

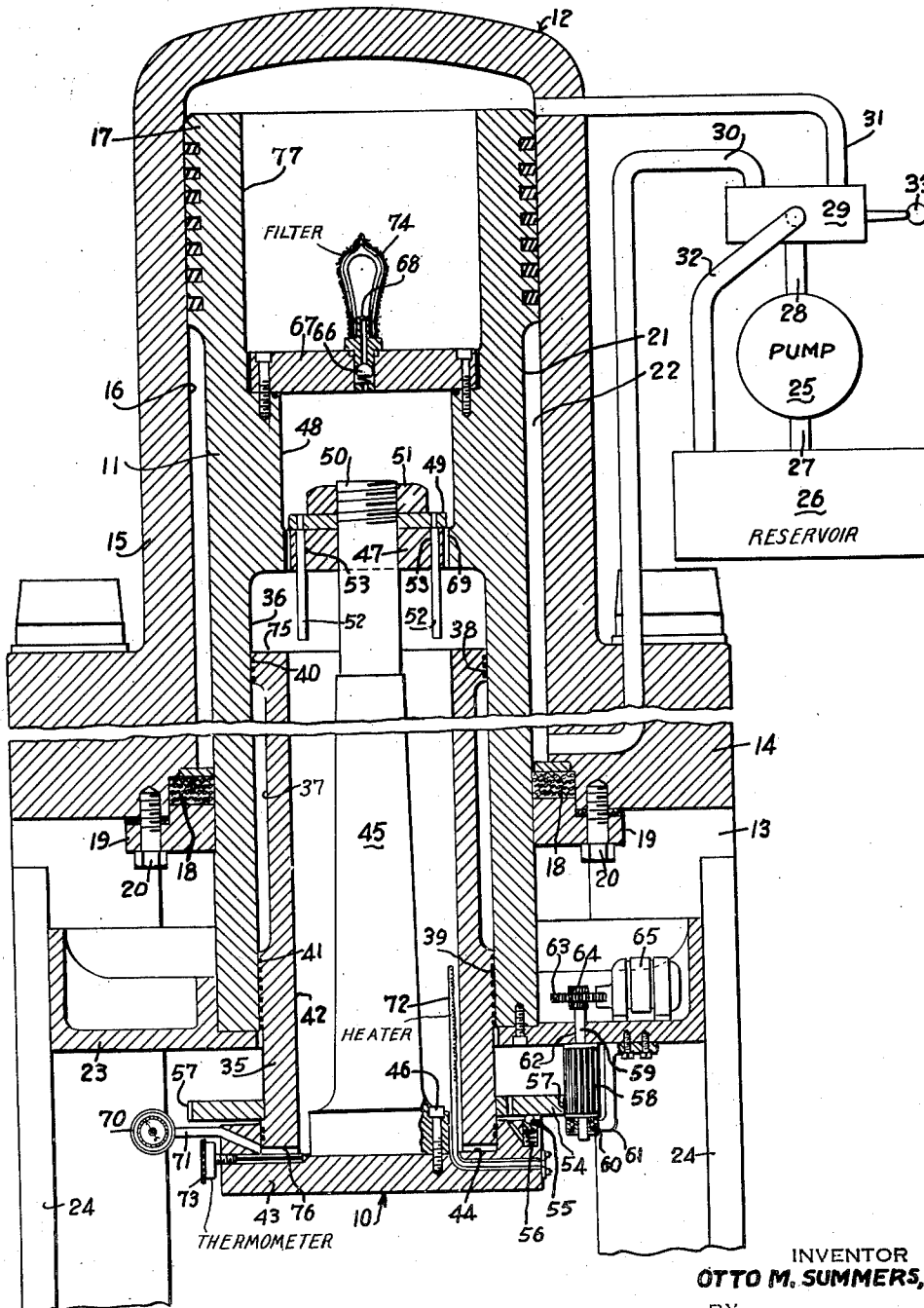
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PRECISION PRESSURE MEASURING PRESS

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PRECISION PRESSURE MEASURING PRESS

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This invention relates to a mechanism for producing pressure that includes an apparatus for indicating the pressure developed by the mechanism.

It is an object of this invention to provide a pressure indicating mechanism in association with a pressing ram of a hydraulic press in such a manner that the pressure developed by the ram upon an article of work will be directly indicated by the pressure indicating mechanism.

Another object of the invention is to provide a pressure ram of a hydraulic motor with a mechanism carried thereby and forming a part of the apparatus for transmitting the pressure of the ram to the work for indicating a pressure developed by the ram upon the work.

Another object of the invention is to provide a pressure indicating mechanism that is supported and carried by a ram of a hydraulic press in such a manner that the pressure indicating mechanism floats freely within the ram and yet transmits the pressure of the ram to the work so that the pressure indicating mechanism will directly indicate the pressure developed by the ram upon the work.

It is another object of the invention to provide a pressure indicating mechanism carried by the ram of a hydraulic motor that consists essentially of a piston member that operates within the ram for developing an internal liquid pressure within the ram whereby to indicate the pressure of the ram upon work that is being done, the piston member of the pressure indicating mechanism providing means for transmitting the power from the ram to the work.

Still another object of the invention is to provide a hydraulic pressure indicating mechanism that is carried by a ram for indicating the pressure developed by the ram and for transmitting the pressure therefrom.

Further objects and advantages will become apparent from the drawing and the following description.

In this invention the pressure indicating mechanism 10 is carried within the ram 11 of a hydraulic motor 12. The hydraulic motor 12 is a part of a forming press that includes the frame 13 having a head 14 that supports the cylinder 15 of the hydraulic motor 12.

The cylinder 15 is provided with an internal bore 16 within which the piston head 17 on the upper end of the ram 11 reciprocates. The lower end of the cylinder bore 16 is closed by means of a packing gland 18 that is retained in position by means of a gland ring 19 secured to the head 14 by means of the bolts 20. As is conventional

practice, the ram 11 has an undercut portion 21 that separates the ram from the internal bore 16 to provide a push back area 22.

The lower end of the ram 11 is provided with a platen 23 that is guided in vertical reciprocation within the press frame 13 by means of the guide members 24 disposed at each corner of the platen 23. A conventional hydraulic circuit may be provided for supplying fluid under pressure to the hydraulic motor 12, and may consist of a pump 25 of any conventional type such as the variable delivery constant pressure type of pump. It is, of course, understood that the pump 25 is driven by a suitable electric motor. The pump 25 receives fluid from the reservoir 26 through a suction line 27 and discharges fluid under pressure into the discharge line 28 that is connected to a four-way valve 29 of conventional design. The four-way valve 29 is provided with pressure supply conduits 30 and 31 that are connected to opposite ends of the hydraulic motor 12 whereby the fluid under pressure supplied to the four-way valve 29 may be alternately supplied to the space above the piston head 17 and into the retraction space 22, whereby to reciprocate the piston 17 and the ram 11 for moving the platen 23 upwardly and downwardly. A return line 32 is provided for returning the fluid from the motor 12 to the reservoir 26 when fluid under pressure is being supplied to one or the other faces of the piston head 17. A suitable handle 33 is provided for actuating the four-way valve 29 in conventional manner.

The pressure indicating mechanism 10 consists of a piston 35 that reciprocates within an axial bore 36 provided in the lower portion of the ram 11. This bore 36 extends through the lower end of the ram 11 so that the piston 35 may extend therefrom. The piston 35 is provided with an undercut portion 37 in the central portion thereof whereby engaging areas 38 and 39 are provided on the surface of the piston 35 that slide upon the wall of the internal bore 36. These engaging areas 38 and 39 are provided with a plurality of annular balancing grooves 40 and 41 to maintain an evenly balanced oil film over the surface of the engaging areas whereby to continuously maintain the oil film between the areas 38 and 39 and the wall of the bore 36 and also to reduce the surface area of the engaging areas that contacts the surface of the internal bore 36 whereby to reduce frictional engagement therebetween. These annular balancing grooves or recesses 40 or 41 thus are filled with oil to maintain the piston centralized within the cylinder bore 36 and out of actual engagement therewith except

through the oil film which also provides lubrication between the surfaces.

The piston 35 has an internal bore 42 that is closed by means of a closure plate member 43 that has a recess 44 therein to receive the lower end of the piston 35, the side wall of the recess 44 being in sliding engagement with the wall of the piston 35.

The closure plate 43 is secured to a stem 45 by means of screws or bolts 46, the stem 45 extending upwardly through the center of the piston bore 42 and through a partition wall 47 that is provided between the internal bore 36 and the internal bore 48 within the ram 11 disposed above the internal bore 36.

A plate member 49 is threaded upon the upper threaded end 50 of the stem 45 and a nut 51 is also threaded thereupon to lock the plate member 49 in position on the stem 45. The plate 49 is provided with a plurality of depending pins 52 that extend through holes 53 provided in the partition wall 47 and are in sliding engagement therewith to permit axial movement of the stem 45 within the internal bore 36 but which prevent rotation of the stem 45 relative to the ram 11.

The closure plate 43 is thus suspended from the partition wall 47 of the ram 11. The piston 35 carries a plate 54 adjacent the lower end thereof that is adapted to be supported upon a plurality of ball bearing members 55 that are positioned within the closure plate 43. Spring members 56 urge the ball bearing members 54 upwardly so as to support the plate 54 in opposed relationship with respect to the closure plate 43. It will thus be seen that since the plate 54 is secured to the piston 35, that the piston 35 will be supported upon the anti-friction bearings 55 and that these bearings are required to carry only the weight of the piston 35 and the plate 54. The outer edge of the plate 54 is provided with gear teeth 57 that are engaged by a pinion 58 carried upon the shaft 59 that is carried in the ball bearing 60 carried in the arm 61 and in the shaft bearing hole 62 that is provided in the platen 23. The shaft 59 carries a worm wheel that may be driven by a worm 64 supported upon the shaft of an electric motor 65 thereby constituting a gear reduction unit for rotating the pinion 58 which in turn rotates the plate 54 for rotating the piston 35 within the cylinder bore 36 of the ram 11 and the recess 44 in the plate 43.

The recess 48 in the ram 11 communicates with the recess 77 in the ram 11 above the recess 48 through means of a check valve 66 that is positioned within the partition wall 67 separating the recesses 48 and 77. The check valve 66 is downwardly acting so that fluid from above the partition wall 67 may pass downwardly through the passage 68 and the check valve 66 into the recess 48. The partition wall 47 is provided with a plurality of passages 69 that permit free communication between the recess 48 and the cylinder bore 36 so that liquid, which in this case is oil being delivered from the hydraulic system, may be supplied into the cylinder bore 36 for completely filling the cylinder bore and the recess 48 when the piston is in position as illustrated in the drawing.

From the foregoing description it will be apparent that the piston bore 42, the cylinder bore 36 and the recess 48 will be completely filled with liquid from the hydraulic system with which the apparatus is associated. A pressure gauge 70 communicates with the liquid within the aforementioned spaces for indicating the pressure

therein by means of a conduit 71 that extends through the closure plate 43 adjacent the lower edge of the piston 35. If desired, the liquid, or oil, within the aforementioned space may be maintained at a substantially constant temperature to retain a constant viscosity by means of an electric heating element 72 that is positioned within the piston bore 42. A dial thermometer 73 may be provided for indicating the temperature of the liquid within the piston bore 42.

A suitable screen or dirt filter 74 may be provided over the opening 68 through which fluid is admitted into the indicating mechanism 10.

From the foregoing description it will be apparent that when the ram 11 and the platen 23 are moved upwardly and downwardly by suitable operation of the hydraulic system associated therewith, that the pressure indicating mechanism, including the piston 35 and the closure member 43, will be moved upwardly and downwardly therewith and in constant relationship thereto. Since the chamber bores 42, 36 and 48 are filled with oil, and the check valve 66 closes as soon as any pressure is developed within the chamber 48, it will be seen that when the closure member 43 engages resistance that the pressure developed by the ram 11, when fluid under pressure is supplied to the top side of the piston 17, will be transmitted from the ram 11 to the piston 35 by means of the body of liquid that is contained within the chamber bores 42, 36, and 48 and thereby transmitted to the closure member 43 that engages the work. However, it will be noted that the area on the top of the piston 75 is equal to the area 76 on the bottom of the piston 35 so that any pressure developed within the chamber spaces 42 and 36 will be transmitted equally to these surface areas and will therefore be balanced so that there will be no tendency of movement of the piston 35 axially within the cylinder bore 36 due to any pressure developed within the chamber bores 42 and 36. Therefore, since there is no axial pressure developed upon the piston 35, there will be no pressure developed upon the friction free bearing members 55 so that irrespective of the pressure developed within the chamber bores 42 and 36, the only pressure applied upon the frictionless bearing will be that occasioned by the weight of the piston 35 and the plate 54. The piston 35 may therefore be rotated freely within the cylinder bore 36 by means of the pinion 58 with very little power, and this rotation reduces, or substantially eliminates any friction between the piston 35 and the cylinder 36 that would tend to prevent axial movement of the piston 35 within the cylinder 36 when the closure plate 43 meets resistance and pressure is built up within the chamber bores 36, 42 and 48.

In operation, it will be assumed that the apparatus is in the position as illustrated in the figure of the drawing so that it is now ready for an advancing stroke to be produced by the ram 11. Fluid pressure will thus be supplied through the conduit 31 to the top side of the piston 17 thereby causing the ram 11 to move downwardly. At this time, the electric motor 65 will be operating in order to slowly rotate the piston 35 within the cylinder 36. The ram 11 and the platen 23 together with the pressure indicating mechanism 10 will move downwardly until the closure plate 43, or a device carried thereby meets resistance, such as when the same meets work. Pressure will then be developed on the top side of the piston 17 by means of the pump 25 urging

the ram downwardly to complete the work, the pressure of the ram being transmitted through the body of liquid that is within the chambers 42, 36 and 48 to the closure plate 43 and thus performing work. However, in so transmitting the pressure, the piston 35 tends to move upwardly axially within the cylinder bore 36 which thereby develops hydraulic pressure of the liquid within the chamber bores 42, 36 and 48 since the check valve 66 will now be closed and the liquid will be entrapped therein. The pressure of the liquid within the chamber bores 32, 46 and 48 will thus be transmitted to the pressure indicating gage 70 whereby the operator of the mechanism can determine exactly the pressure that is being applied by the closure member 43 upon the work since the pressure generated within the chambers is that which is being directly transmitted to the work from the ram 11.

Since the piston 35 is continuously rotating at a slow rate of speed, the precision of operation of the instrument is greatly increased because the tendency of the piston 35 to resist axial movement in very slight increments has been removed by constantly moving the surface of the piston 35 relative to the surface 36.

If for any reason, oil should seep past the surfaces 38 and 39 of the piston 35 and permit the piston 35 to move upwardly in a substantial amount during a pressing stroke of the hydraulic motor 12, when the ram 11 is reversed by the application of fluid under pressure into the retraction side 22 of the hydraulic motor 12, the check valve 66 will open and permit the piston 35 to return to its position illustrated in the drawing and thereby replenish any oil that may have been lost from within the pressure indicating mechanism.

While the apparatus disclosed and described herein constitutes the preferred form of the invention, yet it is to be understood that the device is capable of mechanical alteration, and that all such modifications as fall within the scope of the appended claims are intended to be included herein.

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

1. In an apparatus for producing and indicating pressure the combination of, a hydraulic motor having a hollow double-acting reciprocable ram adapted to be operably connected to a source of hydraulic fluid under pressure for causing reciprocation thereof, the hollow in said ram forming a cylinder, a piston member slidable in said cylinder and having opposed surface areas thereon, work engaging means carried by said ram and forming a seal for the outer end of said piston member and cooperating with one of said areas for establishing hydraulic equilibrium axially upon said member upon application of fluid pressure to said areas from said cylinder to prevent axial movement of said member relatively to said ram as a result of pressure produced within said cylinder, and means hydraulically connecting said cylinder with one side of said ram for maintaining said cylinder filled with liquid and including means for entrapping liquid therein whereby pressure is produced in said cylinder chamber when pressure is applied to said work engaging means tending to move the same axially relative to said cylinder, and means connected with said cylinder to determine pressure developed therein.

2. A pressing mechanism including in combina-

tion, a hydraulic motor having a hollow ram for producing pressure, the hollow in said ram forming a cylinder in said ram open at one end thereof and having wall means for closing the opposite end thereof, a hydraulically balanced hollow member slidably disposed within said cylinder and extending from one end thereof, work engaging means carried by said ram and forming a seal for the outer end of said member and cooperating with said outer end of said member for establishing hydraulic equilibrium axially upon said member upon application of fluid pressure to opposite ends of said member from said cylinder to prevent axial movement of said member relatively to said ram as a result of pressure produced within said cylinder, and a liquid entrapped within said cylinder hydraulically balancing said member against axial movement of said member within said cylinder as the result of hydraulic pressure created therein and for transmitting force from said ram to said work engaging means, and means for indicating the pressure generated in said cylinder to determine the pressure there-in applied upon the work.

3. In an apparatus for producing and indicating pressure the combination of, a hydraulic motor having a double acting reciprocable ram adapted to be operably connected to a source of hydraulic fluid under pressure for causing reciprocation thereof, a cylinder chamber in said ram closed at one end thereof, a piston slidable in said cylinder chamber having surface areas thereon to establish hydraulic equilibrium axially upon said piston upon application of fluid pressure thereto from said cylinder chamber to prevent axial movement of said piston relatively to said ram, said piston extending from said cylinder chamber to engage work and apply pressure thereon, and means hydraulically connecting said cylinder chamber with one side of said ram for filling said cylinder chamber and including means for entrapping liquid therein whereby pressure is produced in said cylinder chamber when said piston tends to move axially into said cylinder chamber, and means for rotating said piston during the advancing power stroke of said ram.

4. A pressing mechanism which consists of the combination of, a hydraulic motor having a hollow ram for applying pressure, the hollow of said ram forming a cylinder chamber in said ram having one end thereof extending through the end of the ram that extends from said motor, a member having a passage therethrough to hydraulically interconnect opposite ends thereof slidably positioned within said cylinder chamber and extending beyond the end of said ram, work engaging means carried by said ram and forming a seal for the outer end of said member and cooperating with said outer end of said member for establishing hydraulic equilibrium axially upon said member upon application of fluid pressure to opposite ends of said member from said cylinder to prevent axial movement of said member relatively to said ram as a result of pressure produced within said cylinder, means carried by said ram and engaging said member for rotating said member relative to said ram during operation of said ram, said cylinder chamber being adapted to be filled with a liquid to hydraulically balance said member against axial movement in said cylinder and for transmitting power from said ram to said work engaging means.

5. The combination of a power producing apparatus and a pressure indicating mechanism associated therewith that includes, a hydraulic mo-

tor having a hollow ram extending therefrom and adapted to be reciprocated in the cylinder of the hydraulic motor, the hollow of said ram forming a cylinder chamber within said ram, a member slidably positioned within said cylinder chamber hydraulically balanced against axial movement therein, means supporting said member including means extending through said member for engaging said ram to thereby support said member upon said ram for reciprocation concomitantly therewith, anti-friction bearing means positioned between said support and said member to carry the weight thereof, means carried by said ram for reciprocation therewith for rotating said member, said cylinder chamber being adapted to contain and entrap a liquid therein for transmitting power applied by said ram and adapted to be compressed within said cylinder chamber when power is transmitted therethrough for generating pressure therein to indicate the pressure being applied therethrough by said ram.

6. The combination of a power producing apparatus and a pressure indicating mechanism associated therewith that includes, a hydraulic motor having a hollow ram extending therefrom and adapted to be reciprocated in the cylinder of the hydraulic motor, the hollow of said ram forming a cylinder chamber within said ram, a member slidably positioned within said cylinder chamber hydraulically balanced against axial movement therein, means supporting said member including means extending through said member for engaging said ram to thereby support said member upon said ram for reciprocation concomitantly therewith, anti-friction bearing means positioned between said support and said member to carry the weight thereof, means carried by said ram for reciprocation therewith for rotating said member, said cylinder chamber being adapted to contain and entrap a liquid therein for transmitting power applied by said ram and adapted to be compressed within said cylinder chamber when power is transmitted therethrough for generating pressure therein to indicate the pressure being applied therethrough by said ram, and to entrap fluid in said cylinder chamber upon generation of pressure therein.

7. The combination of a power producing apparatus and a pressure indicating mechanism associated therewith that includes, a hydraulic motor having a hollow ram extending therefrom and adapted to be reciprocated in the cylinder of the hydraulic motor, the hollow in said ram forming a cylinder chamber within said ram, a member slidably positioned within said cylinder chamber, means for rotating said member, said member having opposed end faces of equal area, a supporting means for said member forming therewith a chamber to which one end of said member is exposed, the opposite end of said member being exposed to said cylinder chamber, fluid passage means interconnecting said last mentioned chamber and said cylinder chamber whereby to apply equal pressure upon both ends of said member as generated by liquid contained within said cylinder chamber as a result of movement of said member and the support means for the same into said cylinder chamber to thereby balance the forces on opposite ends of said member when power is transmitted from said ram through the liquid within said cylinder chamber.

8. The combination of a power producing apparatus and a pressure indicating mechanism that includes a hydraulic motor having a hollow ram extending therefrom, the hollow in said ram form-

ing a cylinder chamber in said ram, a member slidably disposed in said cylinder chamber and having opposite end faces of equal area, passage means through said member, support means carried by said ram and extending through said passage means having a support member on the end thereof to cooperate with said member whereby to support the same and forming a chamber adjacent one end of said member, said chamber being in communication with said cylinder chamber through said passage means whereby the pressure in said cylinder chamber is transmitted equally to both ends of said member to balance the forces thereon and prevent axial movement of said member in said cylinder chamber due to hydraulic pressure developed therein, anti-friction bearing means disposed between said support member and said member for carrying the weight thereof, means for rotating said member relatively to said cylinder chamber, said cylinder chamber adapted to contain a liquid to be compressed by any tendency of axial movement between said member and the support member for the same relatively to said ram to transmit and indicate power applied by said ram.

9. The combination of a power producing apparatus and a pressure indicated mechanism that includes a hydraulic motor having a hollow ram extending therefrom, the hollow in said ram forming a cylinder chamber in said ram, a member slidably disposed in said cylinder chamber and having opposite end faces of equal area, passage means through said member, support means carried by said ram and extending through said passage means having a support member on the end thereof to cooperate with said member whereby to support the same and forming a chamber adjacent one end of said member, said chamber being in communication with said cylinder chamber through said passage means whereby the pressure in said cylinder chamber is transmitted equally to both ends of said member to balance the forces thereon and prevent axial movement of said member in said cylinder chamber due to hydraulic pressure developed therein, anti-friction bearing means disposed between said support member and said member for carrying the weight thereof, means for rotating said member relatively to said cylinder chamber, said cylinder chamber adapted to contain a liquid to be compressed by any tendency of axial movement between said member and the support member for the same relative to said ram to transmit and indicate power applied by said ram, and valve means associated with said cylinder chamber for supplying liquid thereto from one side of said hydraulic motor to replenish liquid therein.

10. In a hydraulic pressing apparatus, the combination that includes, a hydraulic cylinder having a double-acting reciprocating ram therein extending therefrom and adapted to be connected to a source of hydraulic fluid under pressure for reciprocating said ram in said cylinder, a cylinder chamber in said ram, a support member carried by said ram attached to the same for reciprocation therewith and movable axially thereof, a piston slidable in said cylinder chamber hydraulically balanced axially to prevent relative axial movement thereof with respect to said ram as influenced by the application of pressure upon said piston and freely supported by said support member, means for rotating said piston, said cylinder chamber being adapted to receive liquid and including means for entrapping the liquid therein

for compression through means of said piston upon movement of said ram.

11. A hydraulic press that includes, a hydraulic cylinder having a double-acting ram therein and adapted to be connected to a source of hydraulic fluid under pressure for reciprocating said ram, and a pressure-indicating mechanism carried by said ram for reciprocation therewith and through which pressure of said ram is applied upon work for indicating the force applied by said ram which includes a cylinder chamber in said ram open at one end thereof, a support member carried by said ram for engaging work and movable axially of said ram, a piston slidable in said cylinder chamber having surface areas thereon for establishing axial hydraulic equilibrium of said piston and including means supporting said piston on said support member, means for rotating said piston, and means hydraulically connecting said cylinder chamber with one side of said ram for supplying fluid to said chamber and entrapping fluid therein whereby pressure is generated in said cylinder chamber upon relative axial movement between said piston and said ram.

12. In a hydraulic press, the combination of a hydraulic cylinder having a double-acting ram therein and adapted to be connected to a source

of hydraulic fluid for reciprocating said ram, and a piston-cylinder assembly carried by said ram for reciprocation therewith having hydraulic fluid entrapped therein and operable independently of said ram to generate pressure in the entrapped fluid therein separately from the hydraulic pressure fluid applied to said ram to reciprocate the same and to apply the force developed by said ram upon work.

13. In a hydraulic press, combination, a hydraulic cylinder having a double-acting ram therein and adapted to be connected to a source of hydraulic fluid for reciprocating said ram, and a piston-cylinder assembly carried by said ram for reciprocation therewith having hydraulic fluid entrapped therein and operable independently of said ram to generate pressure in the entrapped fluid therein separately from the hydraulic pressure fluid applied to said ram to reciprocate the same and to apply the force developed by said ram upon work, the piston of said piston-cylinder assembly having surface areas thereon to hydraulically balance said piston axially whereby movement of the piston by the pressure generated in the piston-cylinder assembly is prevented, and means for rotating the piston in the cylinder.

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