

May 30, 1967

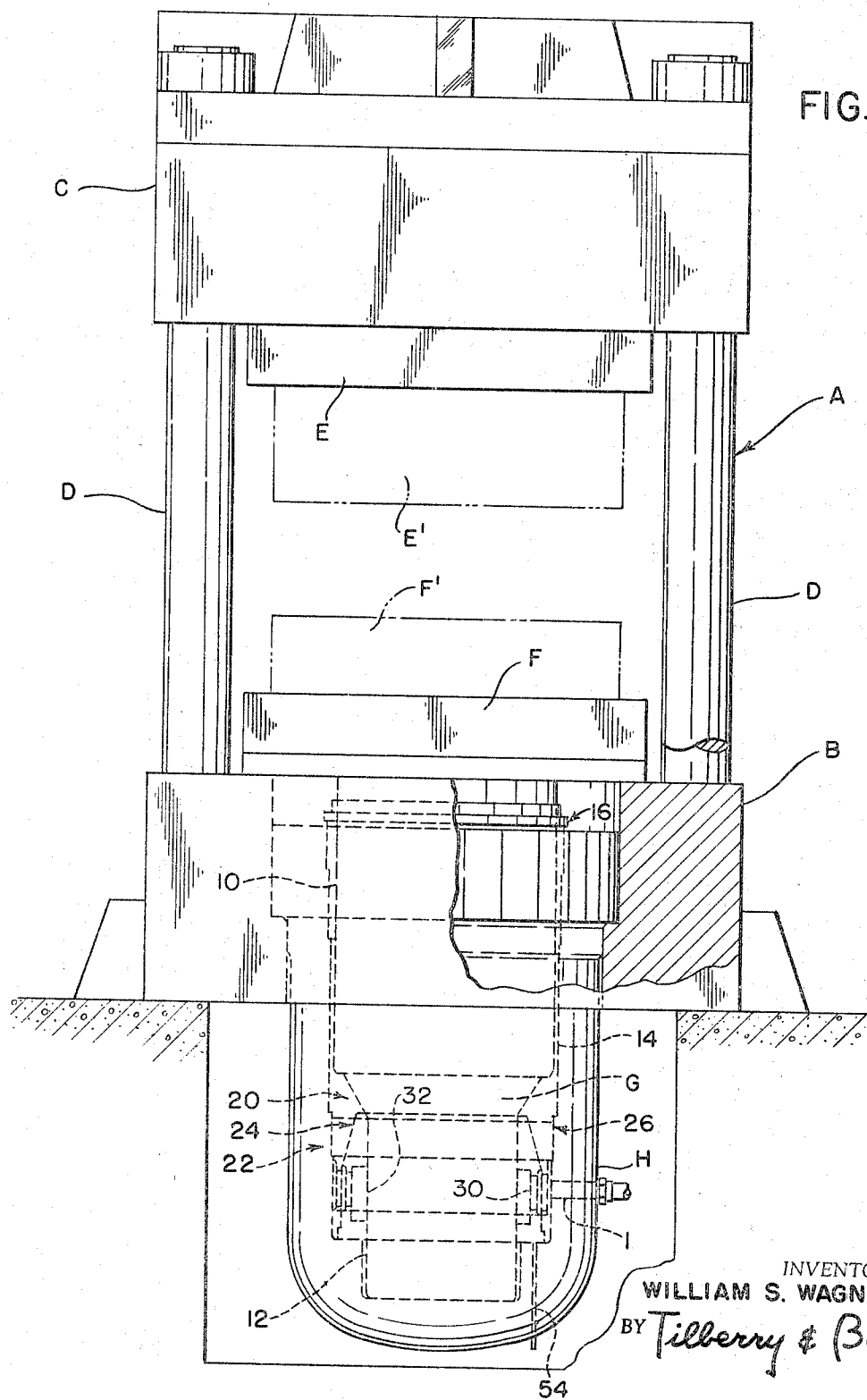
W. S. WAGNER

3,321,952

PRESS RAM GUIDING ARRANGEMENT

Filed Sept. 22, 1964

4 Sheets-Sheet 1



INVENTOR
WILLIAM S. WAGNER
BY *Tilberry & Body*
ATTORNEYS

May 30, 1967

W. S. WAGNER

3,321,952

PRESS RAM GUIDING ARRANGEMENT

Filed Sept. 22, 1964

4 Sheets-Sheet 3

FIG. 3

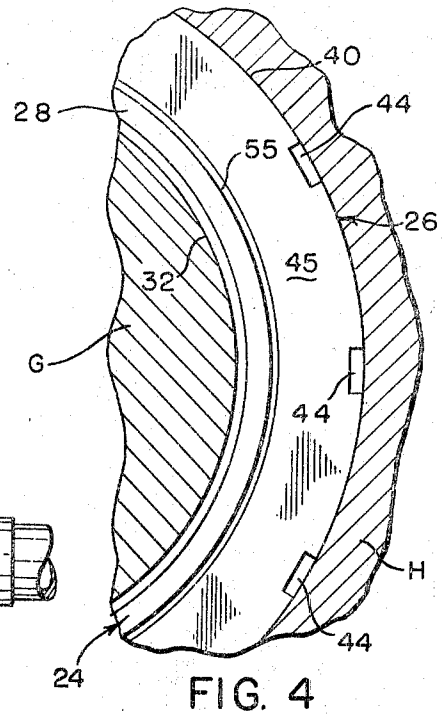
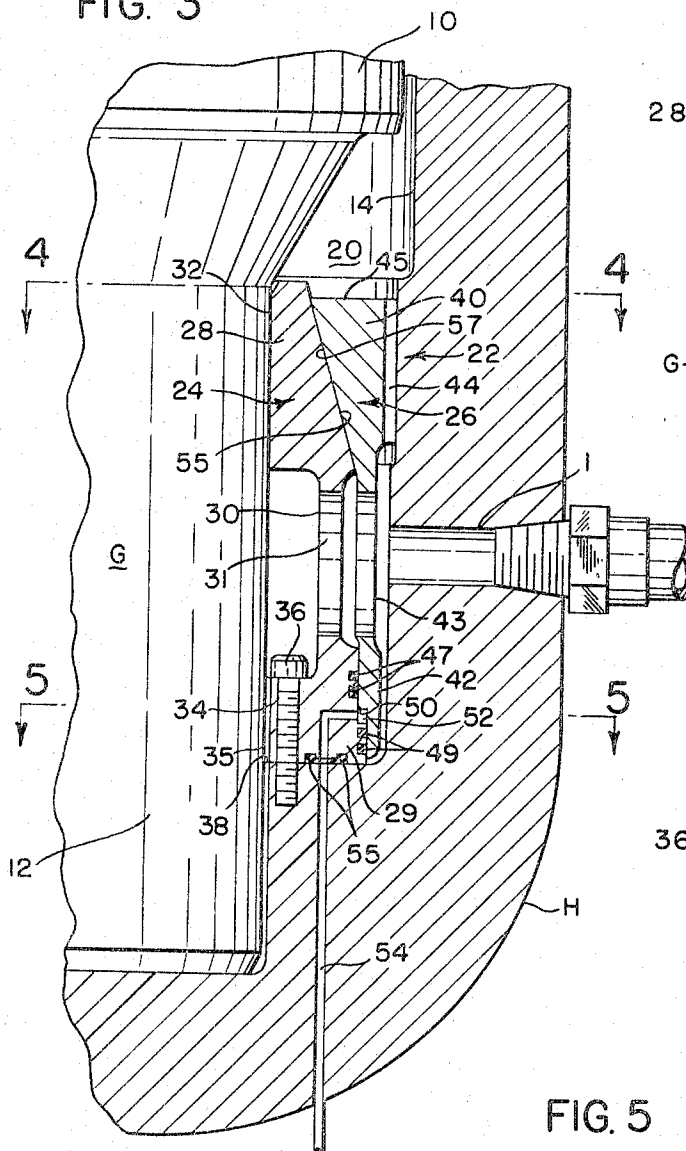
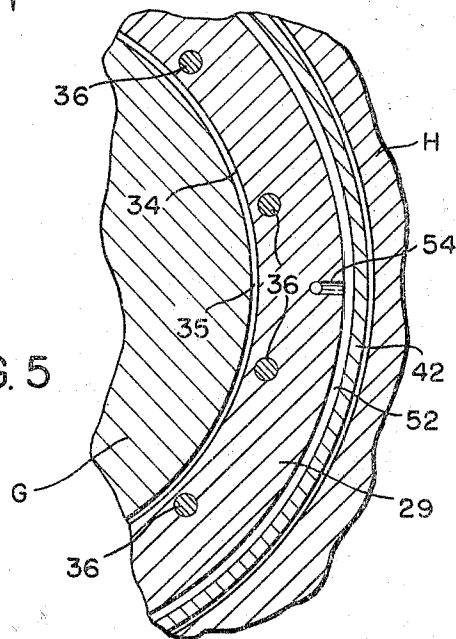


FIG. 5



INVENTOR
WILLIAM S. WAGNER
BY *Tilberry & Body*
ATTORNEYS

May 30, 1967

W. S. WAGNER

3,321,952

PRESS RAM GUIDING ARRANGEMENT

Filed Sept. 22, 1964

4 Sheets-Sheet 4

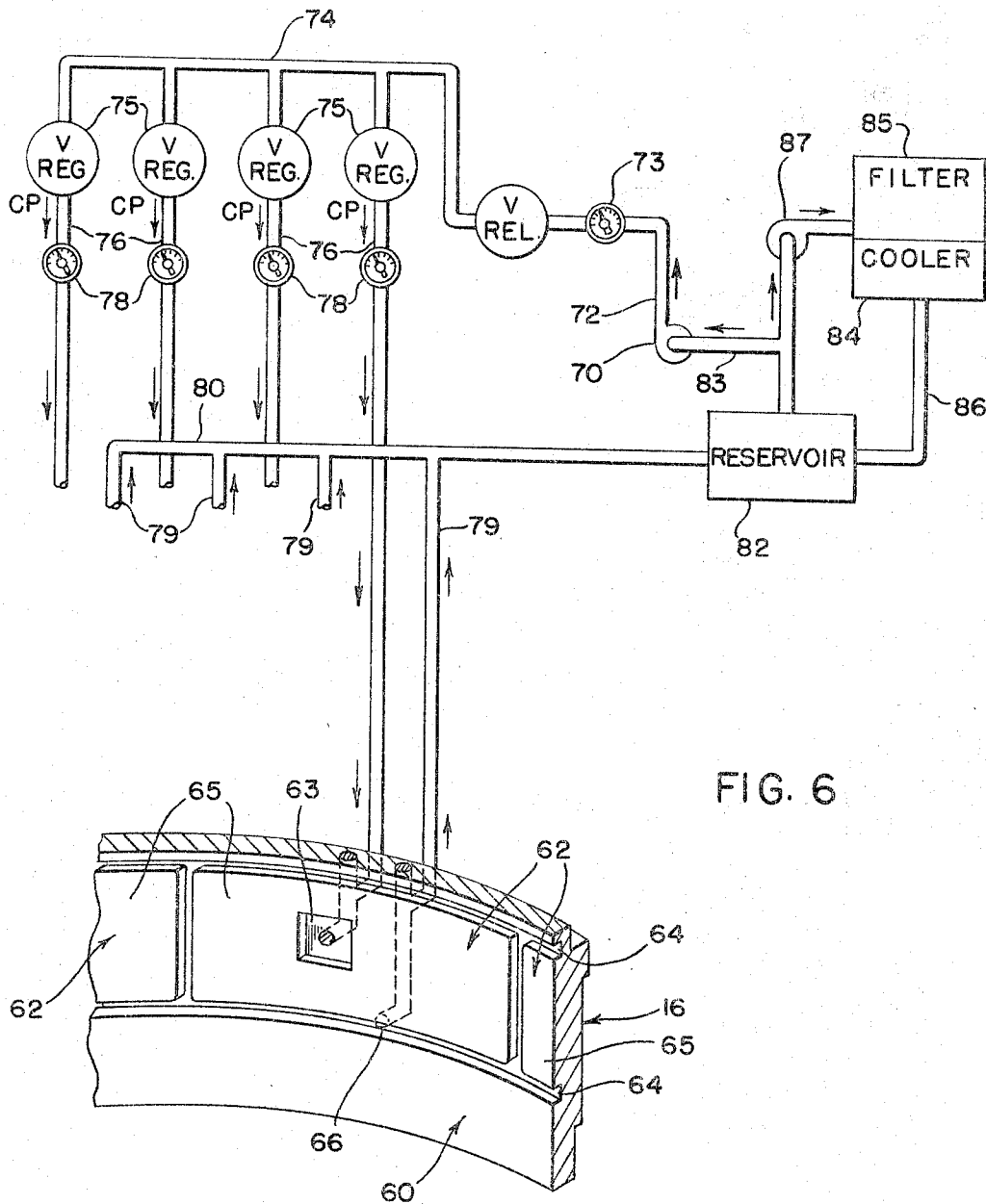


FIG. 6

INVENTOR
WILLIAM S. WAGNER
BY *Tillery & Body*
ATTORNEYS

3,321,952

PRESS RAM GUIDING ARRANGEMENT

William S. Wagner, Navarre, Ohio, assignor to E. W. Bliss Company, Canton, Ohio, a corporation of Delaware

Filed Sept. 22, 1964, Ser. No. 398,266

6 Claims. (Cl. 72-418)

This invention pertains to the art of hydraulic presses and more particularly to certain improvements therefor directed toward maintaining parallelism between a reciprocal press platen and crown.

The invention will be described with reference to an underdriven, hydraulically operated press comprising a bed and a crown restrained by means of four shouldered columns. A platen is reciprocally supported in the bed and acts upwardly against the crown. It should be understood, however, that while the invention will be so described, it has much broader applications and is equally useful wherever parallelism of a reciprocating platen or the like is a special problem.

With a conventional column guided platen there must be an allowance for column deflections to assure a free sliding fit in the bushings. Thus, no matter how close the fit, it is impractical to guarantee parallelism between the platen and crown in the order of a few thousandths of an inch as is often required in very accurate press operations.

Moreover, an off-center loading of a fraction of an inch will cause the platen to cock with respect to the column causing a binding and misalignment condition. This is especially evident with very heavy loads where an eccentricity of a fraction of an inch is enough to cause a deflecting moment on the platen of several hundred inch tons. For example, one tenth of an inch off center loading for a fully loaded three thousand ton press exerts a deflecting moment on the platen of about three hundred inch-tons.

An additional problem in maintaining platen parallelism in such presses is a tendency for the platen plunger to contract in its cylinder and the cylinder to expand when both are subjected to the extremely high hydraulic pressures of high capacity presses. This expansion and contraction, however slight, occurs to some extent even though the plunger and cylinder are solid members, thus allowing some side play at the tail end of the plunger. As a result, a tilting of the platen from the vertical center line of the press occurs.

The present invention contemplates certain improvements particularly applicable to hydraulic presses which overcome these and other problems and maintain platen parallelism to a degree heretofore unknown.

In accordance with the invention, a power press is provided which includes a pair of platens, one being reciprocal relative to the other, an axially extending cylindrical member solidly connected to the reciprocal platen, and means for guiding the reciprocal platen along the center line of the press between raised and lowered positions including a lower annular guide member spaced axially above the uppermost point of travel of the cylindrical member and an upper annular guide member spaced axially above the lower guide member, both members positioned in closely surrounding concentric relationship to the cylindrical member for maintaining the coaxial relationship of the platens.

Where the press is hydraulically actuated, it includes a cylinder connected to a source of fluid pressure within which the cylindrical member is reciprocally operated, the lower guide member being exposed to such pressure in the cylinder and in accordance with the invention including a pair of axially tapered ring members one of which is axially movable relative to the other in response to differential pressures acting thereon and being operable to

expand against the cylinder and cause the other ring member to contract toward the cylindrical member thus eliminating side play between the two.

As an alternative arrangement, the movable ring member may be axially split at intervals in its circumference in order to increase the expansion and contraction of the two ring members.

Also, in accordance with the invention, the upper guide member includes a plurality of equally spaced hydrostatic bearing pads and a fluid pressure system therefor separate from the press hydraulic system for supplying pressurized fluid to the pads individually at equal rates of flow.

The main object of the invention is to provide improvements in a power press which will maintain very precise parallelism of a reciprocal platen thus enabling the press to meet rigid specification of platen to crown alignment.

Another object is to hold a reciprocal press platen in rigid axial alignment while allowing it to be freely raised and lowered with a minimum of friction and drag.

Another object is to provide a power press as referred to above which will reduce platen binding due to eccentric loadings on the platen.

Another object is to provide an hydraulically operated power press capable of handling extremely heavy loads having a platen guiding arrangement which will compensate for contraction and expansion of the platen plunger and cylinder to reduce misalignment tendencies.

A further object is to provide a press as referred to above in which parallelism between the platen and crown is maintained within a few thousandths of an inch even when the platen is fully extended and fully loaded.

These and other objects and advantages will appear more clearly in the following description of the invention which proceeds with a description of the drawings illustrating a preferred embodiment of the invention wherein:

FIGURE 1 is a schematic view of an hydraulic press incorporating the invention;

FIGURE 2 is a partial, vertical, cross-sectional view showing the invention as used with the press illustrated in FIGURE 1;

FIGURE 3 is a fragmentary vertical sectional view of the lower guide member of the invention;

FIGURE 4 is a fragmentary horizontal sectional view of the lower guide member taken along line 4-4 of FIGURE 3;

FIGURE 5 is a fragmentary horizontal sectional view of the lower guide member taken along line 5-5 of FIGURE 3; and

FIGURE 6 is a partial perspective view of the upper guide member of the invention depicting the fluid pressure system for actuating the upper guide member in accordance with the invention.

Referring generally to the drawings wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only and not for the purpose of limiting same, FIGURE 1 shows a column press A in more or less schematic form. The press A includes a bed B and a crown C rigidly held in vertically spaced relationship by four columns D and is of the type having an upper fixed platen E and a lower reciprocal platen F which support die halves E' F' respectively.

A ram G received in a cylinder H mounted securely in the bed B supports the platen F for reciprocal movement.

Those familiar with presses of this type will recognize that the press A is operated by a self contained hydraulic power unit, not shown, which includes suitable controls, high and low pressure pumps, control valves, and pressure regulators for delivering and exhausting hydraulic pressure at a port I upon demand. The fluid pressure raises the platen F and die half F' against the platen E and die half E' for performing a stamping, coining,

embossing or whatever press operation is desired. Since the press details and its associated systems are standard, no further explanation is required of them for an understanding of the invention, however, it should be noted that with such presses, due to the extension and retraction of a platen, a stringent requirement as to the alignment of the upper and lower platens is required where precision work is to be obtained.

Referring now to FIGURE 2, the details of the ram G and cylinder H of press A are more readily apparent.

The ram G is solidly connected to the platen F at its upper end and includes an enlarged, hollow cylindrical portion 10 joined by a lower, reduced diameter, solid cylindrical portion 12. The cylinder H which receives the ram G has an upper cylindrical wall 14 closely surrounding the enlarged cylindrical portion 10 of the ram G and is provided with a bushing 16 in bearing engagement with the portion 10 of the ram. A chevron seal packing 18 below the bushing 16 seals the hydraulic fluid in a chamber 20 communicating with the pressure port I as will be explained. The lower portion of the cylindrical wall 14 defines an enlargement of the chamber 20 adjacent the reduced diameter portion 12 of the ram G. A lower ram guide arrangement generally indicated by the numeral 22 is located in this enlargement.

As best seen in FIGURES 3, 4, and 5, the lower ram guide arrangement 22 includes an inner tapered ring member 24 and an outer tapered ring member 26. The member 24 includes a toe portion 28 connected to a heel portion 29 by means of a webbing 30 having port holes 31 therein. The toe portion 28 has an annular surface 32 slightly larger in size than the reduced diameter portion 12 of the ram G and in accordance with the invention, may be contracted to a size approximately equal to it in a manner which will be described. The heel portion 29 has an annular surface 34 slightly spaced radially from the reduced diameter portion 12 to provide a fluid passageway 35. Bolts 36 hold the member 24 firmly against a radial shoulder 38 of the cylinder H.

The outer ring member 26 is unrestrained and is free to move axially relative to ring member 24. The member 26 includes a toe portion 40 connected to a heel portion 42 by an open webbing 43 in a manner similar to the ring 24. Grooves 44 cut in the outer periphery of toe portion 40 allow hydraulic fluid to fill chamber 20 thus exposing the flat annular surface 45 of ring member 26 to the press actuating pressure. Sealing ring pairs 47 and 49, on the heel portion 29 of ring member 24 sealably engage the heel portion 42 of ring member 26 and define therewith a small annular chamber 52 at atmospheric pressure which communicates with a fluid reserve tank, not shown, through drain passage 54 opening at the bottom of cylinder H. Sealing ring pair 55 seal the drain passage. Each of the rings 47, 49, 55 seal chamber 52 from the pressure in chamber 20. Thus, while the entire chamber 20 may be at press actuating pressure, the chamber 52 is only at atmospheric pressure with the result that an unbalanced hydraulic force is acting on ring member 26 which is proportional to the area of surface 50 of chamber 52. As provided by the invention, the toe portions 28, 40 of ring members 24, 26 have mutually engageable inclined surfaces 55, 57. When ring member 26 is displaced axially due to an unbalanced hydraulic force acting on it, surfaces 55, 57 slide relative to each other producing a wedging action. A radial force component acts on the toe portion 28 causing it to contract to nearly the diameter of ram G while toe portion 40 of member 26 expands against cylinder H.

The ram guiding arrangement 22 is positioned relative to the ram G such that upon raising the ram, the toe portions 28, 40 of ring members 24, 26 will be located axially above the uppermost position of the lower end of ram G when fully raised.

As an alternative arrangement, the toe portion 40 of the outer ring member 26 may be axially split in

tervals around its circumference to permit greater expansion of it and contraction of toe portion 28 with less driving force.

Referring now to FIGURES 2 and 6, the ram G is guided in the reciprocal movement at its upper end by bushing 16 having an annular surface 60 in bearing engagement with the outer surface of the portion 10 of the ram G. The surface 60 has four generally rectangularly shaped hydrostatic bearing pads 62 milled therein. The pads 62 are spaced at equal 90° intervals around the surface 60 and include a center inlet depression 63 and an outer boundary return oil groove 64 with a hydrostatic bearing area 65 extending therebetween.

While four pads 62 are used, it should be understood that this number is not critical to the invention and a greater or fewer number of pads may be used as desired. For example, three pads spaced equally at 120° could be used. The principle of operation of hydrostatic bearings is well known and it will be understood that oil under pressure is pumped in at the inlet 63 and flows radially outwardly between the pad areas 65 and the cylindrical surface of the ram G being collected in grooves 64 for return to the pressure system via outlet ports therein, one of which is indicated at 66. The special function of the pads 62 in guiding the ram G will be explained hereinafter.

Referring to FIGURE 6, a diagrammatic illustration of the hydrostatic pad pressure system is shown which includes a suitable variable volume, pressure compensated pump 70 having an outlet 72 with a pressure gauge 73 therein leading to a manifold 74 feeding four flow control valves 75, one for each hydrostatic pad 62. The flow control valves 75 may be individually regulated to increase or decrease the flow of oil to any one of several pads 62 as desired but in practice the flow is balanced. The outlets 76 of each flow control valve 75 contains a pressure gauge 78 for checking the pressure of each pad 62 prior to the oil being delivered to the inlet 63 of the respective hydrostatic pads. Obviously, if more than four pads were used, an equal number of flow control valves would be provided.

The returning oil is collected in grooves 64 and returned by hydraulic lines 79 to a manifold 80 from which the oil enters a reservoir 82 for return to the pump 70 by way of intake line 83. An oil cooler 84 and filter 85 are connected between the reservoir 82 and intake 83 through a bypass line 86 which includes a pump 87. From this, it may be seen that each pad 62 is independently supplied with oil and the pressure system for guiding the ram G is entirely separated from the hydraulic system of the press A.

As previously mentioned, parallelism between a movable platen and a fixed platen has been in the past controlled largely by the fit of the bushings at the upper and lower ends of the press ram. No matter how close this fit is controlled, it is impractical to guarantee a total parallelism deviation of only one or two thousandths of an inch as required in some applications today. Obviously, the heavier the loading, the more difficult it is to maintain alignment since a slight eccentricity of the load will cause serious deviations. In addition, at extremely high pressures the ram cylinder will expand to some extent and the ram will contract even though they are dense cast bodies. This side play permits a fishtailing of the ram. With the present invention, these difficulties are overcome.

In operation, when it is desired to raise the ram G, hydraulic pressure is supplied at port I causing the ram G to lift off the bottom of cylinder H with hydraulic fluid filling the chamber 20 flowing by way of passageways 44. With the chamber 52 at atmospheric pressure and chamber 20 at operating pressure, a differential pressure will act on ring member 26 having a net downward thrust proportional to the area of surface 50 of chamber 52. This pressure differential wedges the surfaces 55, 57 to

5

gether producing radial force components acting equally on the toe portions 28, 40 causing the one to contract and the other to expand by a predetermined amount so as to take up any play resulting from contraction and expansion of the ram G and cylinder H.

At the upper end of the cylinder H, the ram is guided by the four hydrostatic bearing pads 62 built into the ram bushing 16. The pressure is equal at each pad 62 when the ram G is centered. As a load is supplied, any tendency toward misalignment of the ram G will be reflected by a compensating increase or decrease in pressure on the pads 62 so that equal bearing pressure is maintained. The pad pressure varies inversely as the cube of the clearance between the ram and bushing space. Thus, assuming a 0.001 inch deviation from a normal clearance of 0.005 inch between ram G and bushing 16, the effect is a near doubling of pressure on the resulting 0.004 inch side and a compensating decrease by half on the opposite 0.006 inch side thus tending to maintain platen alignment.

With the invention, platen F is guided between its raised and lowered positions without any significant tilting or cocking and will hold its parallelism with the crown C to within a very high degree. For example, with a 72 inch diameter platen and a 23 inch ram stroke with a 3000 ton load at an eccentricity of 0.100 inch, the novel ram guiding system will hold parallelism of platen and crown to within about 0.0025 inch.

While the invention has been described with reference to a preferred embodiment of the invention, it should be understood that various modifications may be made by those skilled in the art without departing from the invention as defined by the appended claims.

Having thus described my invention, I claim:

1. In a power press including a pair of platens, one being reciprocal relative to the other and having an axially extending cylindrical portion, a sealed main chamber within the press reciprocally receiving said cylindrical portion adapted to be connected to a fluid pressure source, the improvement comprising

means for guiding the reciprocal platen along the center line of the press between raised and lowered positions including;

lower guide means concentrically surrounding the cylindrical portion positioned in the main chamber axially above the uppermost point of travel of the cylindrical portion, said lower guide means defining an interior annular chamber at reduced pressure and being operable in response to the pressure differential between said two chambers to move in radially opposite directions substantially filling the free space between the cylindrical portion and main chamber.

2. The improvement as set forth in claim 1 wherein said lower guide means includes a pair of axially tapered ring members, one being slidable relative to the other and responsive to said pressure differential for wedging both ring members in opposite radial directions.

3. The improvement as set forth in claim 2 wherein said ring members each include a heel portion and a toe portion in mutual engagement, sealing means carried by one heel portion sealably engaging the other and defining said interior chamber, the toe portion of said one

6

ring being engageable along a conical surface with the toe portion of the other ring and upon sliding relative to the other ring, said one ring is expanded while the other is contracted thus radially filling the clearance space existing between said cylindrical portion and main chamber.

4. The improvement as set forth in claim 3 wherein said one ring member is axially split at one place in its circumference to permit greater expansion and contraction of said ring members.

5. The improvement as set forth in claim 1 wherein said means includes an upper guide means concentrically surrounding the cylindrical portion axially above said main chamber and including;

a plurality of circumferentially spaced hydrostatic bearing pads having fluid pressure inlet and outlets, and

a pressure control system separate from said fluid pressure source for delivering and exhausting fluid under pressure to said pads at equal rates of flow so that any misalignment of the reciprocal platen will be resisted by compensating increases and decreases in the radially opposing hydrostatic pads.

6. In a power press including a pair of platens, one being reciprocal relative to the other, a cylindrical ram rigidly connected to the reciprocal platen, a sealed main chamber within the press reciprocally receiving said ram and adapted to be connected to a fluid pressure source, the improvement comprising;

a pair of axially tapered ring members concentrically surrounding said ram positioned in the main chamber axially above the uppermost point of travel of the lower end of the ram and defining an interior annular chamber at reduced pressure, one of said ring members being slidable relative to the other and having an axially facing surface thereon exposed to the pressure in said main chamber and a second axially facing surface exposed to the pressure in said interior chamber, the differential pressure acting on said surfaces causing said one ring to slide relative to the other for wedging the two ring members in opposite radial directions so as to fill the clearance space between said ram and main chamber,

a plurality of circumferentially spaced hydrostatic bearing pads carried by the press above said main chamber in closely spaced surrounding relationship to said ram having fluid pressure in inlet and outlet openings, and

a pressure control system separate from said fluid pressure source for delivering and exhausting fluid pressure to said pads at equal rates of flow so that any misalignment of the reciprocal platen will be resisted at the top by compensating increases and decreases in pressure in the radially opposed hydrostatic pads and at the bottom by the wedging action of said ring members.

No references cited.

WILLIAM W. DYER, JR., *Primary Examiner.*

G. A. DOST, *Assistant Examiner.*