost position of the slide a predetermined load will occur, the press may function continuously without trouble. If, however, in the die setting operation, the slide is set too low, or too near the bed or lower die, or if during operation of the press two work pieces are moved into the die instead of one, or if the work piece is too thick, or is uneven so that it is thicker on one side than on the other, this load or pressure, exerted by the slide when it reaches the end of its stroke, will tend to exceed that pressure for which it was originally set. When this condition exists in a press without the present invention applied thereto, either the press will stall due to the fact that the crank, linkage mechanism, or eccentric means reciprocating the slide cannot continue its movement to the end of the stroke, or the press or die may fail or fracture.

With the present invention applied to the press as illustrated herein, when the load for which the slide has been set is reached and the slide has not yet reached the end of the stroke for which it was set, the continued movement of the slide actuating mechanism will tend to create excessive pressure or an overload. This tendency will tend to move the two link sections 12 and 14 away from each other and an upward force will be exerted along a vertical plane passing through the axis 26 of pivot pin 15. This force will then cause lever arm 29 to rotate about the eccentric axis 27 in a counterclockwise direction, as viewed in Fig. 3, thereby to move piston 32 against the force of the fluid pressure within cylinder 33. If this tendency for excessive pressure or overload is sufficient, the lever arm 29 may be moved substantially to the position shown in Fig. 5. Thus, the yieldable means constituting the fluid pressure device just described will yield when the pressure or load tends to exceed a predetermined amount, thereby absorbing this load and allowing the slide actuating mechanism to complete the stroke of the slide and return to its initial position without overload or excessive pressure, thereby preventing damage to the press or die or stalling thereof.

An additional feature of the present invention is the provision of suitable means automatically to stop operation of the press if the tendency to overload becomes excessive or if the tendency to exceed a predetermined pressure becomes excessive. One manner of accomplishing this result is illustrated more clearly in Figs. 3 and 5 wherein a limit switch 35 is shown as mounted on one side and at one end of cylinder 33. The limit switch 35 has a switch arm 36 extending therefrom and into the path of a rod 37. This rod 37 extends through an opening in one end of cylinder 33 and is mounted for axial move-

ment. The movement of rod 37 is caused when the inner end thereof is contacted by piston 32.

It is clear that when the tendency for excessive pressure or overload is relatively slight, there will only be a slight rotation of lever arm 29 and hence a relatively slight movement of piston 32. When the excessive pressure or overload tends to increase to such a degree that piston 32 will move a sufficient distance to contact the inner end of rod 37, this rod will be moved outwardly from its position shown in Fig. 3 to its position shown in Fig. 5 where it has contacted switch arm 36 of limit switch 35 which will open the operating circuit to the press and stop the operation thereof.

Still another feature which may be desirable is the provision of means for the purpose of indicating whether or not the pressure or load control device is operating. To this end a second limit switch 38 provided with a switch arm 39 may be provided at another point on the same end of the cylinder as limit switch 35. An elongated rod 40 is preferably secured or affixed to piston 32 and extends outwardly through an opening in one end of cylinder 33. The switch arm 39 on switch 38 extends into the path of movement of rod 40 so that when the piston 32 moves a relatively slight amount sufficient to show that the device is in operation, rod 40 will move with piston 32 to contact switch arm 39 and close switch 38. Any suitable means may be provided visually to indicate that the pressure or load control device is operating. For example, switch 38 may be connected to a light 41 for each link (Fig. 1) mounted at a suitable place on the press frame so that during operation of the press and on the working stroke of the slide or slides when the pressure or load tends to exceed a predetermined amount to rotate lever arm 29 and move piston 32, the rod 40 will contact switch arm 39 to close the circuit and illuminate the light. In this case an operator of the press will be able to determine visually whether or not the pressure or load control device is operating. It will be evident that either or both of these switch means may be applied also to the devices of my above referred to copending applications.

The invention, of course, is not limited to the specific eccentric arrangement disclosed herein. It would be possible without departing from the spirit of the invention to reverse the locations of the axis 26 of the pin and the eccentric axis 27. Such an arrangement would then tend to rotate lever arm 29 in the opposite direction in which case the cylinder 33 would have its position reversed or the fluid pressure could be applied to the opposite side of the piston.

It is a feature of the present invention that regardless of the specific arrangement of the eccentric pivot means, it is desirable to have the eccentric axis and the axis of the pivot pin so arranged that a plane passing through the eccentric axis of rotation and the axis of the pivot pin will be substantially perpendicular to the direction of force through the pivot pin. It will be evident that if such a plane passing through the two axes is parallel, or in the same plane as the plane of force through the pivot pin, there would be no such eccentricity present as would cause the lever arm 29 to rotate. It has been determined that if the angle of a plane passing through the eccentric axis of rotation and the axis of the pivot pin with the direction of force through the pivot pin be relatively small, then a greater force will be necessary to cause a yielding of the fluid control device than if this angle is substantially 90 degrees. The more nearly this angle approaches 90 degrees, the more efficient the device will function, so that for best results this angle should be substantially 90 degrees.

The device has been specifically illustrated herein as applied to the links connecting the blank holder slide with the actuating means for reciprocating the slide. It will be evident that the device could also be applied to the link connecting a forming slide with its actuating mechanism provided the arrangement is such that the actuating mechanism pulls the slide toward the mechanism on the working stroke thereof. In other words, the press shown herein has the actuating mechanism for both the blank holder slide and the forming slide in the lower portion of the press, while both slides are mounted in the top of the press to move downwardly on the working stroke. The same arrangement would be followed and the device of the present invention would be equally applicable to an arrangement where the actuating mechanism for the slide is in the upper part of the press and the slide is in the lower part, whereby it will move upwardly on its working stroke.

In some presses there may be but a single adjusting screw, and in other presses there may be two or more adjusting screws. In instances where more than one adjusting screw is used, it may be desirable to have a greater pressure on one side or on one corner of the slide than on the other side or corner. Where the present invention is applied to the link having an adjusting screw formed as a part thereof as disclosed herein, this varying pressure can be obtained by the adjustment of the fluid pressure in each cylinder by means such as valve 42, or any other suitable means. One cylinder may have the pressure therein increased so that a greater pressure on that corner or side of the slide will be obtained. Thus, with the aid of this invention the pressure which would be exerted on any given point of the slide can be varied by varying the fluid pressure within the respective cylinder or cylinders. In actual practice, the rough adjustment may be made by the adjusting screw and the finer adjustment may be made by regulating the fluid pressure within the cylinder. For the convenience of the operator, pressure indicating dials 43 may be provided.

The device has been referred to herein as either a pressure control device or a load control device. The reason for this is that technically when the device is applied to the link or links connecting the outer slide or blank holder slide with its actuating mechanism, its functions are both pressure regulation and load control. This follows from the fact that the pressure of the blank holder slide against the work is being regulated and at the same time overload is being prevented.

When the device is applied to the link connecting a forming slide with its actuating mechanism, then the primary consideration is the protection against overload. The device, however, functions in the same manner structurally whether its end function is to prevent excessive pressure, or to prevent overload. Therefore, throughout this description, as well as in the claims appended hereto, when the device is referred to as a pressure or load control device, it is intended to mean either a device for controlling the overload on a forming slide or a

device to control the pressure or overload on a blank holder slide.

Changes may be made in the form, construction and arrangement of parts from those disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended hereto.

The invention is hereby claimed as follows:

1. In a metal working press of the mechanical type having a reciprocating slide, slide actuating mechanism and a link connected between said slide and the actuating mechanism therefor, said link being formed in two sections, a pressure or load control device mounted on said link and movable therewith, comprising a yieldable member mounted on one of the sections of said link, a lever arm connected at one end thereof to said yieldable member and having its other end mounted in a bearing in said link section to rotate about an axis, a pivot pin passing through said other end of the lever arm and one end of the other link section and having its axis parallel with said first axis and offset from said first axis and from the path of movement thereof, the location of said pivot pin being such that the axial projection thereof is contained within the axial projection of said bearing, and means to prevent relative rotation between the two link sections, whereby relative movement between the two link sections tending to produce excessive pressure or overload will cause said lever arm to rotate about said first axis against the pressure of said yieldable member.

2. In a metal working press of the mechanical type having a reciprocating slide, slide actuating mechanism and a link connected between said slide and the actuating mechanism therefor, said link being formed in two sections, a pressure or load control device mounted on said link and movable therewith, comprising a fluid pressure means mounted on one of the sections of said link, a lever arm connected at one end thereof to said fluid pressure means and having its other end mounted in a bearing in said link section to rotate about an axis, a pivot pin passing through said other end of the lever arm and one end of the other link section and having its axis parallel with said first axis and offset from said first axis and from the path of movement thereof, the location of said pivot pin being such that the axial projection thereof is contained within the axial projection of said bearing, and means to prevent relative rotation between the two link sections, whereby relative movement between the two link sections tending to produce excessive pressure or overload will cause said lever arm to rotate about said first axis against the pressure of said fluid pressure means.

3. In a metal working press of the mechanical type having a reciprocating slide, slide actuating mechanism and a link connected between said slide and the actuating mechanism therefor, said link being formed in two sections, a pressure or load control device mounted on said link and movable therewith, comprising a yieldable member mounted on one of the sections of said link, a lever arm connected at one end thereof to said yieldable member and having its other end mounted in a bearing in said link section to rotate about an axis, a pivot pin passing through said other end of the lever arm and one end of the other link section and having its axis parallel with said first axis and offset from said first axis and from the path of movement thereof, the location of said pivot pin being such that the axial projection thereof is contained within the axial projection of said bearing, and means to prevent relative rotation between the two link sections, whereby relative movement between the two link sections tending to produce excessive pressure or overload will cause said lever arm to rotate about said first axis against the pressure of said yieldable member, and means associated with said yieldable member to stop operation of the press when said lever arm has rotated a predetermined distance around said first axis.

4. In a metal working press of the mechanical type having a reciprocating slide, slide actuating mechanism and a link connected between said slide and the actuating mechanism therefor, said link being formed in two sections, a pressure or load control device mounted on said link and movable therewith, comprising a fluid pressure means mounted on one of the sections of said link, a lever arm connected at one end thereof to said fluid pressure means and having its other end mounted in a bearing in said link section to rotate about an axis, a pivot pin passing through said other end of the lever arm and one end of the other link section and having its axis parallel with said first axis and offset from said first axis and from the path of movement thereof, the location of said pivot pin being such that the axial projection thereof is contained within the axial projection of said bearing, and means to prevent relative rotation between the two link sections, whereby relative movement between the two link sections tending to produce excessive pressure or overload will cause said lever arm to rotate about said first axis against the pressure of said fluid pressure means, and means associated with said fluid pressure means to stop operation of the press when said lever arm has rotated a predetermined distance around said first axis.

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