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Hamada

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[54] **HYDRAULIC BENDING PRESS**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 75,566, Sept. 25, 1970, abandoned.

[30] **Foreign Application Priority Data**

Oct. 13, 1969 Japan 44-81167

[52] **U.S. Cl.** ..... **72/443,** 72/453, 100/269 R

[51] **Int. Cl.** **B21j 9/12**

[58] **Field of Search** ..... 72/453, 389, 443; 100/269 R

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[57] **ABSTRACT**

A hydraulic press for bending plates and the like, is disclosed having a single-acting hydraulic pressing cylinder. A plurality of plunger pumps feed hydraulic fluid of a lower pressure and higher supply rate to the hydraulic pressing cylinder to enhance the speed of the ram during the approach thereof to the partner tool or while a light load is applied. Fluid of a higher pressure and lower supply rate is provided to the pressing cylinder to retard and empower the ram when a heavy load is applied, e.g., after the start of the bending operation.

1 Claim, 2 Drawing Figures

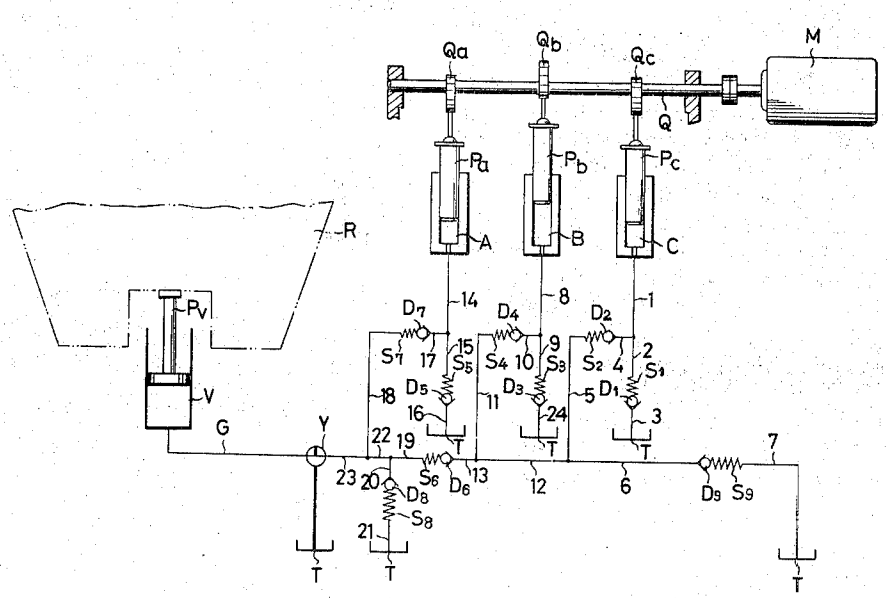
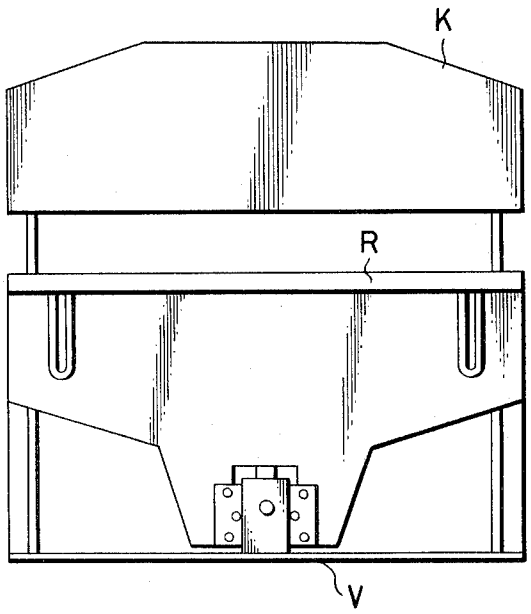


FIG. 1



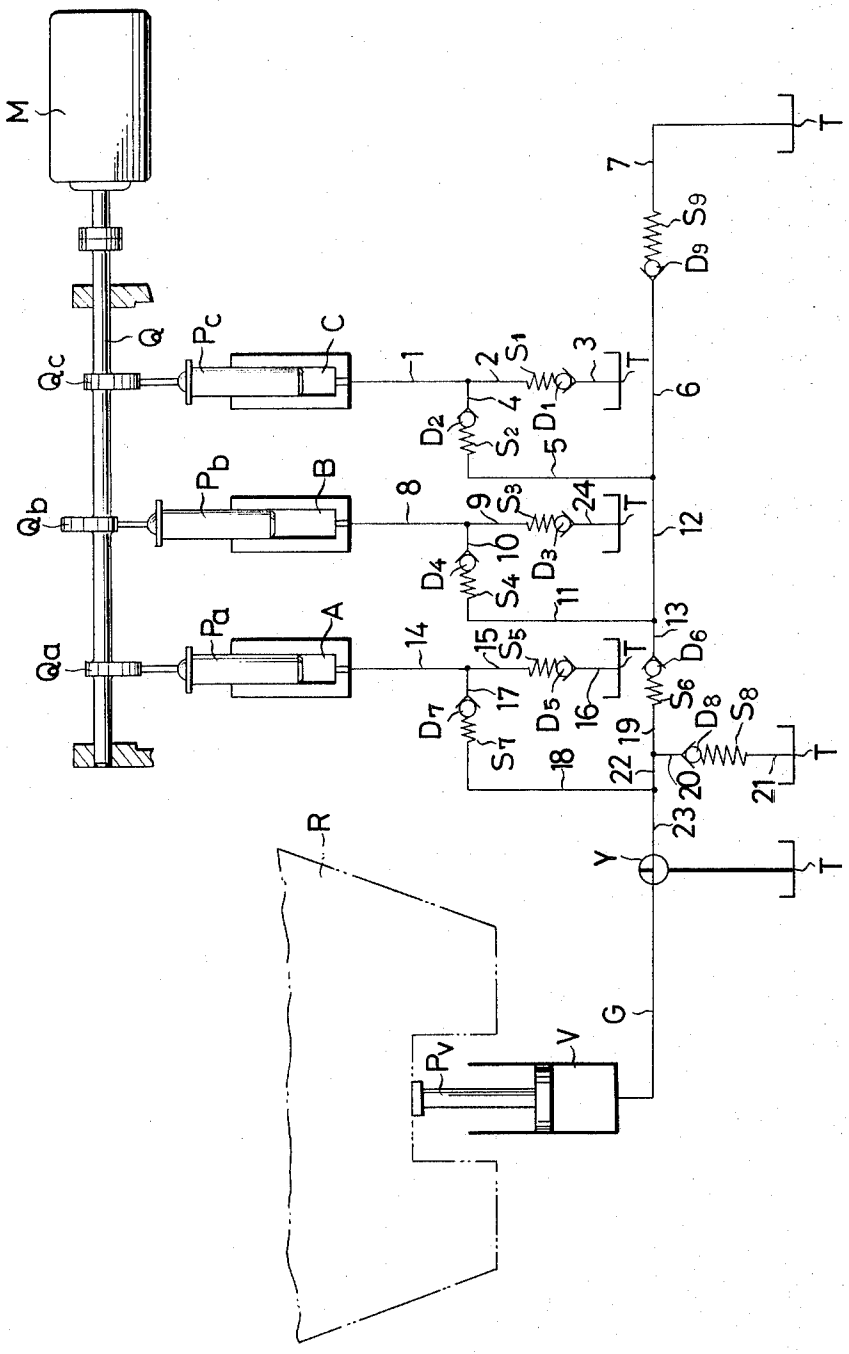

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FIG. 2

HYDRAULIC BENDING PRESS

This is a continuation-in-part of application Ser. No. 75,566, filed Sept. 25, 1970, now abandoned.

DESCRIPTION OF THE INVENTION

The present invention relates to a press brake or so-called bending press, characterized in that one of the upper and lower aprons is designed to rise or fall through the action of a single-acting hydraulic pressing cylinder, and the return movement of the apron is effected by an accumulator or by the apron's own gravity. Plural plunger pumps of the same small shape are adapted to be driven in different shifted phases by a crank shaft or swash discs, in that a first hydraulic cylinder of a first one of the plunger pumps is connected with a fluid path to the pressing cylinder for actuating the apron through a check valve while one end of another fluid path, from another hydraulic cylinder of a second one of the plunger pumps, or of a fluid path from each hydraulic cylinder, is connected with the first-named fluid path to the pressing cylinder, for actuating the one apron through a lower-pressure check valve so as to permit hydraulic fluid to flow from the first cylinder. The other end of the second-named fluid path is connected with a drain circuit through a higher-pressure check valve, and the single-acting pressing cylinder receives the fluid at a lower pressure and higher supply rate, to work at a higher speed, when the apron is lightly loaded, e.g., when approaching to squeeze plate materials between the upper and lower molds. The same pressing cylinder receives the fluid at a higher pressure and lower supply rate, to work at a lower speed, when the one apron is heavily loaded, e.g., for processing the work materials.

The object of the present invention is to provide a hydraulic bending press having the above-mentioned mechanism and presenting desirable functions such that said hydraulic means provides a larger pressure on the latter because said mobile apron receives a larger load at the beginning of the work process, and said hydraulic means is automatically controlled to obtain a high supply rate so as to transfer as quickly as possible when being loaded only with the weight of the mobile apron approaching the upper and the lower molds before the beginning of the work process or only with the resistance of inserting forcedly into the accumulator.

For this purpose, larger machines may resort to the system of feeding hydraulic fluid or oil while approaching one hydraulic cylinder disposed at the center of gravity without load and of collecting the oil supply from plural surrounding hydraulic cylinders after the start of the bending operation. However, smaller machines having a single cylinder cannot adopt such a mechanism.

On the other hand, the category of a single cylinder type includes a conventional system having one pump of a higher pressure and lower supply rate together with two pumps of a lower pressure and higher supply rate, wherein said pumps are changed over, one with the other. This system, however, is complicate in its mechanism and is disadvantageous in requiring switch-over manipulation. Also the production cost is rather high.

A bending press having the above-described mechanism of the present invention carries out automatically a lower-pressure and high-speed operation while being loaded on the mobile apron, and a higher-pressure and lower-speed operation while being highly loaded. In particular, such a bending press can automatically be switched over between a higher-pressure lower-speed operation when requiring higher loading, and a lower-pressure higher-speed operation when requiring only lower loading, according to different work materials.

An exemplary embodiment will be described in detail, for an exemplary arrangement employing three hydraulic pumps, with reference to the attached drawings, wherein

FIG. 1 is a front view of an exemplary bending press; and

FIG. 2 is a partly schematic showing of hydraulic means for the bending press of FIG. 1 of the present invention.

In the bending press as shown in FIG. 1, K denotes a stationary apron and R denotes a mobile apron which can conduct the work process in its elevated position and is free from loading in its bottom position. V denotes a hydraulic pressing cylinder mechanism for driving the mobile apron R.

In FIG. 2, a single-acting hydraulic cylinder mechanism V includes a piston Pv for lifting and dropping the mobile apron R. Q denotes a shaft driven by a motor M; A, B and C denote hydraulic cylinders of plunger pumps of which respective and cooperative pistons P*a*, P*b* and P*c* engage shaft Q at connections Q*a*, Q*b* and Q*c*. T denotes hydraulic fluid or oil tanks (which may be in the form of a single tank, D1, D2, D3, D4, D5, D6, D7, D8 and D9 denote check valves; S1, S2, S3, S4, S5, S6, S7, S8 and S9 denote springs for the check valves; G denotes a fluid feeding tube for the hydraulic working cylinder V of the mobile apron; numerals 1 to 24 denote various fluid paths.

In the mentioned constructions, the spring S9 is more powerful than the spring S6, and D6 denotes a low pressure check valve. Valve D6, with its appropriate spring S6, is disposed between fluid path sections 6, 7. D8, a relief check valve, is designed to relase hydraulic fluid at the maximum pressure obtained when a work material plate is squeezed between the upper and lower molds at the end of the bending process and prevents these molds from approaching each other. In this manner, D8 prevents any damages of other hydraulic members and naturally works with a pressure higher than that of D9. D9 is formed as a high pressure check valve.

Preferably, as shown, fluid paths 19, 23 are connected to tank T by way of valve D8, having spring S8, between fluid path sections 20, 21. Springs S1 to S5, S7 are of course for the respective valves D1 to D5 and D7, respectively. Valves D1, D2 and D3 are flanked (with their springs) by the respective fluid path sections 2, 3; 9, 24; and 15, 16.

Now that the construction of the bending press has been described, the function thereof will be explained. When the hydraulic cylinders A, B and C for respective plunger pumps are in the fluid feeding stroke, the cylinder C works to close the check valve D1, while the pressure fluid in the hydraulic cylinder C opens the check valve D2 through fluid paths 1, 4 and is introduced in path 13 through paths 5, 12. The hydraulic cylinder similarly works to close the check valve D3, open the check valve D4 through paths 8, 10 and is introduced in path 13 through oil path 11. Then this fluid supply is added to the pressure fluid of the hydraulic

cylinder C in path 13 to open the low pressure check valve D6 and is introduced into supply tube G through paths 19, 22 and 23.

On the other hand, the high pressure check valve D9 closes to interrupt the flow through path 7. Furthermore, during the fluid feeding stroke of the hydraulic cylinder A, the pressure fluid closes the check valve D5 and opens the check valve D7 through paths 14, 17 thus flowing through paths 18, 23 toward oil supply tube G together with the pressure fluid from the hydraulic cylinders B and C.

All this while, the high pressure check valve D9 remains closed. It is noted that, when the working portion of the rising mobile apron approaches the working portion of the stationary apron without effecting any operation, the pressure fluid supplied from the hydraulic cylinders A, B and C is incorporated to work as its entire mass so as to form a condition of low pressure and high supply rate, thus causing the working apron to rise rapidly.

When the working apron begins to press a work material, the work load increases rapidly to involve a pressure increase inside fluid path 23, thus closing the check valve D6 so that the pressure fluid from the hydraulic cylinders B, C opens the valves D2, D4, D9 and returns into one of the tanks T, relatively without resistance. Thus a large working load is not required.

In this manner, as the working load of all the pumps or the output power of motor M concentrates exclusively into the hydraulic cylinder A, the condition of high pressure and low supply rate is established so that the mobile apron may work at a slow speed and with a large power.

When the bending operation is finished, a change-over valve Y is turned to connect the fluid supply tube G and path 23 with a discharge circuit. In this case, the mobile apron begins to rise or fall by its own gravity or by the effect of an accumulator and so the upper and lower molds separate to resume their initial positions. The pressure from the cylinder A of the plunger pump is discharged through path 14, 23 and the change-over valve Y, while all the pressure fluid from the cylinders B, C is discharged through paths 22, 23 and change-over valve Y after passing the check valve D6 because the spring S6 is less powerful than the spring S9, as explained before. The operation of the bending press is always started by changing over the valve Y to connect the fluid supply tube G with path 23.

As described hereinbefore, the bending press of the present invention is constructed in the manner that the motor and the plunger pump are continuously rotated, and the simple manipulation of the change-over valve permits the working apron to automatically move at a higher speed in the case of requiring smaller load for the approach of the upper and lower molds, and to move at a lower speed, in the case of requiring a heavier load for the actual bending process. The invention, therefore, offers such a simple and sure structure of bending press in a compact form.

I claim:

1. A hydraulic press for bending plates and the like, comprising, in combination, an upper and a lower apron, one of said aprons being designed selectively to rise and to fall by the action of a single-acting hydraulic pressing cylinder, return movement of said one apron being effected by the apron's own gravity, a plurality of plunger pumps driven in different shifted phases alternatively by respective swash discs, a first hydraulic cylinder of the first one of said plunger pumps connected with a first fluid path to said pressing cylinder for actuating said one apron through a check valve while one end of a second fluid path, from a second hydraulic cylinder of the second one of said plunger pumps is connected with said first fluid path to said pressing cylinder, for actuating said one apron through a lower-pressure check valve so as to permit hydraulic fluid to flow from said first cylinder, the other end of said second fluid path being connected with a drain circuit through a higher-pressure check valve, the working characteristics of said one apron being changed over so that, in the case of said one apron being loaded lightly such as for approaching one of upper and lower molds, said one apron works with a lower pressure and a higher supply rate, whereas in the case of said one apron starting the press work, the fluid supply from said second cylinder is discharged without noteworthy resistance, and only the fluid supply from said first cylinder is introduced into said pressing cylinder so that said one apron works with a higher pressure and a lower supply rate.

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