Dec. 25, 1962 A. FERRANTI 3,070,146

SYSTEM AND RELATED DEVICE FOR BALANCING HYDRAULIC PRESSES IN GENERAL

Filed Oct. 2, 1959 2 Sheets-Sheet 1

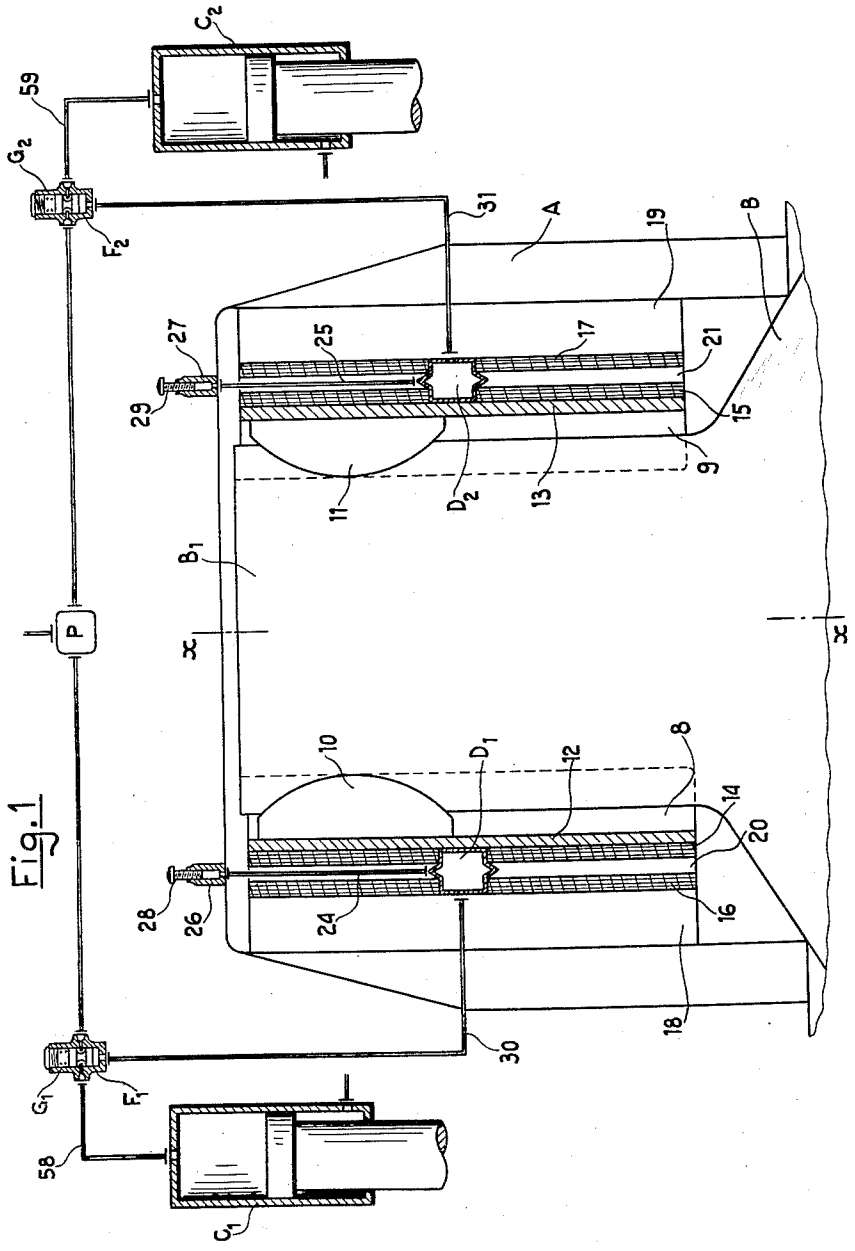


Fig. 1

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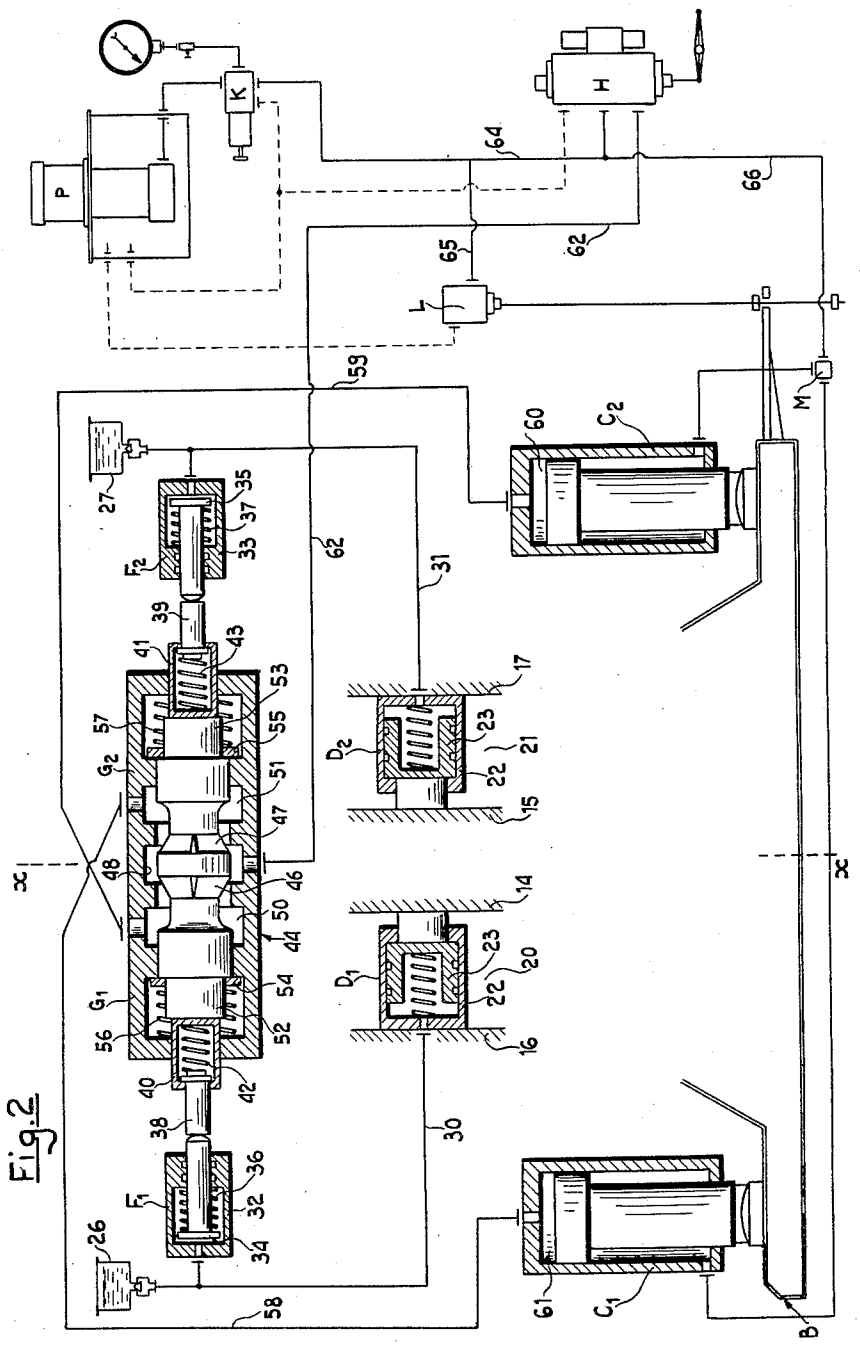


Fig. 2

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SYSTEM AND RELATED DEVICE FOR BALANCING HYDRAULIC PRESSES IN GENERAL

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This invention relates to a system, and related device, for balancing hydraulic presses or similar equipment, e.g. bending and folding machines.

In some classes of hydraulic presses or similar equipment, e.g. bending and folding machines, shears and the like, which comprise two or more cylinder-piston units, unbalance conditions often arise when the load or the workpiece are, even slightly, out-of-center or misaligned in respect to the moving section, or drive elements of the machine. This results in severe ill-effects, by which the strength of the whole structure of the machine is affected. Attempts have been made to prevent these drawbacks by means of devices designed to control the flow of pressure fluid into the two or more cylinder-piston units in a manner to decrease the pressure in the one of said units which is the farthest from workpiece, and to increase the pressure in the unit nearest to workpiece. However, such devices have not wholly met the requirements, since they are called into action when the top and bottom press tables are no longer disposed in parallel relation with one another. Now, such devices must obviously give a quick response to even the slightest deviation from parallel relation, and this unavoidably results in an hypersensitiveness of the hydraulic system. Such sensitive systems are acted upon even as result of allowable, irregular deviations and even when the press is not under load. On the other hand, would such a system be less sensitive it would give a less sensitive response to deviations from parallel relation of press tables, and the hydraulic system should be thereby acted upon only after the structure of machine has been unduly stressed. In such event, even assuming that permanent damages are not caused, it would undoubtedly result in impairment and wear by which the efficiency and life of machine guideways are severely shortened.

The above drawbacks are positively obviated by the system according to the invention, through which the press hydraulic system is instantaneously acted upon as soon as asymmetric or unbalanced stresses are brought about in the machine by the load, or by the out-of-center location of workpiece, and the system operates to counterbalance the unbalance efficaciously by a suitable reaction.

The system according to the invention is characterized in that the transverse thrust brought about by the unbalanced load in the movable press section, which is thereby forced against the related guideways, is utilized for the actuation of means designed to control the flow of pressure fluid to different cylinder-piston units with which the press is fitted, and to establish differential pressures in the cylinders.

The above inventive idea may be carried into practice in many different embodiments or forms of device by which the system according to the invention is practised. Such embodiments will obviously depend from the features of presses, or of machines in which they are to be embodied.

Said device is characterized by means located between the fixed and movable guides of the press and by means through which said first means are suitably connected with valve gears designed to control the flow of pressure fluid to different cylinders of the press hydraulic equipment.

The means by which the transverse thrust of shift press

movable section is sensed, might be of any already known type, e.g. of the mechanical or hydraulic type; in this latter case, the volume of a fluid, and preferably of a liquid, is modified proportionally to transverse shift of the movable press section, caused by the unbalanced load, and such modifications are transmitted to the valve gear.

The invention will now be disclosed in the following description, taken with the accompanying darwings, wherein a preferred embodiment of the device by which the system according to the invention is carried into practice is shown, both description and drawings being given only as a non restrictive example.

In the drawings:

FIG. 1 diagrammatically shows a bending and folding machine having a device constructed according to the invention; and

FIG. 2 is a detail diagram of connections of the hydraulic equipment of above machine.

Referring now more particularly to the above figures, A is the press frame (in the case as considered: a bending and folding machine), and B is the movable section which is conveniently connected with, and powered by the cylinder piston units C_1 and C_2. In addition to the guides as shown, and which will be discussed in more detail later, the press frame is fitted also with further guides, not shown, located in the lower section thereof, the pistons of cylinders C_1, C_2 being connected adjacent thereto.

A lug B_1 is formed on the middle portion of upper side of press movable ram section B. Said lug is provided with pillows **10—11**, seated into suitable concave seats formed on lug sides, and designed to cooperate, in sliding-fit relation, with side guides **8** and **9**, as well as with end-guides **12—13**, the latter guides being engaged with the opposite faces of said pillows.

Said guides consist of strips secured to frame A with the interposition of further resilient strips **14—15** and **16—17**. Latter strips are made of a suitable material, whereby they elastically yield under the stresses arising in the press. The whole assembly is kept in place by shoulders **18—19** formed on said frame A.

The resilient strips **14—15** and **16—17** are suitably spaced, as shown in the drawings, thereby forming intervening spaces **20** and **21**, which extend across the whole length of the above described complemental guides. As already stated, some guides are located above the machine, while the conventional press guides are located below the pistons C_1—C_2.

Sensing means including at least one elastic member D_1 and D_2 is located between the guide strips **12, 13** and guide means including related shoulders **18, 19**. Such member can be resiliently squeezed, thereby varying its capacity, according to what will be explained later.

In the case as considered, said elastic members are fitted in the middle portions of the above decribed complemental guides. However, the elastic members might be fitted in other locations, and might also be made in the form, and with the features most suitable, according to embodiment of the device in question, and also according to the operational features of the machine in which said device is to be embodied.

In the case as shown in the FIG. 2, each elastic member D_1—D_2 consists of a cylinder **22**, wherein a piston **23**, kept under the action of a spring, is slidingly fitted. The free end of each cylinder **22** is designed to cooperate with the resilient strips **16** and **17**, while the piston is designed to cooperate with the resilient strip **14** and **15**.

Obviously, said elastic members might also consist of corrugated or bellows like bodies, fitted into the intervening spaces **20** and **21**.

Each elastic member is respectively connected with a piping **24** and **25**, which respectively lead into the reservoirs **26** and **27**. In latter reservoirs a liquid is con-

tained, with which both the elastic members and the hydraulic circuit, which will be described later on, are kept permanently filled. The reservoirs 26 and 27 are provided with check valves, designed to allow the flow of liquid from one of the reservoirs to related members D_1 and D_2, while preventing the flow in opposite direction; moreover, said reservoirs are tightly closed by the plugs 28 and 29, to effect—when required—a pressure to the pressurizing of the fluid contained in the circuit.

The pipings 30—31 respectively lead to a drive motor F_1—F_2, acting on balancing gear-valves G_1—G_2, by which the flow of pressure fluid to cylinder-piston units C_1 and C_2 is suitably controlled.

In the embodiment form as shown in the FIG. 1, drive-motors F_1 and F_2 are fitted on the balancing valve-gears G_1 and G_2, whilst a different embodiment form is shown in the FIG. 2.

More precisely, in latter embodiment form, each driving element F_1 (F_2) consists of a cylinder 32 (33) having a sliding piston 34 (35) biased by the action of a spring 36 (37) in a direction away from its corresponding balancing gear valve G_1. The rods of pistons 34—35 are designed to cooperate with suitable counter-rods 38—39 slidingly fitted in the tubes 40—41, wherein spring means 42—43 are arranged to bias these rods outwardly.

The tubes 40—41 in turn are slidingly fitted and coaxially guided in suitable bores, formed in a block 44, comprising the balancing valve-gear assembly G_1—G_2.

The ends of tubes 40—41 are designed to cooperate with the opposite end faces of a double piston 46—47, by which the communication between a central chamber 48 and the side chambers 50—51 is suitably controlled, as explained later in more detail.

The tubes 40—41 cooperate with extensions 52—53 formed on both ends of double piston 46—47. The flanges 54—55, threaded on the piston, serve as stops for the springs 56—57, by which same piston is acted upon in opposite directions each time it is moved, while when the piston is in its balanced position, as shown in the FIG. 2, the action of said springs is counteracted by shoulders formed in the inside of body 14.

The chambers 50—51 are connected by the pipings 58—59, with the upper chambers 60—61 of cylinders C_2—C_1, while the central chamber is connected by the piping 62 with a three-way valve gear H, which in turn, is connected, by the piping 64, with the pressure generator P, through an adjustable valve K by which the pressure can be controlled. A branch pipe 65, starting from the piping 64, leads in the already known manner, to end-stroke valve L, controlled by the movable section B of a press or similar equipment, and by which the lower cylinder-chambers C_1—C_2 are fed through a suitable pressure reducer M.

The operation of device based on the abovedescribed system, and depending on press operation, is as follows: the downward stroke of press movable section B is performed in the already known manner, by the pressure of fluid fed into the upper chambers of cylinders C_1—C_2. The pillows 10—11 will slide freely between the guides 8—9 and 12—13. Under such conditions latter guides are all parallel with one another, and they are also in parallel relation with the main guides of the machine, which obviously are parallel with the axis X—X of same machine.

The abovestated conditions will prevail even when the press is working a piece symmetrically located in respect to symmetry axes of the machine.

However, as already known when the workpiece is shifted in respect to said symmetry axes, a bending moment is brought up and, through the movable section (and above all through the lug B_1 thereof), an overpressure is consequently exerted against the side guides 12 or 13.

Due to peculiar design of said guides, and also due to the action of pillows 10—11, they will be thrust sidewise, whereby the deformable member D_1 or D_2 is compressed, while the opposite member D_2 or D_1 is allowed to expand. Thus, a pressure is brought up on one side, and acts on the drive motor F_1 or F_2, while the other motor F_2 or F_1 is acted upon by the vacuum caused on the opposite side. Assuming that the deformable member D_1 is squeezed, a given amount of fluid will be transferred into the cylinder 32 of motor F_1, whereby the related piston 34 is moved from left to right, and the spring 42 is compressed in the tube 40 through the counter-rod 38. The latter tube is thereby moved from left to right, thus destroying the previously considered equilibrium condition, due to the action of spring 56 and 57, as well as of springs 42—43. It follows that the double piston 46—47 is shifted from left to right, thereby causing on one side an increase in the port through which the communication is established between the chambers 48—50, and on the other side a decrease in the communication port between the chambers 48—51.

Thus, the pressure will be increased in the chamber 60 of cylinder C_2, and decreased in the chamber 61 of cylinder C_1. Otherwise stated, in unbalanced (i.e. higher) pressure is exerted by the press, through the cylinder-piston unit nearest to workpiece.

In general, the double piston 46—47 of valve gears G_1, G_2 is shifted to increase the flow of pressure fluid to upper chamber of cylinder C_1 or C_2, or to decrease the flow of pressure fluid into the upper chamber of cylinder C_2 or C_1 as required to correct the unbalance caused by the out-of-center or misaligned load. Obviously, the action exerted by the valve gears G_1—G_2 will be proportional to unbalancing action, i.e. to abnormal stress which is exerted on either of guides 12—13.

As already stated, the foregoing description has been made with reference to a special press, usually known as bending and folding machine. In some instance, it is impossible to place the sheets to be folded symmetrically in respect to symmetry axis X—X of machine, and this results in unduly high stresses being exerted on the guides.

By the device according to the invention, a complete balancing of stresses is attained. Moreover, the top and bottom tables of machines are kept in the due parallel relation. The intervention of stress balancing device is nearly instantaneous, owing also to particular location of sensing members D_1—D_2, which are fitted very far from the working table of folding machine, whereby an even very slight deviation from parallel relation of top and bottom tables, will result in a large shifting of lug B_1, and thus also of sensing members D_1 and D_2.

As disclosed in the other patent of same inventor, already referred to, the guides 12—13 are elastically forced against the faces of pillows 10—11, or more exactly said pillows, due to shifting of lug B_1 in either direction, are more or less forced against the guides. To said pressure will respond both the resilient strips 14—15 or 16—17, as well as the deformable members D_1, D_2 and 22 or 23.

It must be understood that many changes and modification might be made to the invention, to make the same best suited to meet the design and operational features of machines. Thus, e.g., lever systems might be interposed between the guides 12—13 and the deformable members D_1, D_2, to amplify the shifting of same guides.

Moreover, the balancing gear-valves G_1—G_2 might be actuated by suitable mechanical control devices, connected to guides fitted to lug B_1.

Obviously, the protection as applied for, extends also to the press, and in particular to the bending and folding machine embodying the device in question.

While the invention has been described with some detail, it is to be understood that the description is for the purpose of illustration only, and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What I claim is:

1. In a bending machine, press and similar device, including a work table, a movable ram section reciprocable in directions toward and away from said table, the improvement comprising guide means for said ram section disposed on each side thereof including spaced resilient portions elongated in the direction of movement of said ram section and deflectable adjacent the location of guiding engagement with said ram section upon the latter encountering an unbalancing force such as produced by encountering an eccentrically disposed workpiece, a separate fluid pressure actuated piston and cylinder combination for reciprocating said ram section for each side of said ram section, each including a relatively movable piston and cylinder, one of which is connected to said ram section adjacent each respective guide means, fluid pressure means connected to each piston and cylinder combination, and sensing means disposed between the spaced resilient portions of said guide means and connected to said fluid pressure means including means to control the pressure directed to each of said piston and cylinder combination to thereby direct a greater fluid pressure to said piston and cylinder combination adjacent the portion of said ram section encountering the greatest load.

2. In a bending machine, press and the like according to claim 16, wherein said sensing means includes a resiliently deflectable member located between the spaced resilient portions of said guide means.

3. In a bending machine, press and the like according to claim 1, wherein said sensing means is located remotely from the end of said ram section which contacts a workpiece.

4. In a bending machine, press and the like according to claim 1, wherein said sensing means includes a resiliently deflectable member located between the spaced resilient portions of said guide means, and wherein said piston and cylinder combination includes means connected between said fluid pressure means and said cylinder to pressurize said cylinder to lower the piston, said piston being connected to said ram section to lower said ram section.

5. A bending machine, press and the like, comprising a work table upon which a workpiece is positioned, a ram reciprocatable upwardly and downwardly above said work table, a first piston and cylinder combination adjacent one side of said movable ram section including a fixed cylinder, a piston connected to said ram section and being reciprocatable in said cylinder to reciprocate said ram section, a second piston and cylinder combination adjacent the opposite side of said ram section and including a fixed cylinder and a piston slidable therein connected to said ram section and reciprocable in said cylinder to reciprocate said ram section, first and second vertically elongated guide ways on each side of said ram section, said guideways including spaced resilient portions and said ram section including a portion bearing against and slidable along said guideways during reciprocation thereof, a sensing member disposed between the resilient portions of each of said guideways and responsive to deflection of said resilient portion due to the unbalancing disposition of said ram section between said guideways, pressure means connected to said first and second cylinder to effect reciprocation of the piston therein, and control means connected between each of said sensing means and said pressure means serving to increase the pressure directed from said pressure means to the cylinder adjacent the side of the ram section encountering the greatest load.

6. A bending machine, press and the like according to claim 5, wherein said control means includes a balancing cylinder having a balancing piston movable backwardly and forwardly therein, passage means centrally connecting said balancing cylinder to said pressure means, separate first and second passage means on each side of said actuating passage means and connected to said first and second cylinder and piston combinations respectively, said sensing means including means to shift said control piston to effect greater communication through the interior of said balancing cylinder between said fluid pressure passage means and the cylinder-piston combination adjacent the section of the ram encountering the greatest load through the interior of said balancing cylinder.

7. A bending machine according to claim 5, wherein said sensing means includes a cylinder portion connected to one of said spaced resilient members and a piston portion reciprocatable in said cylinder portion connected to the other of said spaced resilient members.

8. A bending machine, press and the like according to claim 5, including end stroke valve means having an actuating portion disposed in the path of movement of said ram section and connected between said fluid pressure means and each of said first and second cylinders to reverse the movement of said piston therein by directing pressure to the side of said piston to move it upwardly when said ram section has reached the end of its stroke.

9. A bending machine, press and the like according to claim 5, wherein said sensing means includes a resiliently deflectable member connected to the fluid pressure source for said first and second piston and cylinders, and a fluid reservoir connected to said resiliently deflectable members and permitting fluid flow only to said resiliently deflectable members.

10. A bending machine according to claim 5, wherein said ram section includes a narrowed upper portion, said guide means being disposed on each side of the narrowed upper portion of said ram section, and outstanding means on said ram portion bearing against said guide means and slidable therealong during the reciprocation of said ram section.

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