

July 15, 1952

E. M. DREIS
LEVELING MECHANISM FOR HYDRAULICALLY
ACTUATED PRESS BRAKES

2,603,145

Filed April 25, 1950

4 Sheets-Sheet 1

Fig. 1.

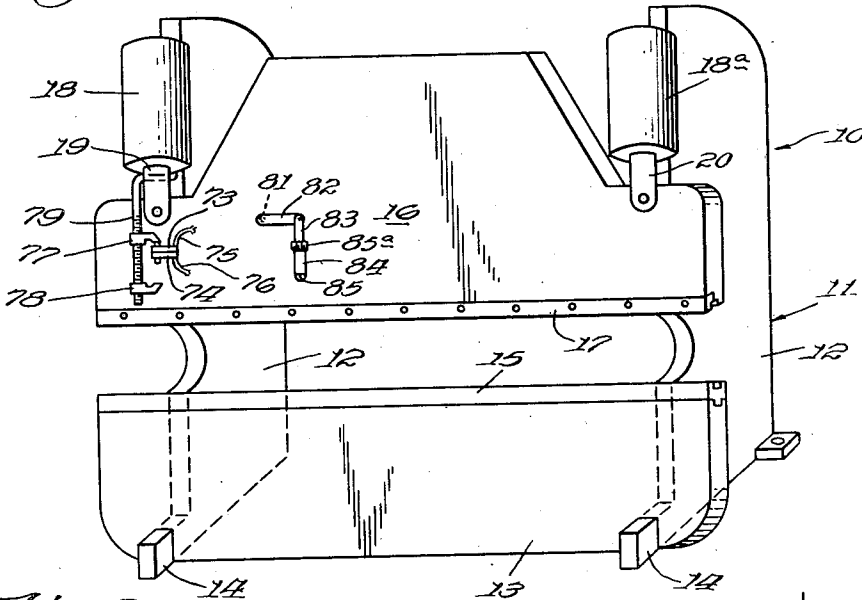
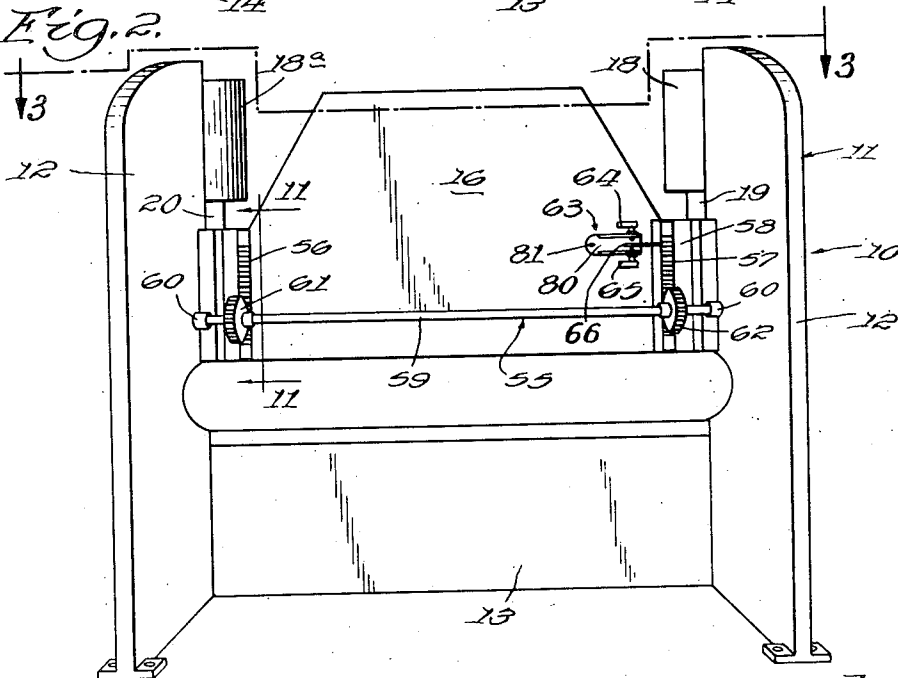


Fig. 2.



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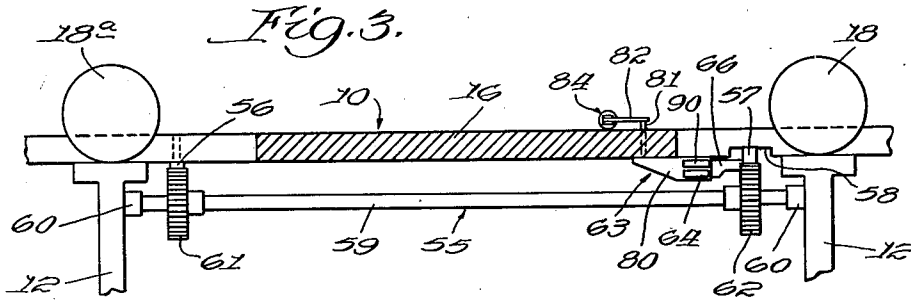
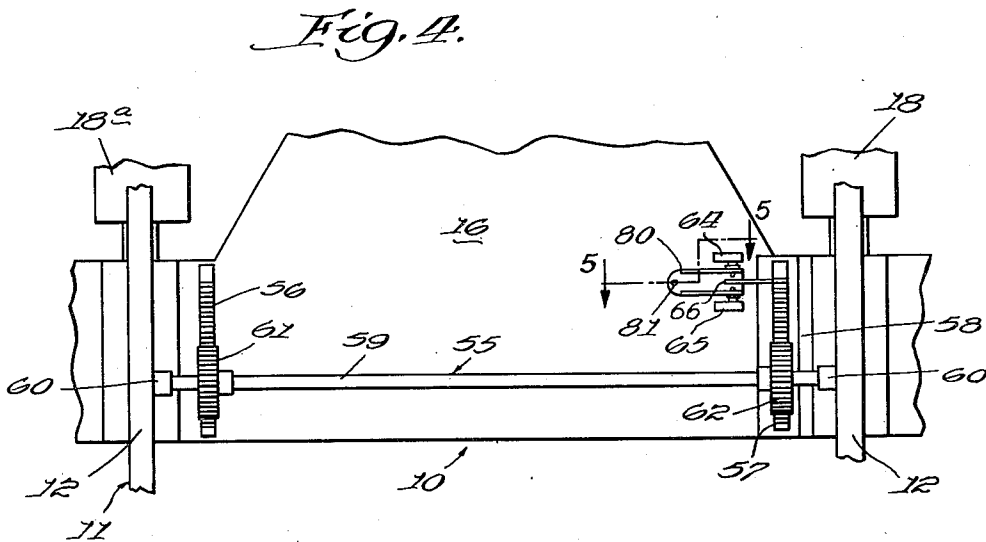
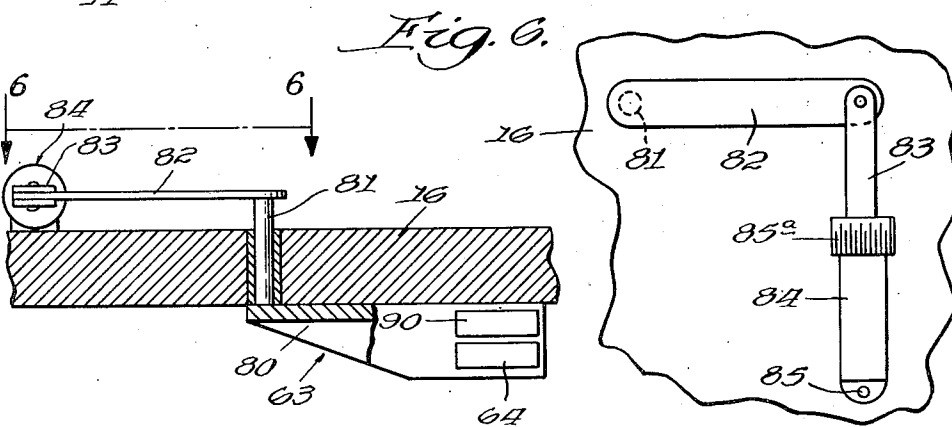
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4 Sheets-Sheet 2



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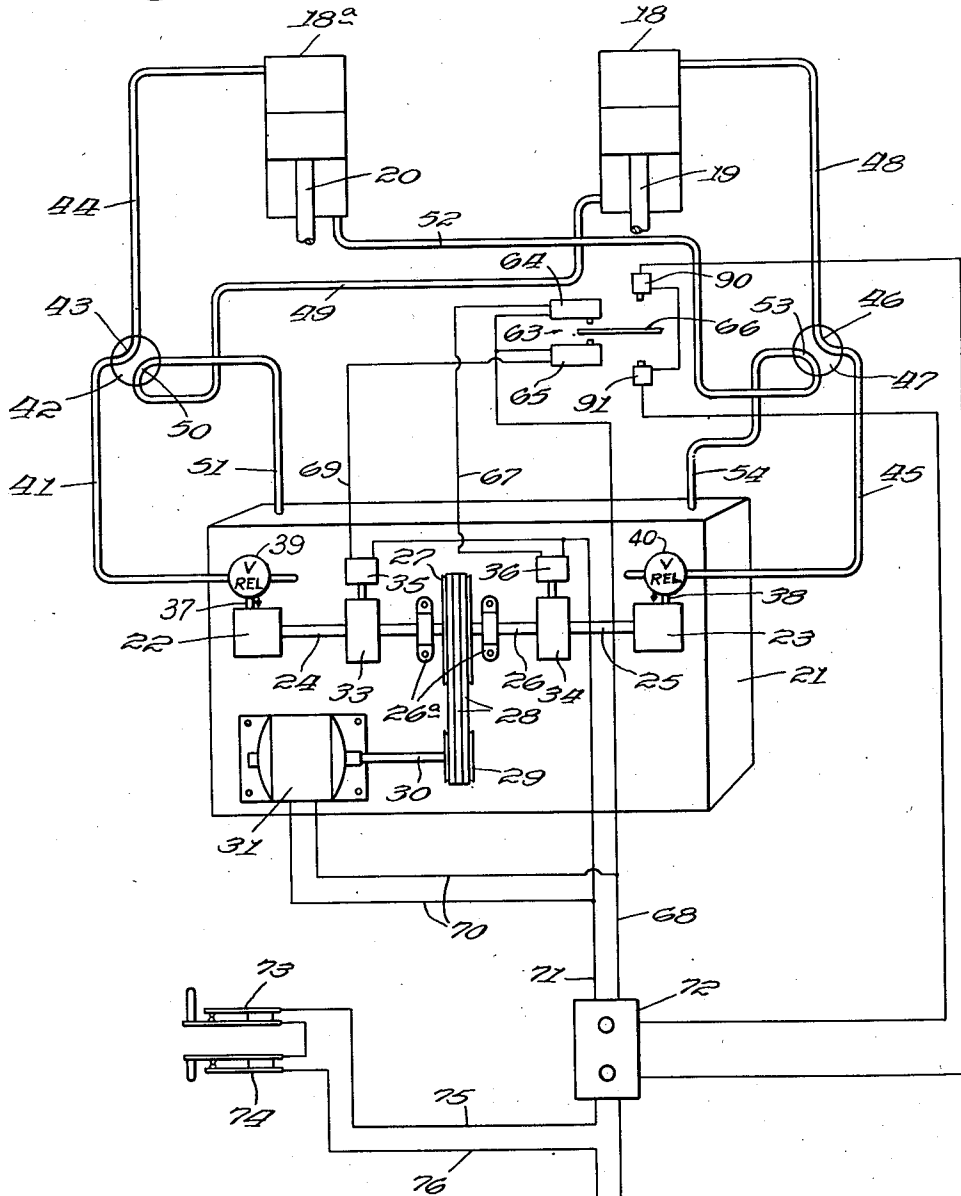
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4 Sheets-Sheet 3

Fig. 7.



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ACTUATED PRESS BRAKES

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Fig. 8.

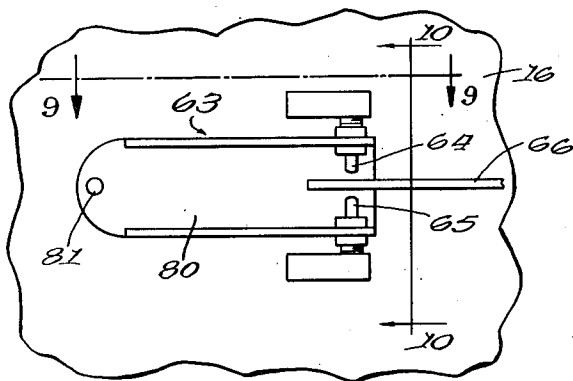


Fig. 10.

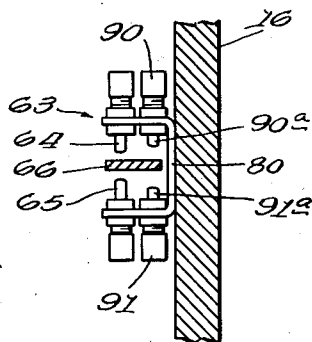


Fig. 9.

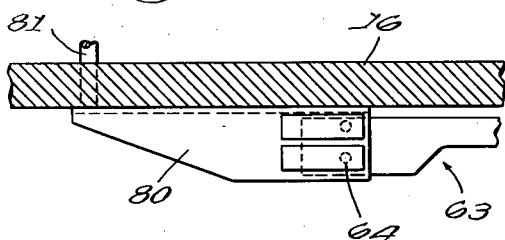
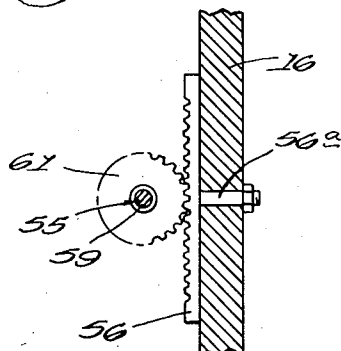


Fig. 11.



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UNITED STATES PATENT OFFICE

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LEVELING MECHANISM FOR HYDRAULICALLY ACTUATED PRESS BRAKES

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Application April 25, 1950, Serial No. 157,860

11 Claims. (Cl. 100-46)

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This invention relates to a fluid actuated mechanism and more particularly to a hydraulic press brake. More specifically the invention relates to a leveling mechanism for maintaining uniform and coordinated movement in a plurality of hydraulic cylinders, the mechanism being particularly applicable to a press brake.

In hydraulic press mechanisms operated by a plurality of hydraulic cylinders, it has been exceedingly difficult to coordinate the pressure and movement of both cylinders in a uniform and synchronous manner to effect level travel of the press ram. Under various conditions the ram will tilt during movement this tilting being very undesirable and resulting from uneven operation of the cylinders. It is applicant's prime object therefore to provide an improved leveling mechanism arranged to coordinate or synchronize a plurality of hydraulic cylinders thereby effectuating level movement and operation of the ram of a press.

Another object is to provide a level mechanism for maintaining a uniform movement in a plurality of fluid pressure motors.

It is a further object to provide a leveling mechanism for a hydraulically operated press, the leveling mechanism including electrically controlled means operable in response to uneven movement of a ram to regulate the flow of hydraulic fluid to a group of hydraulic motors or cylinders.

A still other object is to provide a hydraulic press with a plurality of hydraulic cylinders, the cylinders being controllable, during uneven travel of a ram, from a switch mechanism mounted on the ram.

Another object is to provide a leveling mechanism for coordinating the hydraulic units of a press. The leveling mechanism including a pair of racks, one of said racks being mounted on the ram, and a second rack slidably mounted with respect to said ram.

A still further object is to provide a leveling mechanism for maintaining uniform movement of a plurality of hydraulic units, the mechanism including a movable member having a rack mounted thereon, a second rack slidably positioned with respect to the movable member and a rotatable member for engaging both racks, the slidable rack being engageable with a switch mechanism for controlling a pump operative to supply fluid to the hydraulic units.

Another object is to provide a leveling mechanism for a hydraulic ram, the mechanism including a switch mechanism responsive to un-

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even travel of the ram for actuating fluid pressure means to correct the travel of said ram, said switch means including safety switches adapted to be actuated during an extreme uneven condition of the ram for stopping the operation of said hydraulic ram.

These and further novel objects of the invention will become more fully apparent from a reading of the specification in connection with the accompanying sheets of drawings.

In the drawings:

Figure 1 is a front view in elevation of a hydraulic press mechanism.

Figure 2 is a rear view in elevation of the hydraulic press shown in Figure 1.

Figure 3 is a partial plan view partly in section, of a hydraulic press showing a portion of a press ram in section.

Figure 4 is an enlarged view of a rear portion of a hydraulic ram showing a switch mounted thereon.

Figure 5 is a detail sectional view of a switch mounting on a hydraulic ram, the view being taken along the line 5-5 of Figure 4.

Figure 6 is a detail view of an adjustment for a switch taken along the line 6-6 of Figure 5.

Figure 7 is a schematic view of a hydraulic system and the switch and circuit diagram for a leveling device.

Figure 8 is a detailed elevational view of a switch mechanism mounted on the ram.

Figure 9 is a sectional view of the switch mechanism taken on line 9-9 in Figure 8.

Figure 10 is a sectional view of a switch mechanism taken along line 10-10 of Figure 8.

Figure 11 is a sectional view of a rack mounted on a ram, the view being taken substantially along line 11-11 of Figure 2.

Referring now particularly to Figures 1 through 4 inclusive, a hydraulic or fluid pressure operated press is generally designated by the reference character 10. The press 10 includes a housing 11 having uprights 12. A press bed or vertical anvil plate 13 is supported on legs 14 projecting forwardly from the uprights 12. A channel shaped die securing member 15 is supported on the bed 13. A ram 16 is supported on the front of the uprights 12, the ram 16 including a die securing plate 17 coextensive with the lower edge of the ram 16. A pair of fluid extensible devices in the form of hydraulic cylinders 18 and 18a are connected to the uprights 12, the cylinders 18 and 18a being connected at transversely spaced points to the ram by piston rods 19 and 20. The cylinders 18 and 18a are effective to reciprocate

the ram 16 with respect to the housing 11 and the bed 13.

The hydraulic system

The hydraulic system for supplying fluid under pressure to the cylinders 18 and 18a is best shown in the schematic view of Figure 7. A hydraulic reservoir or tank 21 has mounted thereon a pair of transversely spaced pumps 22 and 23. The pumps 22 and 23 are respectively driven by stub shafts 24 and 25. A common shaft 26 is mounted in bearings 26a, the shaft being rotated by means of a V-belt pulley 27 which is driven by belts 28 from a pulley 29 rotated by a shaft 30 from an electric motor 31. Between the ends of the shafts 26 and the stub shafts 24 and 25 electrically controlled mechanisms in the form of electric clutches 33 and 34 are provided. The clutches 33 and 34 are of a conventional type which are normally energized in driving relation.

The type of clutch that may be utilized may be an electro-magnetic clutch that is normally clutching and may be electrically de-energized. Or it may be any mechanical or electrical clutch that can be electrically controlled to establish and to break driving relation with a power unit in response to a switch control.

Rectifiers 35 and 36 are respectively connected to the clutches 33 and 34. These rectifiers are a part of the conventional mechanism of a magnetic clutch assembly and need not be described in detail.

The pumps 22 and 23 are connected by conduits 37 and 38 to relief valves 39 and 40. The cylinder 18a receives fluid under pressure from the pump 22 through a conduit 41 connecting the relief valve 39 with a conventional four-way valve 42. The valve 42 has a passage 43 which, in the position shown in Figure 7 is in communication through a conduit 44 with the upper end of the cylinder 18a, both the cylinders 18 and 18a being the two way pressure types.

The cylinder 18 receives fluid under pressure from the pump 23 through a conduit 45 which is in communication with a passage 46 in a four-way valve 47. The passage 46 in turn may be placed in communication with a conduit 48 in communication with the upper end of the cylinder 18.

The cylinder 18 has a conduit 49 in communication with its lower end, the conduit 49 being adapted to communicate with a passage 50 in the valve 42. The conduit 49 through the passage 50 is adapted to communicate with a conduit 51 leading to the reservoir 21. The cylinder 18a has its lower end in communication with a conduit 52 which is in communication with a passage 53 in the four-way valve 47. The passage 53 is adapted to communicate with a conduit 54 leading to the reservoir 21.

The leveling mechanism

The leveling mechanism is generally designated by the reference character 55. The mechanism 55 comprises a rack bar 56 which is carried by the ram 16 for reciprocation therewith. A second rack 57 is laterally spaced from the rack 56, the second rack being slidable in a wide slot or groove 58 extending vertically in the ram 16. In other words the rack 57 can slide vertically in the slot 58 relative to the ram during movement of said ram 16. The slot 58 is sufficiently wide so that the ram 16 can tilt a certain degree without affecting the vertical position of the rack 57. A torque tube 59 is journaled on the housing up-

rights 12 by bearings 60. A pinion 61 secured to the shaft 59 is in meshing engagement with the rack 56 and a pinion 62, secured to the shaft 59, is in mesh with the rack 57. It can be seen therefore that the rack 57 is supported and held in vertical relation by its engagement with the pinion 62 and is thus held in the vertical coordinated relation with respect to the rack 56, independently of the sliding movement of the ram 16. The rack 57 is held in the slot 58 by means of the pinion 62 but the sliding movement of the ram at the point of contact with the rack 57, does not affect the position of said rack. Thus the rack 57 may be termed as being independently supported free of the ram 16.

Referring now particularly to Figures 4 and 7 a limit switch mechanism 63 is pivotally mounted on the ram 16 adjacent the rack 57. The switch 63 has upper and lower switch elements 64 and 65. The elements 64 and 65 are adapted to be engaged by a lug or trip plate 66 which may make or break the switch elements as will be explained in the operation. The switch element 64 is connected by suitable circuits 67 and 68 to a source of electricity as shown, and to the rectifier 36 which controls the clutch 34. The switch element 65 is connected to rectifier 35 by circuits 68 and 69 and to a source of electricity as shown. The electric motor 31 is connected by leads 70 to the wire 68 and to a wire 71 controlled from a push button switch 72.

Upper and lower switches 73 and 74 are mounted on the front face of the ram 16 as shown in Figure 1. These switches 73 and 74 are connected by leads 75 and 76 to the circuit as shown in Figure 7. Adjustable arms 77 and 78 are moveably mounted on a rod 79 the rod being suitably supported on a portion of the housing 11. The switches 73 and 74 may be opened and closed in a conventional manner by the arms 77 and 78 for limiting the vertical reciprocation of the ram 16.

The pivotal connection of the switch mechanism 63 is best shown in Figures 5 and 6. The switch mechanism 63 is supported by a plate 80 connected to a shaft 81 extending through the ram 16. A link 82 is connected to the shaft 81 and the link 82 is connected to a reciprocating plunger 83 of a micrometer 84. The micrometer 84 may be of a conventional type and is pivotally connected to the ram 16 as indicated at 85. An adjusting sleeve 85a may be rotated for effecting reciprocation of the plunger 83 to secure in turn angular positioning of the plate 80 and switches 64 and 65.

The operation

In the position shown in Figures 1, 2, and 7 the ram 16 is ready to begin downward movement. The motor 31 is set in operation by switch 72 and the shaft 26 begins rotation. The clutches 33 and 34 are in operative relation and the pumps 22 and 23 are actuated through stub shafts 24 and 25. Fluid under pressure flows through conduits 41 and 44 to the upper portion of cylinder 18a and likewise fluid under pressure flows through conduits 45 and 48 to cylinder 18 causing the ram to move downwardly. Fluid at the lower end of the cylinders 18 and 18a is returned respectively by conduits 49 and 51 and conduits 52 and 54 to the reservoir 21.

As the ram 16 is moving downwardly the rack 56 effects rotation of the pinion 61 thereby rotating the torque shaft 59. This rotation of shaft 59 reacts on rack 57 to keep this rack in

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the same level coordinated or vertical position as rack 56, since the ram 16 can move relative to the sliding rack 57. The groove or slot 58 is sufficiently wide so that the rack 57 is still maintained in operative relation with respect to the pinion 62 despite tilting movement of the ram or uneven operation. Likewise the rack 56 is free to pivot with respect to the ram 16 by means of a pivot pin 56a which extends through the ram. In other words the racks 56 and 57 remain in a substantially vertical and parallel position despite tilting of the ram since they are held in this position by the pinions 61 and 62.

In a condition wherein the cylinder 18 is operating faster than the cylinder 18a the ram is progressing further in its downward pass on the side having the floating or sliding rack 57. Under this condition the rack 56 is relatively stationary and consequently the torque bar or shaft 59 is locked against rotation. The pinion 62 is thus held against movement and the rack 57 remains stationary or positioned in the same vertical-coordinated relation as the rack 56. The ram on the side of the cylinder 18 continues to move and the switch 64 therefore makes engagement with the lug 66 whereupon the switch 64 is actuated to energize the rectifier 36 which in turn permits the clutch 34 to slip with respect to the shaft 25 and pump 23. Less fluid is therefore delivered from pump 23 to cylinder 18 and the pump 22 continues delivering fluid pressure to cylinder 18a whereupon this retarded cylinder continues downward movement of the ram until a level position is reached. When a level position of the ram has been reached the switch 64 is again returned to its original position and the clutch 34 again transmits operating force to the pump 23 thereby actuating cylinder 18.

In a condition wherein the cylinder 18a operates faster and cylinder 18 is retarded the ram progresses faster on the side of the rack 56. In this condition the rack 57 is maintained level with rack 56 and since rack 56 has moved downwardly with the ram 16, the rack 57 is in a relatively lower position with respect to the switch 65 whereupon the lug 66 engages switch 65 to actuate the same. This causes the rectifier 35 to actuate the clutch 33 to slip causing relative lesser delivery operation of the pump until cylinder 18 has caught up whereupon the switch 65 is disengaged and normal operation continues. Thus the leveling mechanism is effective to keep the ram in a level position since during any tilting movement the switches react to control fluid delivery to the cylinder that is advanced in operation.

Under certain operating conditions it is desirable to move the ram in a tilted or angular position. To adjust the switch position angularly with respect to the ram, the operator need merely turn the adjusting member 85a of the micrometer 84 whereby the plate 80 will be moved to the desired position on the ram. The switch mechanism 63 will then be positioned in proper angular relation to the rack 57 and the lug 66 so that the ram may be reciprocated in a tilted position, the leveling mechanism being effective to synchronize or coordinate the cylinders during any variance of the ram from the desired tilted or angular position during reciprocation.

The downward movement of the ram 16 has been described. During upward movement the valve 42 is shifted so that conduits 41 and 49 are in communication through passage 50

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whereupon piston rod 19 is moved upwardly. Fluid from the upper end of cylinder 18a returns through conduits 44 passage 43 and conduit 51 to the tank 21. The valve 47 is moved to place conduit 45 in communication with conduit 52 through passage 53 and cylinder 18 is operated to move piston rod 20 upwardly. The conduit 48 is now in communication with conduit 54 through passage 46 and fluid returns from cylinder 18 to the tank 21.

During the upward travel the cylinder 18a is operated by pump 23 and cylinder 18 is operated by pump 22. This connection which is reverse to the connection during downward movement of the ram permits the operation of the leveling mechanism without any reversal of the switch mechanism or relocation of the switches. If during tilting of the ram during upward travel switch 64 is engaged, the clutch 34 slips and fluid delivery to the cylinder 18a is controlled or halted. On the other hand if switch 65 is actuated the clutch 33 slips and cylinder 18 is controlled in its reception of fluid.

In Figures 7, 8, 9 and 10, safety switches 90 and 91 are provided adjacent the switch mechanisms 63. These switches are in series with the electrical circuit and switch 72 in a suitable manner to break the circuit to the clutches and the electric motor in the event that either of the switches 64 and 65 are inoperative for any reason. The contact elements 90a and 91a are positioned above and below the respective contacts of the switches 64 and 65. Movement therefore of the contact plate 66 beyond either of the contacts of the upper or lower switches 64 and 65 shuts off the electrical system completely thereby stopping all fluid flow to the cylinders 18 and 18a.

Thus it can be seen that the level travel of the ram is effectively assured by the leveling mechanism during both upward and downward travel of the ram. The degree of misalignment or angularity of the ram necessary to operate the switches can be adjusted to close limits and the slidable rack provides an effective simple and positive actuator for the switches. Equal travel of the extensible devices is thus maintained without the use of a rigid mechanical ram control, but with a positive mechanism for controlling fluid delivery. The retarded cylinder or piston is permitted to catch up while fluid control is exercised over the advanced piston. One of the prime features of the invention is exemplified in the sliding rack and its novel cooperation with the torque shaft and switches. The leveling device can be utilized in any construction where level uniform travel of a part is necessary and the part is actuated by a plurality of spaced power units having a tendency to operate in a non-uniform manner.

It is realized that reversal of the parts can be accomplished and that changes may be made which do not depart from the spirit of the invention as disclosed nor the scope thereof as defined in the appended claims.

What is claimed is:

1. A fluid pressure actuated press having a housing and a vertically reciprocable ram, horizontally spaced first and second fluid pressure extensible devices connected to said housing and said ram for reciprocating said ram; means for coordinating the operation of said extensible devices to provide for level uniform travel of said ram, said means including a first vertically extensible rack connected to the ram adjacent one

end of the ram thereof for vertical movement with said ram, a second vertical rack horizontally spaced from said first rack, said second rack being independently supported relative to said ram adjacent a second end of said ram, a rotatable shaft 5 journaled on said housing, said shaft having rotatable members engaging said racks whereby during reciprocation of said ram said second rack is maintained in vertically coordinated relation with respect to said first rack; means for supplying fluid under pressure to said first and second 10 fluid extensible devices, said last named means including first and second fluid pumps respectively communicating with said first and second extensible devices, power means adapted to operate said pumps, first and second electrically controlled clutch means between first and second pumps and said power means, and first and second switch 15 means connected to said ram for reciprocation therewith and respectively connected to said first and second clutch means, said first and second switch means being individually engageable by said second rack during tilting of one end of the ram with respect to the other end whereby said clutches are individually actuated in response to the switches to control the fluid delivery of said pumps to the extensible devices during unequal operation of one extensible device with respect to the other.

2. A hydraulic press having a housing and a reciprocable ram, spaced first and second fluid pressure extensible devices connected to said ram and said housing for reciprocating the ram; means for coordinating the operation of said extensible devices to provide for level uniform travel of said ram, said means including a first rack secured to the ram for reciprocation therewith, a second rack laterally spaced from said first rack, said second rack being independently supported free of the ram whereby the ram is slidably movable in a vertical direction with respect to said second rack, a rotatable torque shaft journaled on the housing, said torque shaft including a first member connected to the torque shaft for rotation therewith, said first member engaging the first rack for rotating said torque shaft and a second member connected to said torque shaft for rotation therewith, said second member engaging said second rack for securing the same in substantially the same vertical position as said first rack during rotation of the torque shaft; means for supplying fluid under pressure to said extensible devices comprising first and second fluid pumps, the pumps having first and second delivery conduits respectively in communication with said first and second extensible devices, a first return conduit connecting the first extensible device with the second pump, a second return conduit connecting the second extensible device with the first pump, means for rotating said pumps comprising a power unit, first and second electrically controlled clutches respectively between the first and second pumps and said power unit, first and second switch means on said ram, and means connecting said switch means and said electrically controlled clutches, said switch means being individually engageable by said second rack during tilting movement of the ram for de-energizing one of said clutches thereby stopping fluid delivery of one of said pumps to one of said extensible devices, said switch means being arranged and constructed to again energize said clutch during return of the ram to a level position.

3. A fluid pressure actuated press having a housing and a vertically reciprocable ram, hori-

izontally spaced first and second fluid pressure extensible devices connected to said housing and said ram for reciprocating said ram; means for coordinating the operation of said extensible devices to provide for level uniform travel of said ram, said means including a first rack connected to the ram adjacent one end thereof for reciprocation therewith, a second rack spaced from said first rack, said second rack being supported independently relative to said ram adjacent a second end of said ram, a rotatable shaft journaled on said housing, said shaft having pinions engaging said racks whereby during reciprocation of said ram said second rack is maintained in position with respect to said first rack; means for supplying fluid under pressure to said first and second fluid extensible devices, said means including first and second fluid pumps respectively communicating with said first and second extensible devices, power means adapted to operate said pumps, first and second electrically controlled clutch means between said first and second pumps and said power means, and first and second switch means connected to said ram for reciprocation therewith and respectively connected to said first and second clutch means; said first and second switch means being individually engageable by said second rack during tilting of one end of the ram with respect to the other end whereby said clutches are individually actuated in response to the switches to control the fluid delivery of said pumps to the extensible devices during unequal operation of one extensible device with respect to the other.

4. In a fluid pressure actuated press having a reciprocable ram, spaced first and second fluid pressure extensible devices connected to said ram for reciprocating the same, means for supplying fluid under pressure to said fluid extensible devices including a pump in communication with said fluid extensible devices; a leveling mechanism for coordinating the operation of said extensible devices to provide for level uniform travel of the ram comprising, a first rack supported on the ram for reciprocation therewith, a second rack spacedly positioned with respect to said first rack, said second rack being positioned independently free of the ram whereby said ram may move relative to said second rack, a rotatable shaft stationarily positioned with respect to said ram, said shaft having a first member rotatable with said shaft engaging said first rack whereby said shaft is rotated during reciprocating movement of said ram and said first rack, said shaft having a second member rotatable with said shaft engaging the second rack for maintaining said second rack in coordinated relation with respect to said first rack, a switch movable with said ram, means connecting said switch with said pump, and means on said second rack for engaging said switch during tilting movement of said ram, whereby said pump is controlled in response to said switch to regulate the fluid flow to one of said extensible device until level position of said ram is again established.

5. In a hydraulic press having a vertically reciprocable ram, spaced first and second hydraulic units connected to said ram for reciprocating the same, means for supplying fluid under pressure to said fluid hydraulic units including a pump in communication with said hydraulic units leveling mechanism for coordinating the operation of said hydraulic units to provide for level uniform travel of the ram comprising, a first rack supported on the ram for vertical reciprocation

therewith, a second rack transversely spaced with respect to said first rack and substantially parallel thereto, said second rack being positioned free of the ram whereby said ram may move relative to said second rack, a rotatable shaft stationarily positioned with respect to said ram, said shaft having a first pinion engaging said first rack whereby said shaft is rotated during reciprocating movement of said ram and said first ram, said shaft having a second pinion engaging the second rack for maintaining said second rack in vertically coordinated relation with respect to said first rack, a switch mechanism means connecting said switch mechanism with said pump, and means on said second rack for engaging said switch mechanism during tilting movement of said ram, whereby said pump is controlled to regulate the fluid flow to one of said hydraulic units until level position of said ram is again established.

6. In a hydraulic press having a housing and a vertically reciprocable ram, horizontally spaced first and second hydraulic units connected to said housing and said ram for reciprocating said ram; means for supplying fluid under pressure to said hydraulic units including first and second pumps, a power unit for operating said pumps, first and second electrically controlled clutches between the power units and said pumps; a leveling mechanism for coordinating the operation of said hydraulic units to provide for level uniform travel of said ram comprising, a first rack supported on the ram for reciprocation therewith, a second rack horizontally spaced from said first rack, said second rack being independently supported with respect to said ram, means for maintaining said first and second racks in horizontal spaced alignment during movement of said ram including a rotatable member connected to said housing, first and second pinions connected to said rotatable member for rotation therewith, said pinions each engaging one of said racks, a switch on said ram, and means connecting said switch with said first and second clutches, said switch including first and second contact elements individually engageable by said second rack during tilting of said ram for actuating either of said clutches thereby controlling operation of one of said pumps for regulating the delivery of fluid to one of said hydraulic units until level travel of said ram is established.

7. In a fluid actuated press having a housing and a vertically reciprocable ram, horizontally spaced first and second hydraulic units connected to said housing and to said ram for reciprocating said ram; means for supplying fluid pressure to said hydraulic units including a pump structure, first and second conduits connecting said pump structure and said first and second hydraulic units; a leveling mechanism for coordinating the operation of said hydraulic units to provide for level uniform travel of said ram including a first rack connected to the ram for reciprocation therewith, a second rack supported independently of said ram, means for maintaining said first and second racks in hori-

zontally aligned relation during movement of said ram including a rotatable member journaled on the housing, first and second pinions connected to said rotatable members for rotation therewith, said pinions engaging the racks whereby said rotatable member is rotated, and means connected to said pump structure and constructed and arranged for engaging the second rack during tilting of said ram to control said pump structure and the fluid delivery through one of said conduits to one of said hydraulic units until a level position of said ram is established.

8. For a movable reciprocating member having first and second spaced fluid pressure extensible devices connected thereto and first and second fluid pressure actuators respectively connected to the first and second extensible devices; a leveling mechanism for coordinating the operation of the extensible devices comprising a first rack bar connected to the reciprocating member adjacent one end, a second rack bar horizontally spaced and connected to the reciprocating member adjacent a second end, said rack bar being supported independently of the ram, a rotating shaft including pinions engaging and coordinating the position of said racks, and control means on the reciprocating member responsive to tilting uneven movement of said member for engaging the sliding rack thereby activating the control means for regulating the fluid pressure actuator to control the fluid flow to said extensible devices thereby coordinating the operation of said device.

9. In a reciprocating member as claimed in claim 8 wherein the control means includes a switch engaging the sliding rack for controlling the fluid pressure actuators.

10. In a reciprocating member according to claim 9 wherein the control means includes a pair of electrically controlled clutches and switch means mounted for reciprocation on said ram, said switch means being connected to said clutches, the clutches being adapted to control the fluid actuators, said clutches being responsive to the actuation of the switches for controlling the fluid pressure actuators.

11. In a reciprocating member according to claim 8 wherein the first rack bar is pivotally connected to the ram whereby the first rack bar may be adjusted angularly.

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