Sept. 15, 1942. P. C. POCOCK ET AL 2,296,051

BALANCING COLUMN FOR HORN PRESSES

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FIG. 1.

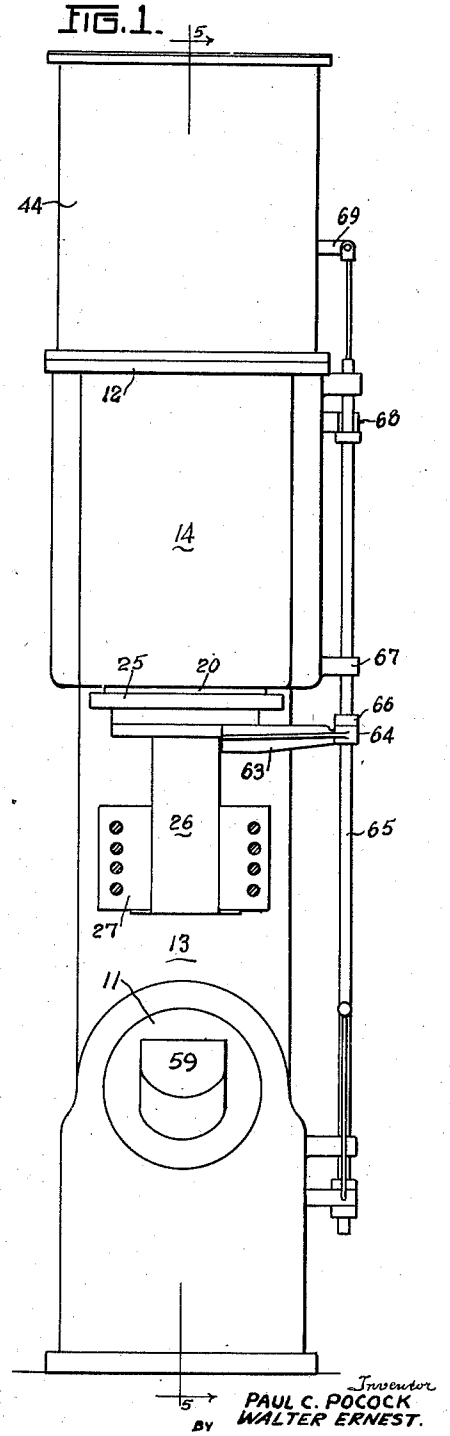


FIG. 2.

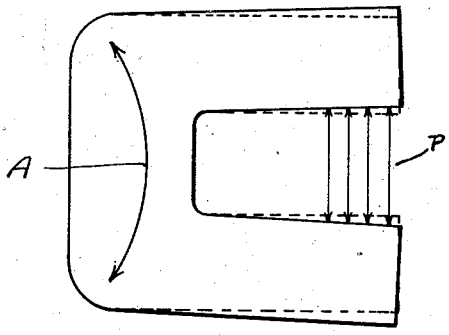


FIG. 3.

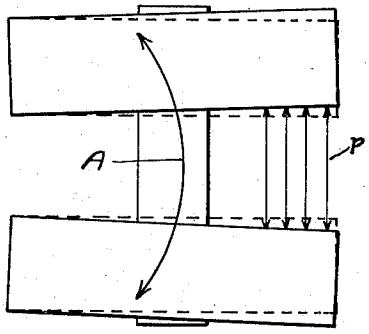
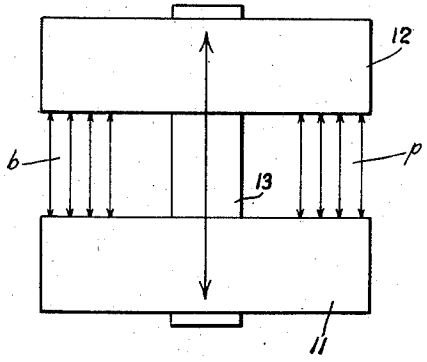


FIG. 4.



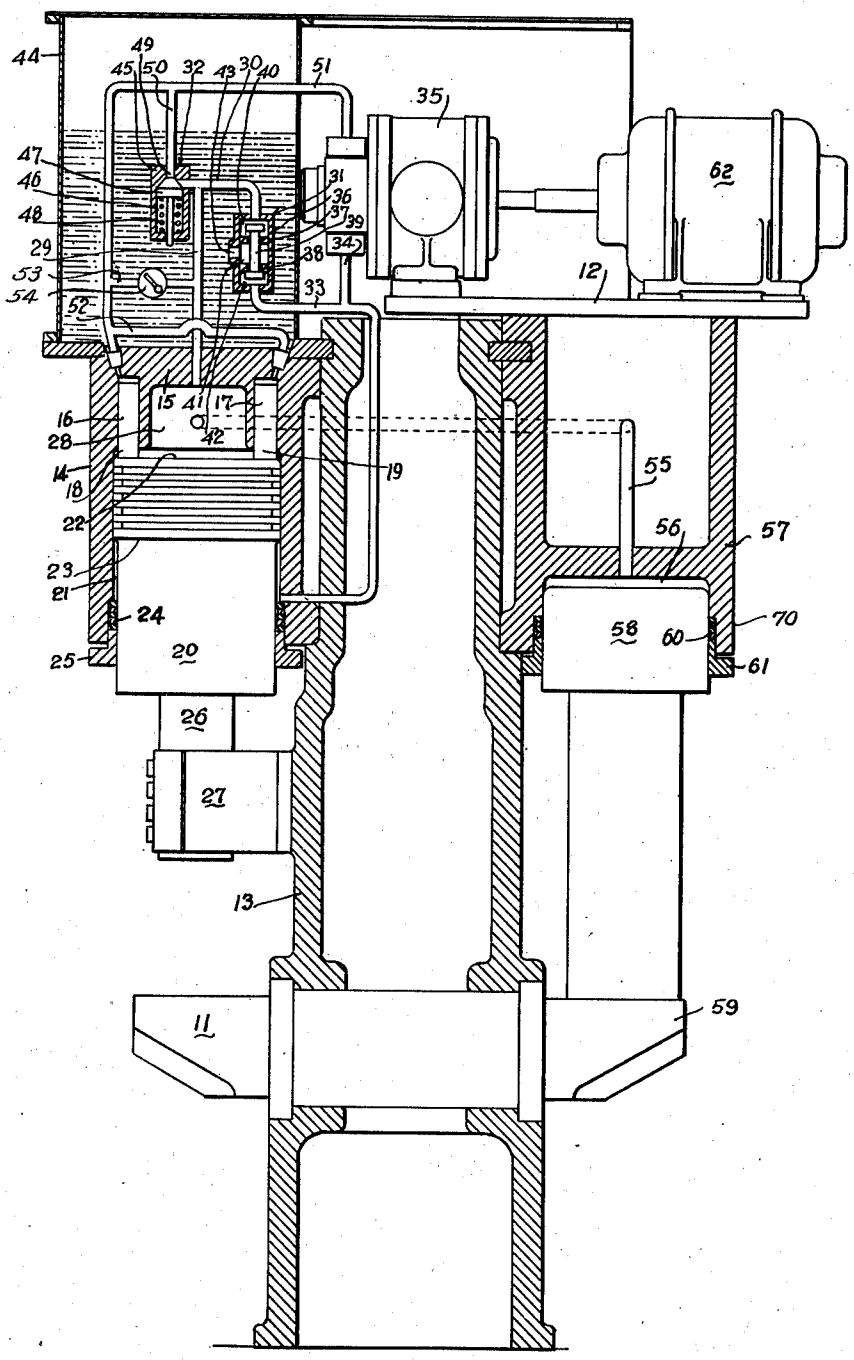
Inventor
PAUL C. POCOCK
WALTER ERNEST.
BY
Attorneys

Sept. 15, 1942. P. C. POCOCK ET AL 2,296,051

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FIG. 5.



Inventor
PAUL C. POCOCK,
WALTER ERNEST.

BY

Attorneys

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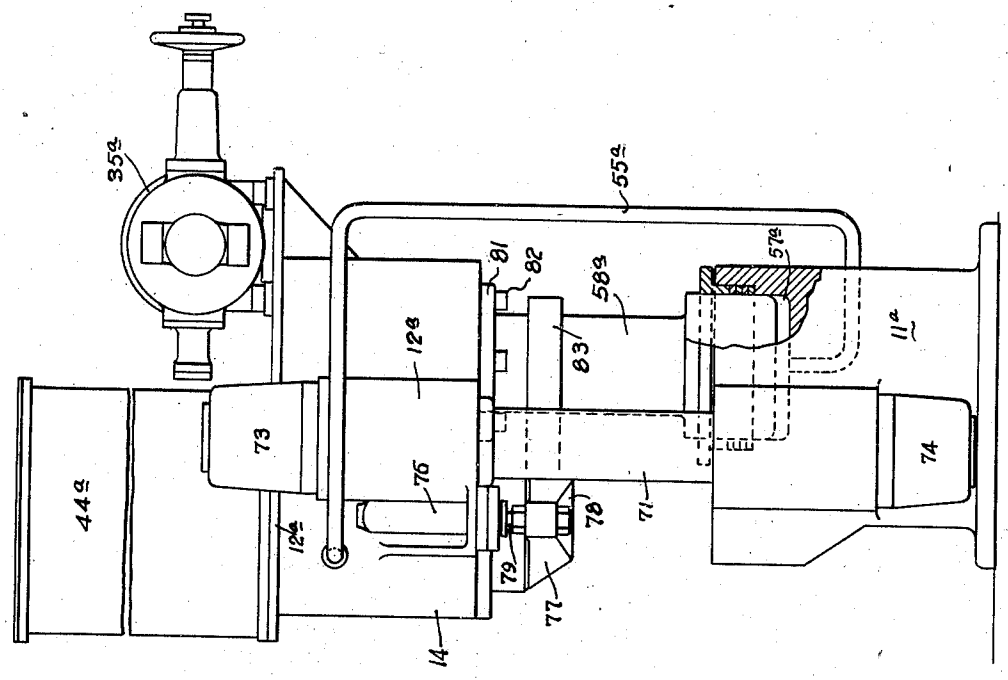


FIG. 7.

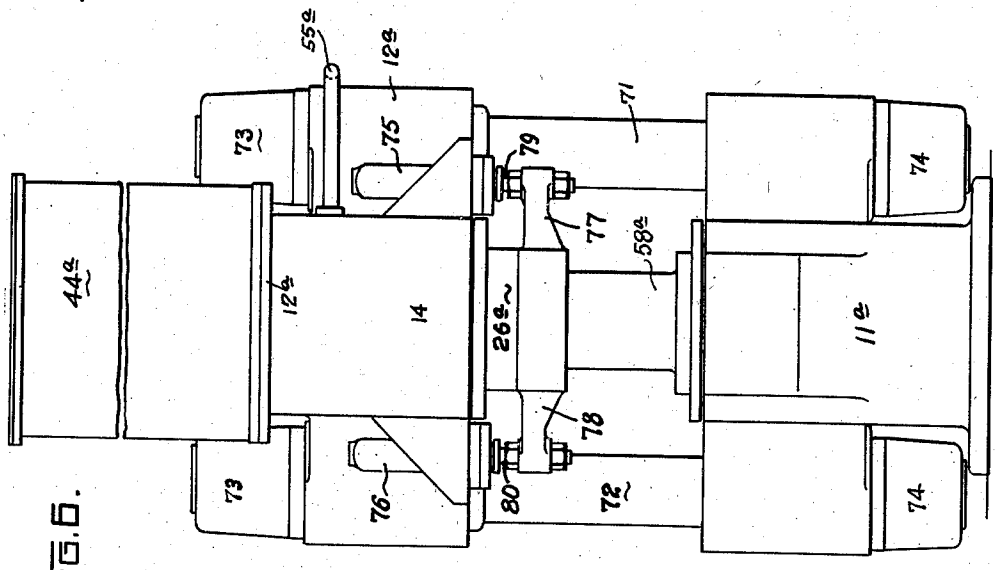


FIG. 6.

Inventor
PAUL C. POCOCK,
WALTER ERNEST.
BY
Attorneys

Patented Sept. 15, 1942

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BALANCING COLUMN FOR HORN PRESSES

Paul C. Pocock and Walter Ernst, Mount Gilead, Ohio, assignors to The Hydraulic Development Corp., Inc., Wilmington, Del., a corporation of Delaware

Application June 19, 1940, Serial No. 341,312

7 Claims. (Cl. 100—71)

This invention relates to presses, and in particular to so-called open gap or horn presses, which comprise a C-shaped frame portion.

It is well known to those skilled in the art that in the conventional design of open gap or horn presses, tremendous unbalanced forces tend to bend away the press bed from the press head, and thereby materially bend or deflect the connecting member interconnecting the press head and press bed. Therefore, the connecting member has to be built as a very heavy structure to resist these bending forces. This deflection is often also a source of considerable difficulty in keeping dies aligned or in producing perfect work pieces, and makes this type of press unsuited for certain classes of work.

Accordingly, it is an object of the invention to provide an open gap or horn press which, although simple in construction, will overcome the above mentioned drawbacks.

It is another object of the invention to provide an open gap or horn press, in which the bending force exerted by the pressing plunger on the supporting means interconnecting the press head and press bed will automatically be balanced, so as to prevent bending of said supporting means.

Another object consists in providing a press of the type referred to above, in which the bending forces exerted by the pressing plunger on a portion of the press frame are hydraulically balanced.

It is a further object to provide an open gap or horn press in which the press head and press bed are interconnected by a central column having on one side thereof the pressing plunger and on the other side of said column hydraulic balancing means.

It is a still further object of the invention to provide an open gap or horn press in which the press head and press bed are connected with each other by strain rods, and in which hydraulic pressing means are provided on one side of said strain rods while on the other side thereof balancing means hydraulically connected with said pressing means are provided.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

Figure 1 is a side view of an open gap or horn press according to the invention.

Figures 2 and 3 diagrammatically illustrate the bending forces exerted on conventional open gap or horn presses heretofore in use.

Figure 4 diagrammatically illustrates the balancing of the pressing forces according to the invention.

Figure 5 is a section along the line 5—5 of Figure 1.

Figure 6 shows a front view of a press comprising a further embodiment of the invention.

Figure 7 is a side view of Figure 6.

General arrangement

In general, the open gap or horn press according to the present invention, comprises a pressing plunger arranged on one side of supporting means connecting the press bed and the press head, while on the opposite side of said supporting means hydraulic balancing means is provided adapted to exert a force upon the press frame which force is responsive to the force exerted by the pressing plunger upon the press frame but acts in a direction opposite thereto. More specifically the balancing means comprises a substantially stationary cylinder and a substantially stationary plunger arranged in said stationary cylinder so that a cushioning chamber is provided between the bottom of said cylinder and the adjacent surface of the stationary plunger, while conduit means is provided for connecting said cushioning chamber with the cylinder of the pressing plunger.

Structural arrangement

Referring to the drawings in detail, the press according to the invention comprises a press bed 11 and a press head 12 connected with the press bed 11 by supporting means. According to the embodiment of Figures 1 and 5, the said supporting means consists of a central column 13 having connected therewith, on one side thereof, a cylinder 14. The top of the cylinder 14 is closed by the cylinder head 15 having two small cylinder bores 16 and 17. Reciprocably mounted in the cylinder bores 16 and 17 are plungers 18 and 19, while a piston 20 is reciprocably mounted in the bore 21 of the cylinder 14. The plungers 18 and 19 may be separated from or connected with the piston 20. The piston 20 is a double-acting piston with a larger advancing area 22 and a smaller retraction area 23. The bottom of the piston 20 is surrounded by packing material 24 compressed by a gland 25 in order to prevent leakage from the cylinder bore 21. Connected to the piston 20 is a ram 26 slidably mounted in guiding means 27 connected with the central column 13.

The cylinder head 15 comprises a chamber 28 communicating through a conduit 29 with a con-

duit 30 connected on one hand with a shuttle valve 31 and on the other hand with an admission valve 32. The other end of the shuttle valve 31 is connected with a conduit 33 leading on one hand, by means of conduit 34, to one side of the variable delivery pump 35 and on the other hand to the lower portion of the cylinder bore 21. The shuttle valve 31 comprises a casing 36 with partitions 37 and 38 and a shiftable valve member 39 passing through said partitions and adapted selectively to establish communication between the valve chamber 40 and the valve chamber 41, or the valve chamber 42 and the valve chamber 41. The valve chamber 41 has an opening 43 effecting communication between the valve chamber 41 and the interior of the fluid tank 44.

The admission valve 32 comprises a casing 45 with a bore 46 having reciprocably mounted therein a valve member 47 continuously urged by a spring 48 to close the port 49 communicating with the conduit 50 which, in its turn, communicates with the conduit 51. One end of the conduit 51 leads to the pump 35, whereas the other end of the conduit 51 leads to the cylinder bore 16 and by means of the branch conduit 52 to the cylinder bore 17. Interconnected between the conduits 51 and 29 is a conduit 53 with a check valve 54.

The chamber 28 of the cylinder head 15 communicates through a conduit 55 with the cylinder bore 56 of a balancing cylinder 57 connected in any convenient manner with the upper portion of the central column 13 and the press head 12. Mounted in the cylinder bore 56 of the balancing cylinder 57 is a balancing plunger 58 attached to arm 59 of the press bed 11 so that the balancing plunger 58 is substantially stationary. The balancing plunger 58 is surrounded by packing material 60 compressed by gland 61 to prevent leakage from the cylinder bore 56 of the balancing cylinder 57. The press head 12 carries, in addition to the pump 35, an electric motor 62 having its motor shaft connected to the shaft of the pump 35. The ram 26 is connected with an arm 63 having a collar 64 through which slidably passes a push rod 65 with a collar 66 adjustably connected thereto. The push rod 65 is reciprocable in lugs 67 and 68 connected with the press head and is connected by means of a lever system 69 with the shift ring (not shown) of the variable delivery pump 35. The lever system 69 is operated in a manner well known to those skilled in the art. Thus, for starting a working stroke of the press, it is operated in one direction, whereas it is operated in the opposite direction for initiating the retraction stroke. At the end of the retraction stroke the arm 63 with the collar 64 engages the collar 66 on the push rod 65 thereby actuating the same for moving the flow-control member of the variable delivery pump to no-delivery or neutral position.

Operation

Supposing that all parts occupy the position shown in Figure 5 of the drawings which position corresponds to the end of the retraction stroke, and that it is now intended to start a working stroke of the press illustrated in Figure 5. To this end the motor 62 is started in any convenient manner so that the pump 35 is operated. Energization of the motor 62 likewise causes, for instance by energizing a solenoid, a shifting movement of the lever system 69 so that the pump 35 is moved into its forward stroke position. Pressure fluid is then delivered through the conduits 51 and 52 into the cylinder bores 16 and 17 where it acts upon the plungers 18 and 19 so as to move the piston 20 downwardly. In case the piston 20 moves downwardly by its own gravity, the fluid conveyed through the conduits 51 and 52 merely fills the cylinders 16 and 17. During the first portion of the downward movement of the piston 20 the space between the cylinder head 15 and the advancing area 22 of the piston 20 is filled by fluid passing from the fluid tank 44 through the shuttle valve 31 and the conduit 29 into the chamber 28. The fluid expelled by the piston 20 passes through the conduits 33 and 34 to the suction side of the pump. This fluid is supplemented also by fluid passing from the tank 44 through the shuttle valve 31 and the conduit 33 into the conduit 34, since the quantity of fluid expelled by the piston 20 during the forward stroke is less than the quantity of fluid needed to fill the space between the advancing side 22 of the piston 20 and the cylinder head 15. As soon as the ram 26 engages the work piece, pressure in the cylinder 14 builds up. The pressure now present in the conduit 51 acts upon the valve member 47 of the admission valve 32 so as to move the valve member 47 downwardly against the thrust of the spring 48. Port 49 of the admission valve 32 is now open and pressure fluid delivered by the pump 35 flows through the conduit 51, the admission valve 32 and the conduit 29 into the chamber 28 where it acts upon the piston 20. The pressure in the conduit 51 also shifts the valve member 39 so as to close off communication between the conduit 30 and the fluid tank 44.

If no further provisions were made, the great pressure exerted by the ram 26 through the work piece upon the left side of the press bed 11 would bend the said side of the bed downwardly, while simultaneously the left-hand side of the press head would be bent upwardly, and the column or supporting member interconnecting said press head and press bed would be bent along the line A in Figures 2 and 3. However, due to the provision of the balancing cylinder assembly, according to the present invention, such bending of the column 13 is prevented. It will be appreciated that the pressure acting upon the advancing area 22 of the piston 20 is conveyed through the conduit 55 into the chamber 56 of the balancing cylinder 57 where it acts upon the bottom 70 of the balancing cylinder 57 and upon the adjacent surface of the balancing plunger 58. Consequently, the bending forces exerted upon the press bed 11 by the pressing plunger 58 are directed opposite to the bending forces exerted upon the press bed 11 by the ram 26. Since furthermore, the pressure acting upon the piston 20 equals the pressure acting upon the balancing plunger 58, it is obvious that the bending forces exerted by the piston 20 and the plunger 58 balance each other because the lever arms from the center line of the piston 20 and plunger to the center line of the press bed 11 are equal. It will be noted that the plunger 58 remains substantially stationary; in other words, does not move relative to the balancing cylinder 57.

The balancing operation is diagrammatically illustrated in Figure 4 from which it will be seen that the forces p exerted by the pressing ram 26 upon the press bed and press head equal the forces b exerted by the balancing plunger 58 so that no bending of the column 13 occurs, in contradistinction to the previous device in which,

as is illustrated in Figures 2 and 3, the bending forces *p* exerted by the pressing ram are not balanced so that the connecting member interconnecting the press bed and press head is bent along the line A. This causes also a material reduction in the bending of the press head and press bed.

When the pressure in the pressing cylinder 14 has reached a predetermined value, or if the pressing ram 26 has reached a predetermined position, the variable delivery pump is reversed in a manner well known to those skilled in the art for starting the retraction stroke of the press piston 20. Fluid pressure now passes from the pump 35 through the conduits 34 and 33 into the lower portion of the press cylinder 14 where it acts upon the retraction area 23 of the piston 20. The pressure in the conduit 34 is conveyed through the conduit 33 to the shift valve member 39 which is shifted upwardly thereby preventing communication between the conduit 34 and the fluid tank 44. The fluid expelled by the plungers 18 and 19 passes through the conduits 51 and 52 to the suction side of the pump, while the pressure fluid expelled by the advancing area 22 during the retraction stroke of the piston 20 passes through the conduits 29 and 30 and through the shuttle valve 31 into the fluid tank 44. If the fluid conveyed through the conduit 51 to the suction side of the pump 35 should not be sufficient for supplying the fluid required at the retraction side of the piston 20, the check valve 54 will open under the suction effect in the conduit 51 so that fluid from the conduit 29 may be passed into the conduit 51 to the suction side of the pump 35. It will be noted that also during the retraction stroke of the piston 20, the space between the bottom 70 of the balancing cylinder and the adjacent area of the balancing plunger 58 remains filled with fluid. However, since during the retraction stroke of the press piston 20 no bending forces are exerted upon the press frame, no balancing operation of the balancing plunger 58 is necessary nor will it be effected since no pressure prevails in the chamber 56.

When the piston 20 approaches the end of its retraction stroke, the arm 63 connected with the press ram 26 engages, by means of its collar 64, a collar 66 attached to the push rod 65, thereby lifting the latter and causing the same to move the variable delivery pump 35 to neutral position where it stays until a new cycle is started.

Second embodiment

The press shown in Figures 6 and 7 differs from the press shown in Figure 1 primarily in that the press bed 11*a* and the press head 12*a* are interconnected with each other by strain rods 71 and 72 and nuts 73 and 74 instead of the central column 13 provided in the press of Figure 5. Furthermore, the booster cylinders 75 and 76 have taken the place of the cylinders 16 and 17 in the press arrangement of Figure 5. In addition thereto the press ram 26*a* is connected by means of the arms 77 and 78 with the plungers 79 and 80 respectively, which are reciprocably mounted in the booster cylinders 75 and 76.

Another difference between the press according to Figures 6 and 7 and the press of Figure 5 consists in that in the first mentioned press the arrangement of the balancing plunger 58*a* is reversed. In other words, the balancing cylinder 57*a* is supported by the press bed 11*a* and the balancing plunger 58*a* is prevented, by any convenient means, from moving downwardly during the retraction stroke of the press. To this end, according to the embodiment of Figures 6 and 7, the balancing plunger 58*a* is provided with a flange 81 connected by screws 82 to the press head 12*a*. If desired, the balancing plunger 58*a* may be prevented from moving downwardly during the retraction stroke by the provision of stops in the balancing cylinder 57*a*. The remaining parts shown in Figures 6 and 7 substantially correspond to those shown in Figure 5 and are designated with the same reference numerals; however, the letter *a* has been added.

The operation of the press illustrated in Figures 6 and 7 is the same as that described in connection with the embodiment in Figures 1 and 5. Since the balancing plunger 58*a* remains substantially stationary, it may be provided with a guiding arm 83 which embraces the ram 26*a* and constitutes a guide therefor.

It will be understood that I desire to comprehend within my 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, comprising in combination a press bed, a press head, supporting means interconnecting said press bed and said press head and supporting the latter, a hydraulically operable main cylinder-piston-assembly for shaping a work piece, a substantially stationary balancing cylinder-piston-assembly arranged on the other side of said supporting means, and means continuously establishing hydraulic communication between said main cylinder-piston-assembly and said balancing cylinder-piston-assembly for causing the latter to balance the bending forces acting upon said supporting means.

2. A hydraulic press, comprising in combination a frame including a press bed, a press head, and supporting means interconnecting said press bed and press head, a pressing plunger arranged on one side of said supporting means and adapted to act upon a work piece, a balancing cylinder rigidly connected with the press head, conduit means continuously effecting hydraulic communication between said balancing cylinder and said pressing plunger and a balancing plunger rigidly connected to said press bed and adapted in cooperation with said balancing cylinder to balance bending forces exerted by said pressing plunger upon said supporting means.

3. In a hydraulic press, a frame including a press bed, a press head and supporting means spacing said press bed and press head and supporting the latter, a pressing plunger arranged on one side of said supporting means and operable to shape a work piece, a balancing plunger arranged on the other side of said supporting means and rigidly connected to said press head, and a balancing cylinder in continuous hydraulic communication with said pressing plunger and rigidly connected to said press bed for receiving said balancing plunger, said balancing cylinder and balancing plunger being adapted in cooperation with each other to balance bending forces exerted by said press plunger upon said supporting means.

4. A hydraulic press, comprising a press bed for receiving a work piece, a press head and supporting means interconnecting said press bed and press head, a hydraulically operable main cylinder-piston-assembly arranged on one side of said

supporting means and adapted to act upon a work piece, a substantially stationary balancing cylinder arranged on the other side of said supporting means and supported by said press bed at a point opposite to that point of the press bed which receives the work piece, a substantially stationary balancing plunger telescoped in said balancing cylinder and engaging said press head, means for maintaining said plunger spaced from the bottom of said cylinder, and means hydraulically interconnecting said main cylinder-piston-assembly and said balancing cylinder during the entire working stroke for conveying the pressure in said main cylinder-piston-assembly to said balancing cylinder for balancing the bending forces exerted by said main cylinder-piston-assembly upon said supporting means.

5. A hydraulic press, comprising in combination a press bed, a press head, a supporting column arranged centrally with respect to said press bed and interconnecting said press bed with said press head while supporting the latter, a press cylinder supported by said press head and arranged on one side of said supporting column, a pressing plunger reciprocably mounted in said press cylinder and adapted to act upon a work piece, a fluid source for supplying pressure fluid to said press cylinder for actuating said pressing plunger, a balancing cylinder-piston-assembly substantially stationarily mounted diametrically opposite to said press cylinder, and conduit means continuously hydraulically interconnecting said pressing plunger and said balancing cylinder-piston-assembly for conveying the advancing pressure in said press cylinder to said balancing cylinder-piston-assembly for balancing the bending forces exerted by said pressing plunger upon said supporting column.

6. In a hydraulic press, a press bed, a press head, a plurality of strain rods interconnecting said press bed and press head and supporting the latter, a hydraulically operable pressing plunger supported by said press head and arranged on one side of said strain rods, and a substantially stationary balancing cylinder-piston-assembly mounted on the other side of said strain rods and continuously hydraulically connected with said pressing plunger for balancing the bending forces exerted by said pressing plunger upon said strain rods.

7. In a hydraulic press, a frame including a press bed, a press head and supporting means interconnecting said press bed and press head and supporting the latter, a hydraulically operable pressing ram for shaping a work piece, said pressing ram being reciprocable on one side of said supporting means, a balancing cylinder piston assembly mounted on the other side of said supporting means and comprising a stationary cylinder and a stationary balancing plunger telescoped in said balancing cylinder, guiding means supported by said cylinder piston assembly for guiding said pressing ram, and means hydraulically interconnecting said pressing ram and said balancing plunger during the entire pressing operation of said pressing plunger for substantially preventing bending of said supporting means.

PAUL C. POCOCK.
WALTER ERNST.