Sept. 1, 1942. H. F. MacMILLIN ET AL 2,294,676

METAL STRETCHING PRESS

Original Filed March 25, 1940

FIG. 1

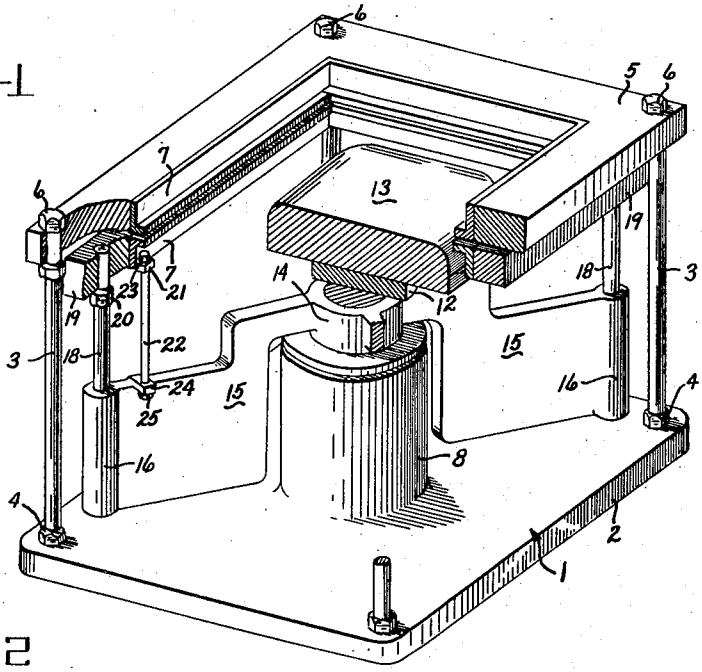
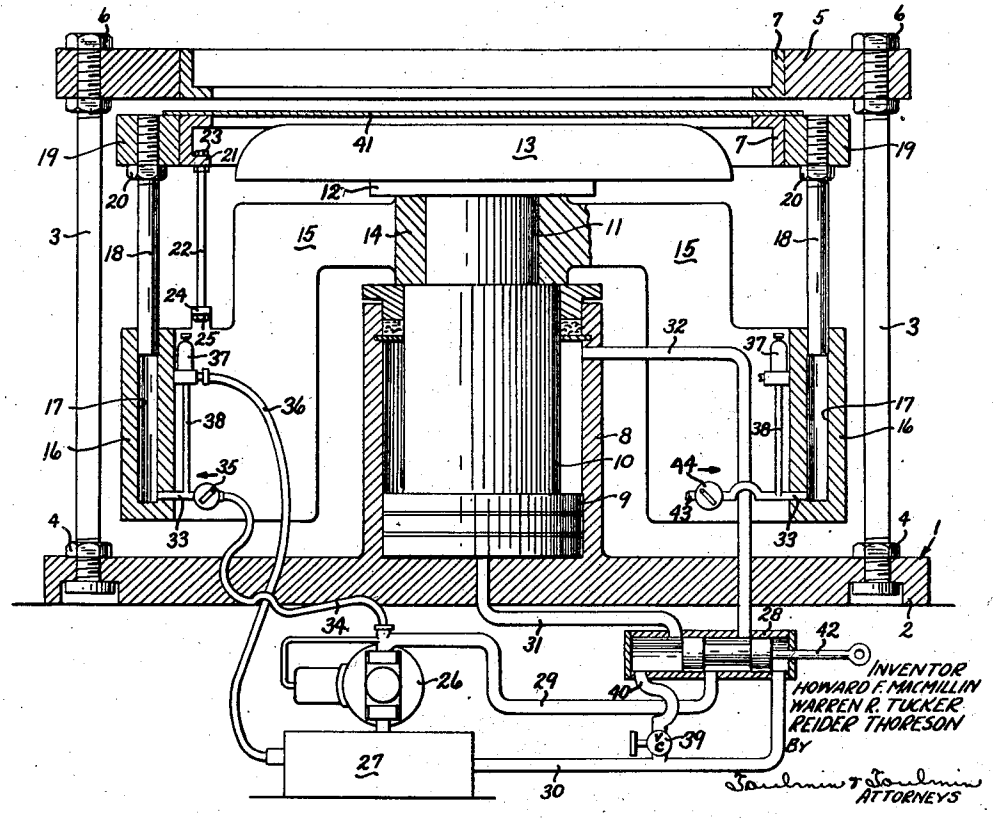


FIG. 2



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METAL STRETCHING PRESS

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6 Claims. (Cl. 113—45)

The present invention relates to hydraulic presses, and particularly to presses of the type that employ mechanism for clamping the workpiece to the press.

This application is a division of our application Serial Number 325,780 filed March 25, 1940 and entitled "Metal stretching press."

In certain forms of hydraulic drawing presses it is sometimes necessary to clamp the sheet of metal to the bed or top plate of the press. Various methods for doing this have been proposed, and practically all of these methods depend on the use of clamping or gripping forces derived from pneumatic cylinders, electric motors or hand-power-operated through levers. The use of these forces obviously requires a source of energy different from that employed in the press, which adds to the expense of the press as a whole, also to the installation and to the complexity of operation. Furthermore, the power-multiplying levers are often of a complicated mechanical character due to the manner and direction in which the force is applied.

Presses of this general type quite frequently require precise timing between the clamping and pressing forces, particularly to insure that the gripping effect is provided before the metal is worked. Obviously, this timing requirement is difficult to achieve and maintain, where separate sources of energy are employed for the gripping and pressing operations.

Another precaution which must be taken is to insure that the clamping effect is not withdrawn until the punch of the press has broken contact with the metal. Moreover, in so-called "stretching" presses in which certain slippage of the metal is permitted and required to accommodate the drawing or forming operation, it is often difficult to make the necessary adjustments of the prior-art clamps to not only insure proper timing but also the proper amount of slippage, and it is harder yet to change the adjustments of the lamps individually to produce local pressing effects.

The primary object of the present invention is to provide a hydraulic press which is adapted to grip the work with or without slippage, and to eliminate all of the disadvantages in connection with prior-art presses of this general character.

Another object is to provide a press in which the gripping or blank holder jaws are acted upon by the same source of power which is employed for operating the press.

A further object is to provide a hydraulic press in which the clamping effects are obtained by direct hydraulic pressure, thus insuring perfect coordination between the press and the work-clamping mechanism. Only a single source of hydraulic power is required for these two purposes, so that when pressure is applied to the fluid of the press and the clamping mechanism is simultaneously subjected to the pressure of the same fluid.

A still further object is to provide a hydraulic press in which the workpiece is gripped at a number of different areas throughout the surface of the workpiece, and ready adjustment may be made of the final clamping effects at the various clamping positions.

In carrying out the above objects there is provided a number of hydraulically actuated pistons for applying pressure to a similar number of clamps or gripping devices spaced about the workpiece and receiving their power from the same source of pressure fluid which operates the press. Each of these pistons reciprocates in cylinders, the pressure of which may be adjusted as a whole or individually in order to provide the necessary general or special clamping effects.

Other objects and features will be apparent as the specification is perused in connection with the accompanying drawing.

In the drawing:

Figure 1 is a perspective view with a part broken away and in section, of a hydraulic press improved in accordance with the present invention.

Figure 2 is a sectional view of the press shown in Figure 1 except that the platen, the plunger and some of the immediately associated parts are shown in elevation.

The press is supported on a flat base member 1 of rectangular configuration having countersunk holes 2 at the corners thereof, for receiving a number of strain rods 3 threaded at each end. These rods are firmly secured to the base 1 by nuts 4 and their upper ends carry a top plate 5 secured in position by pairs of nuts 6. The top plate has a rectangular opening which is adapted to receive die strips 7 bolted or otherwise secured thereto. The base member 1 is provided with an upstanding cylinder 8 at the center, in which a piston 9 and plunger 10 are adapted to reciprocate. The plunger 10 has a turned-down shoulder 11 at the top, and this shoulder portion carries the usual platen 12 and the punch 13.

Surrounding the shouldered portion and rigidly secured thereto there is a hub 14, from which radiate, at equi-distant positions, four wing-shaped members 15 which take the general form of an

S-configuration, and are constituted of flat pieces of metal terminating in a number of cylinders 16. These cylinders are bored, as indicated at 17, from the top and closed at the bottom. The bores 17 slidably receive pistons 18, which are threaded at the top into a rectangular gripping plate 19. Nuts 20 may be employed to assure rigid contact between the plungers and the plate. The plate 19 has a rectangular opening similar to the top plate 5, and the sides of the opening are adapted detachably to receive die strips 7 which may be secured as by bolts thereto.

These die strips are provided not only with inwardly projecting die surfaces, as in the case of the other embodiments, but also with an additional lip 21. These lips 21 contain openings which receive guide rods 22 which are firmly secured to the lips by nuts 23. The lower ends of the rods 22 move through openings which are provided in extensions 24 formed on the wing members 15. The rods at the bottom may carry nuts 25. The arrangement is such that the wing members 15 are adapted to slide upwardly over the rods 22, the nuts 25 assisting in determining the lower limit of travel of the wing elements.

The hydraulic system includes the pump 26, the oil tank 27, the four-way valve 28 and the high pressure line 29 and the low pressure line 30. There is a pipe 31 extending from the upper surface of the valve 28 to the lower end of the cylinder 8. A length of pipe 32 connects the space to the rear of the piston 9 with the upper surface of the valve 28. There is a fluid inlet opening 33 at the lowermost portion of each clamping cylinder 16, and this opening is connected to the high pressure side of the pump through a flexible pipe 34 and a check valve 35. It will be noted that this valve is so arranged as to permit fluid to pass inwardly toward the bore 17 of the clamping cylinders. It will be understood that communication is made between the high pressure side of the pump and the lower portions of all of the clamping cylinders through their respective check valves 35. A flexible pipe 36 is taken from the low pressure side of the pump or the oil tank 27, through an adjustable pressure relief valve 37 and a short length of pipe 38, to the opening 33. This valve may be conveniently secured to the upper portion of the cylinder in order to facilitate adjustment. There is a choke valve 39 positioned in the low pressure line 40 leading from the valve 28.

The parts are shown at the instant that the main piston 9 has reached its lower limit of travel, and it is assumed that the finished article formed by the previous pressing operation has been removed from the machine. A fresh metal sheet 41 is placed in position within the space between the die strips 7. The operator then causes the rod 42 of the four-way valve to be moved to the left, causing high pressure fluid to be introduced into the pipe 31. As the pressure below the main piston increases, the plunger 10 will rise and will carry the wing members 15 upwardly together with the clamping cylinders 16. These cylinders have been previously filled with fluid through the conduit 43 and the check valves 44. Consequently, as the cylinders move with respect to the plungers 18 the fluid within the bores 17 is immediately placed under pressure, causing the plungers to move upwardly and to press the gripping plate 19 against the work 41, thus holding the metal sheet firmly between the plates 5 and 19. Continued upward movement of the plunger causes the plungers 18 to be pressed upwardly with greater force, thereby increasing the clamping effect at the metal sheet.

In the event that this pressure becomes excessive, surplus fluid in the bores 17 is permitted to pass from the inlets 33 into the vertical pipes 38 where they operate the relief valves 37, and this fluid is then permitted to return to the tank through the conduits 36. The clamping effect at the plates 5 and 19 is entirely completed at the time the plunger 10 is moved to such a height as to cause the punch 13 to contact with the metal sheet. Continued movement of the punch will cause the requited deformation of the metal sheet, in accordance with the shape and size of the opening between the upper die strips 7 and as also determined by the shape of the punch. It is apparent that during the upward movement of the plunger 10 the wings 15 slide upwardly over the guide rods 22. The fluid which is entrapped at the rear side of the piston 9 finds ready access to the low pressure side of the pump or a tank through the pipes 32 and 30. When the punch has reached its upper limit of travel, as determined by the operator or in any other suitable manner, the rod 42 is moved to the right, which is the position shown in Figure 2. Under these conditions high pressure fluid passes from the pipe 29 to the pipe 32 which leads to the rear side of the piston 9. At the same time the space in front of the piston is in communication with the tank through the pipes 31, 29, the choke valve 39 and the pipe 30. The choke valve 39 is for the purpose of limiting the rate at which the fluid is exhausted from the front side of the main piston during the downward movement of that piston.

As the plunger 10 moves downwardly, due to the pressure fluid passing through the pipe 32, it carries with it the punch 13 and the wings 15. The cylinders 16 carried by the wings also move downwardly, which tends to reduce the pressure of the fluid in the bores 17. However, it will be noted that these bores are always in communication with the high pressure side of the pump through the flexible pipes 34, and further that the only way the fluid can escape is through the relief valves 37 which are set to operate only above a predetermined pressure. Consequently, while the pressure is reduced to some extent by the movement downwardly of the cylinders 16, nevertheless there is sufficient pressure still exercised on the plungers 18 to maintain sufficient clamping effect between the plates 5 and 19 when the punch 13 breaks contact with the formed metal article. As the plunger 10 continues its downward movement the cylinders 16 travel downwardly a corresponding distance, which eventually will reduce the pressure of the contained fluid to such a value as to permit the plate 19 to descend of its own weight. Such a condition is under the direct control of the adjustments accorded the relief valves 37, and preferably takes place only after the punch 13 has moved an appreciable distance away from the work.

Thus it is evident that clamping pressure is assured at a time prior to when the punch 13 contacts the metal sheet during the working stroke and is also maintained for a sufficient length of time after the punch starts to descend. It is further apparent that the time relation between these clamping effects and the movement of the punch can be accurately correlated and adjusted by proper control of the pressure relief valves 37. The adjustment of these valves also affects the intensity of the clamping force so that

any degree of gripping action may be obtained in order to permit slippage between the metal sheet and the clamping plates, or firmly to hold the sheet without any slippage whatsoever. It is further evident that by the use of the individual relief valves 37 for each clamping cylinder, any special and local clamping effect can be obtained, for example, by adjusting one or more of these valves to be actuated at a different relief pressure than the remaining valves.

It will be understood that we desire to comprehend within our invention such modifications as come within the scope of the claims and the invention.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. A hydraulic press for fabricating articles out of sheet metal, said press comprising a main pressing cylinder and a clamping cylinder, a plunger in each of said cylinders, a punch carried by the plunger in the pressing cylinder and adapted to move upwardly against the metal sheet which is to be formed into the article, the clamping cylinder being secured to the plunger of the pressing cylinder, a clamping plate secured to the plunger of the clamping cylinder for holding the metal sheet in position during the pressing operation, and means for applying pressure fluid separately to the lifting side of the plungers in the main and clamping cylinders respectively whereby the punch is caused to contact with the metal sheet and the plunger in the clamping cylinder moves upwardly to move the clamping plate into clamping position.

2. A hydraulic press for fabricating articles out of sheet metal, said press comprising a main pressing cylinder and a plurality of clamping cylinders symmetrically arranged about the pressing cylinder, a plunger in each of said cylinders, a punch carried by the plunger of the pressing cylinder and adapted to move upwardly against the metal sheet which is to be formed into an article, wing members extending outwardly from the plunger in the pressing cylinder and secured to the clamping cylinders whereby the clamping cylinders are caused to move upwardly when the plunger of the main cylinder rises, a clamping plate secured to the plungers of the clamping cylinders for holding the metal sheet in position during the pressing operation, a source of pressure fluid, a conduit extending directly from the high pressure side of said source to the working side of the plungers in the clamping cylinders whereby the pressures maintained in said clamping cylinders are equal, and means for applying fluid pressure from said source to the lifting side of the plunger in the main cylinder whereby the main plunger and the clamping cylinders are caused to be elevated and the pressure of the fluid in the clamping cylinders rises to such value as to cause the clamping plungers to be moved upwardly and to force the clamping plate against said sheet of metal so that the metal sheet is clamped in position before the punch carried by the main plunger contacts with said sheet.

3. A hydraulic press for fabricating articles out of sheet metal, said press comprising a main pressing cylinder and a plurality of clamping cylinders symmetrically arranged about the pressing cylinder, a plunger in each of said cylinders, a punch carried by the plunger of the pressing cylinder and adapted to move upwardly against the metal sheet which is to be formed into an article, wing members extending outwardly from the plunger in the pressing cylinder and secured to the clamping cylinders whereby the clamping cylinders are caused to move upwardly when the plunger of the main cylinder rises, a clamping plate secured to the plungers of the clamping cylinders for holding the metal sheet in position during the pressing operation, a source of pressure fluid, conduits extending directly from the high pressure side of said source to the working side of the plungers in the clamping cylinders, pressure relief valves connected respectively between said conduits and the low pressure side of said source whereby the pressures maintained in said clamping cylinders are equal, and means for applying pressure fluid from said source to the lifting side of the plunger in the main cylinder whereby the main plunger and the clamping cylinders are caused to be elevated and the pressure of the fluid in the clamping cylinders rises to such value as to cause the clamping plungers to be moved upwardly and to force the clamping plate against said sheet of metal so that the metal sheet is clamped in position before the punch carried by the main plunger contacts with said sheet, said pressure relief valves being of adjustable character so that the pressure within the clamping cylinders will not exceed a predetermined work-slipping value whereby slippage is permitted between the metal sheet and the clamping plate in order to accommodate the stretch of the metal during the forming operation.

4. A hydraulic press comprising a main pressing cylinder and an auxiliary clamping cylinder, a plunger in each of said cylinders, a punch carried by the main plunger for forming a metal sheet into a desired shape, a clamping plate carried by the clamping plunger for holding the sheet in position during the forming operation, a mechanical connecton between the main plunger and the clamping cylinder, a source of pressure fluid and a control valve therefor, said valve being provided with high pressure and low pressure openings which communicate with said source, a piston in said valve, said valve also being provided with a pair of openings which are adapted to be an ingress and an egress respectively for the fluid in an alternate manner depending on the position of the piston within said valve, a conduit extending from the ingress opening to the working side of the main plunger, a second conduit extending from the egress opening to the rear side of the main plunger, a third conduit extending directly from the high pressure side of said source to the working side of the clamping plunger, and means including a relief valve connected to said third conduit for limiting the fluid pressure in the clamping cylinder to a work-slipping value as the main plunger is lifted by the fluid passing through the conduit which extends from said ingress opening and carrying with said plunger the clamping cylinder.

5. A hydraulic press comprising a main pressing cylinder and an auxiliary clamping cylinder, a plunger in each of said cylinders, a punch carried by the main plunger for forming a metal sheet into a desired shape, a clamping plate carried by the clamping plunger for holding the sheet in position during the forming operation, a mechanical connection between the main plunger and the clamping cylinder, a source of pressure fluid and a control valve therefor, said valve being provided with high pressure and low pressure openings which communicate with said

source, a piston in said valve, said valve also being provided with a pair of openings which are adapted to be an ingress and an egress respectively for the fluid in an alternate manner depending on the position of the piston within said valve, a conduit extending from the ingress opening to the working side of the main plunger, a second conduit extending from the egress opening to the rear side of the main plunger, a third conduit extending directly from the high pressure side of said source to the working side of the clamping plunger, and means including a relief valve connected to said third conduit for limiting the fluid pressure in the clamping cylinder to a work-slipping value as the main plunger is lifted by the fluid passing through conduit C and carrying with said plunger the clamping cylinder, said relief valve being of an adjustable character whereby the plunger in the clamping cylinder is caused to be elevated at such a rate that the clamping plate contacts the metal sheet before the punch contacts said sheet as the main plunger is being lifted.

6. A metal stretching press for stretching articles of complicated shape from sheet metal, said press comprising a main pressing cylinder and a clamping cylinder, a plunger in each of said cylinders, a punch carried by the plunger in the pressing cylinder and adapted to move upwardly against the metal sheet which is to be formed into the article, the clamping cylinder being secured to the plunger of the pressing cylinder, a clamping plate secured to the plunger of the clamping cylinder for holding the metal sheet in position during the pressing operation, a source of pressure fluid, a conduit extending directly from the high pressure side of said source to the working side of the plunger in the clamping cylinder, and means for applying fluid pressure from said source to the lifting side of the plunger in the main cylinder whereby the main plunger and the clamping cylinder are caused to be elevated and the pressure of the fluid in the clamping cylinder rises to such a value as to cause the clamping plunger to be moved upwardly and to force the clamping plate against said sheet of metal.

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