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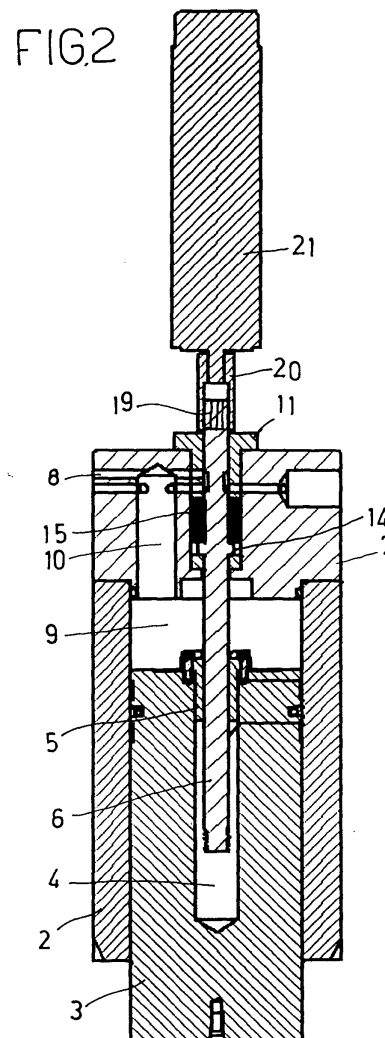
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(54) **Electro-hydraulic linear actuator for presses**

(57) The invention deals with the field of presses and, more precisely, deals with a linear actuator that comprises a simple- or double-acting jack with movement of piston or rod (3) obtained by means of an electro-hydraulic system. The rod or piston (3) provides for a scroll (5) in which a nut screw (6) can rotate and is actuated by a reversible electric motor (21); the nut screw provides for an annular groove (16) adapted to normally discharge the hydraulic circuit supplying the jack during the quick descent and rise steps of the rod. The upward movement of the screw, from the tool working start time, makes the oil discharge circuit close and therefore generates the electric plus hydraulic thrust on- to rod or piston: Resilient means (15) are provided that counteract the upward movement of the screw.



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Description

[0001] The present invention deals with an electro-hydraulic linear actuator for operating presses, where the term "electro-hydraulic" means an actuator or jack in which the piston movement occurs through an electric actuator or by means of an hydraulic thrust according to the press working cycle steps.

[0002] As known, in the working cycle of a press actuated by a jack, the following are provided: a first step of descending the jack piston in order to take a tool connected thereto to operate on a work-piece to be worked; a second step of working or pressing and a third step of ascending the piston in order to take the tool back in its cycle beginning conditions.

[0003] In order to increase the machine productivity, it is necessary that the first and the third steps are as quick as possible, being dead steps in which the tool does not exert any pressure or working on the work-piece.

[0004] In general, the first step of quick descending can be easily reached since the gravity force aids the hydraulic thrust, while the third step of ascending or contrary to the thrust step must be obtained with quick actuator means.

[0005] For such purpose, the known prior art provides for the use of a double-acting hydraulic jack that is supplied by an hydraulic circuit comprising proportional servo-valves in order to have low speeds during placement and high speeds for movements.

[0006] Also with the introduction of proportional valves, the piston translation times are long, since they are mainly due to the hydraulic system.

[0007] Object of the present invention is making the movements quicker without impairing the thrust efficiency.

[0008] In order to obtain such object, the technical problem to be solved is completely removing the hydraulic action during the press tool movements, leaving for such hydraulic action only the step of positioning and pressing.

[0009] Such object is fully reached by the electro-hydraulic actuator for presses, object of the present invention, which is characterised by what is included in the below-listed claims.

[0010] Characteristics and advantages will be better pointed out by the following description of a preferred embodiment shown, merely as a non-limiting example, in the enclosed tables of drawing, in which:

- figure 1 shows the actuator as a whole in an elevation view;
- figure 2 shows the actuator according to the longitudinal section C-C of figure 1;
- figure 3 shows, in the same view as figure 2, an enlarged part of the actuator during its quick actuating step;
- figure 4 shows the part of figure 3 in the press work-

ing step.

[0011] With reference to the figures, 1 designates a simple-acting hydraulic jack composed of a liner or cylinder 2 within which a piston 3 slides, at the end of which a working tool of a press, not shown, is secured.

[0012] Rod and piston, in the shown example, coincide.

[0013] In the piston, a coaxial hole 4 is provided, closed in its upper part by a scroll 5 within which a worm screw 6 is threaded.

[0014] The liner is closed in its upper part by a head cover 7, in which an oil delivery duct 8 is provided, that sends oil into the cylinder chamber 9 through a duct 10.

[0015] The worm screw 6 crosses the cover 7 and is supported by the cover itself through a bush 11 and a thrust bearing or bushing 12 inserted in an hole 13 coaxial with the piston axis.

[0016] The worm screw 6 has an abutment ring 14 that rests against the bearing or bushing 12 due to the pressure of a resilient means composed of a pack 15 of Belleville washers inserted between such thrust bearing 12 and the bush 11.

[0017] The worm screw further has means for discharging the jack chamber 9: these means, in the shown example, are composed of an annular groove 16 that communicates an oil discharge duct 17 with the chamber 9 through a channel 18.

[0018] The screw 6, after having crossed the bush 11, has in its end side a portion of grooved shaft 19 that engages a sleeve 20 with internal groove.

[0019] The sleeve 21 is keyed-in on the shaft of a reversible electric motor 21.

[0020] The screw will advantageously be of the ball re-circulation type.

[0021] The operation of the linear actuator will now be described.

[0022] The electric motor 21 rotates the screw 6 that makes the scroll 5, and therefore the rod or piston 3 connected thereto, quickly move downwards. The movement performed by the electric motor is surely quicker than a movement performed with hydraulic oil.

[0023] The quick descent performed by the electric motor goes on till the working tool-carrying rod encounters the obstacle of the work-piece to be worked.

[0024] The rod block and the continuous screw rotation make the screw itself ascend counteracting the action of the pack of Belleville washers (as shown in figure 4).

[0025] The pack of Belleville washers is compressed and the annular groove, that before discharged the pump to the oil tank, by moving upwards closes this discharge and the jack chamber 9 is pressurised and then the electric axis can go on in its descent stroke aided by the oil pressure thrust onto the rod. In this step, it is the oil pressure that exerts the greatest thrust onto the tool.

[0026] The rod ascent, or better the reversal of the electric motor rotary motion, takes back the screw in

contact with the thrust bearing, opening the discharge towards the oil tank and allowing the oil outflow from the jack chamber 9.

[0027] The hydraulic circuit is normally being discharged and is pressurised only during the press tool working step. 5

[0028] Briefly, the quick rod or piston movement, both when descending and when ascending, is performed by the electric system composed of reversible motor 21, screw 6, scroll 5 stiffly connected to rod 3, while the pressing working stroke is jointly performed by electric motor and hydraulic circuit being pressurised. 10

[0029] The hydraulic circuit could also be of the double-acting type, depending on the electric system inertia, in order to exploit the lower jack chamber to reduce the system inertia. 15

[0030] According to a further embodiment, not shown, the means adapted to discharge the chamber 9 in the quick movement steps could also be composed of a valve actuated by the screw movement. 20

Claims

1. Electro-hydraulic linear actuator for presses of a type comprising a jack to whose rod or piston a working tool is connected, **characterised in that**, in the jack piston, a scroll (5) is provided to which a worm screw (6) is engaged, said worm screw (6) being actuated by a reversible electric motor (21), said worm screw (6) being provided with means adapted to normally discharge an hydraulic circuit for supplying the jack during the steps of quick descending and returning to a lifted position and to close the discharges during the step of tool working, said means being driven by the worm screw (6). 25 30 35
2. Actuator according to claim 1, **characterised in that** the means adapted to normally discharge the hydraulic circuit comprise an annular groove (16) obtained on the worm screw (6) next to an oil discharge duct and an oil supply channel (18) from the hydraulic circuit. 40
3. Actuator according to claims 1 and 2, **characterised in that** the worm screw has a ring (14) on which a resilient means (15) presses, such means (15) pushing the screw, and therefore the related annular groove, into a closure position of the hydraulic circuit discharge channel when the electric motor is no more able to descend the rod or piston. 45 50
4. Actuator according to claim 1, **characterised in that** the means adapted to discharge the chamber (9) are composed of a valve actuated by the worm screw movement. 55

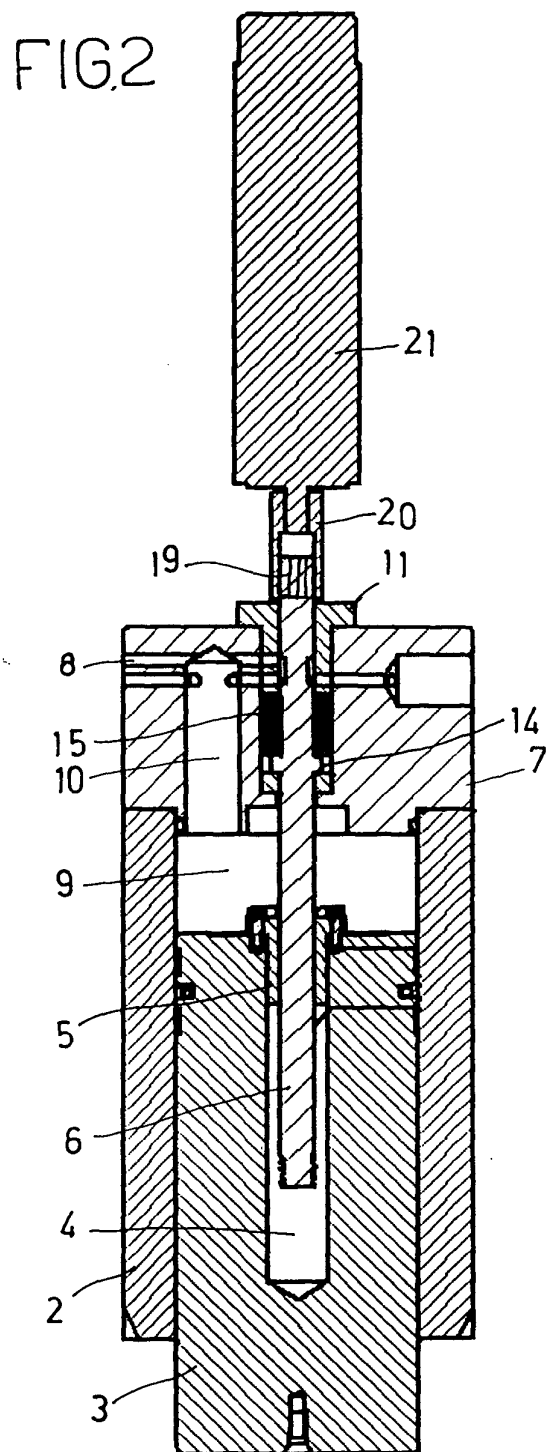
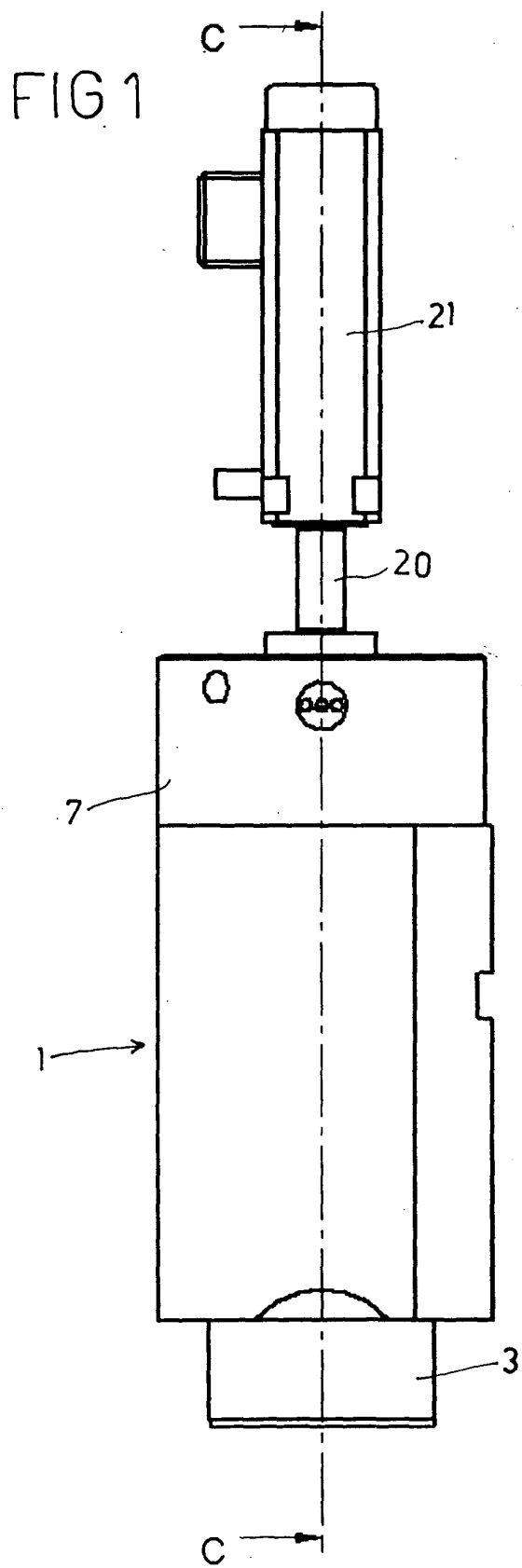


FIG.3

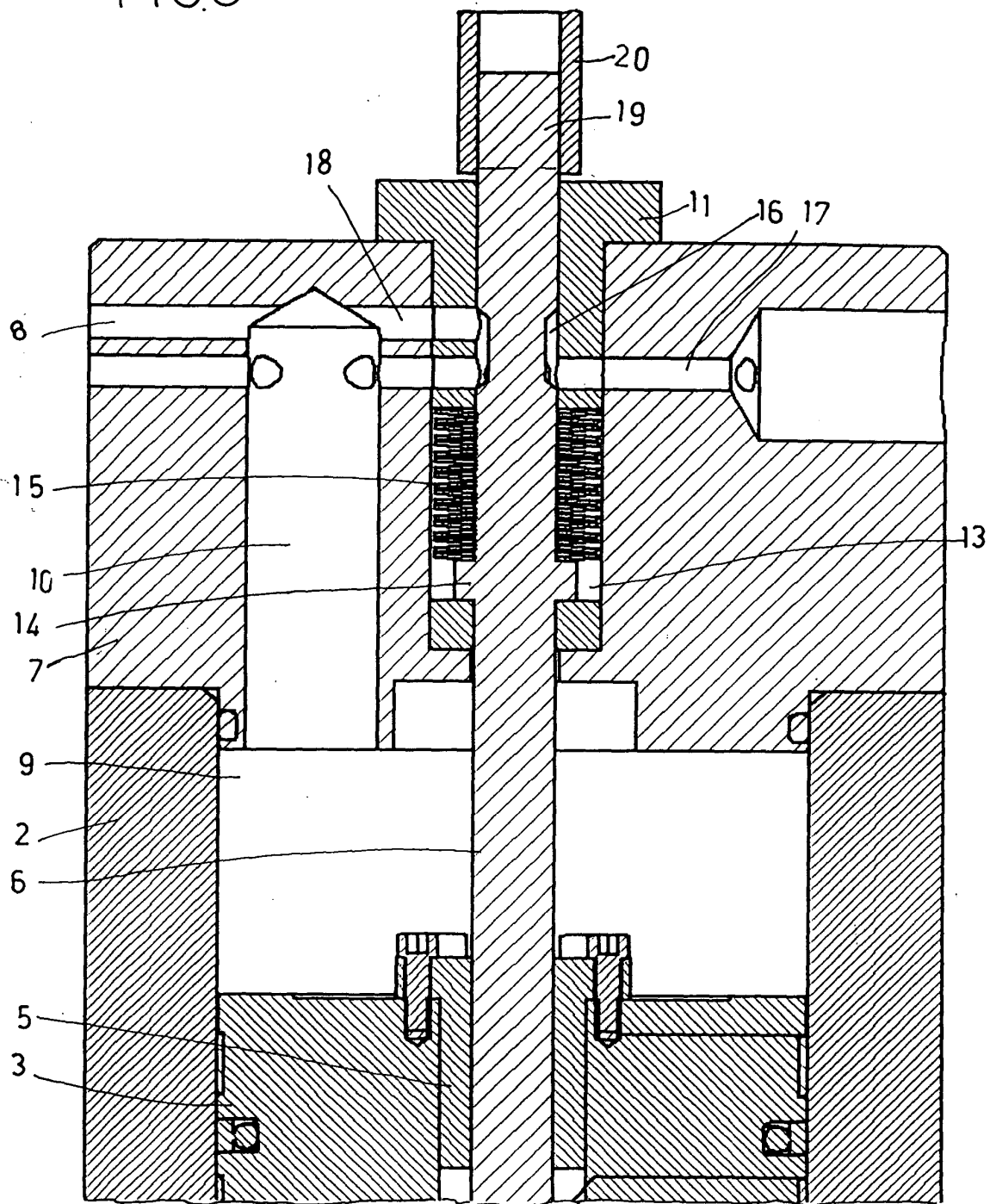


FIG.4

