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Amacker

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[54] **HYDRAULIC PRESS**

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[58] **Field of Search** ..... 100/35, 269 R, 269 A; 91/167, 173; 425/150, 450

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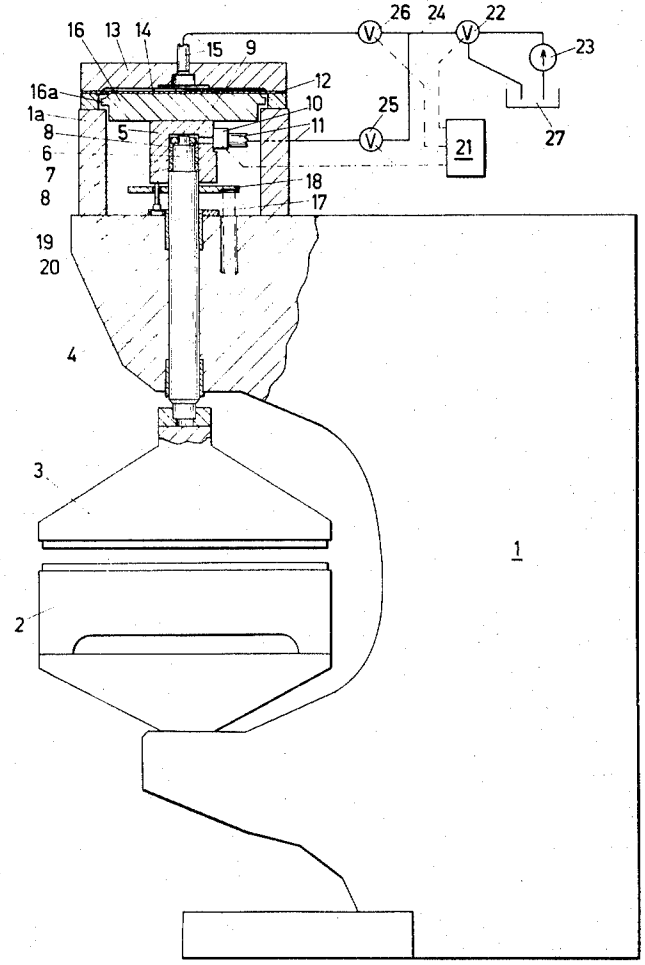
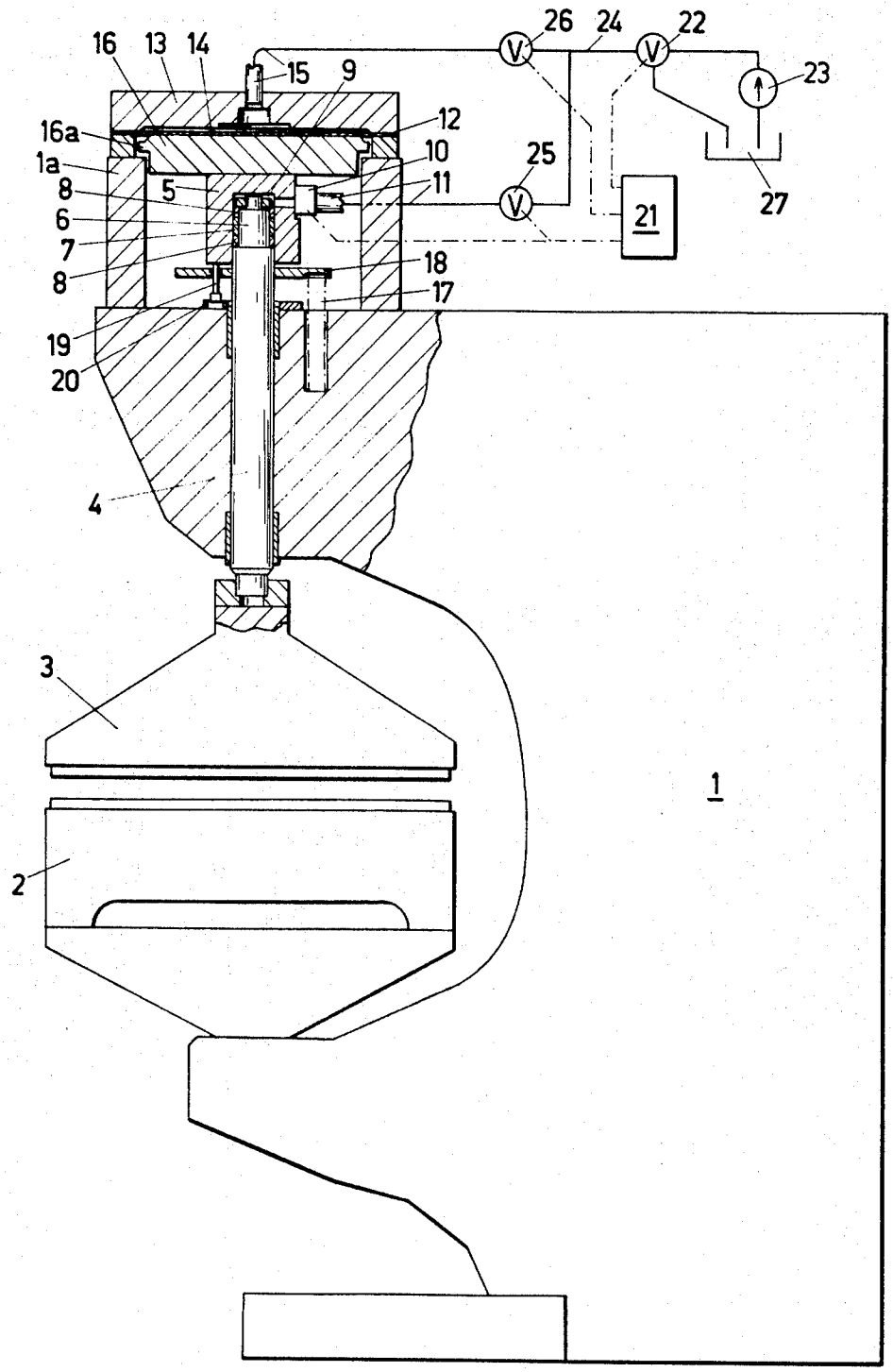
[57] **ABSTRACT**

For consecutively effecting, in each pressing operation of a hydraulic press, an approach stroke at high speed and under low power, and a pressing stroke at low speed but substantially greater power, the invention uses two hydraulic pressing units, such as cylinder-piston-units, mounted in tandem between a stationary machine frame and a movable pressing member, one of the two pressing units having a substantially greater effective surface area, for example piston area, than the other unit. Manually operable or automatic control means are provided for admitting pressure fluid, in a first phase of each pressing operation, into the pressing unit having the smaller effective surface area to effect the approach stroke, and for then locking this unit and admitting pressure fluid into the pressing unit having the greater effective surface area to effect the pressing stroke. Both a high speed during the approach stroke and a high power during the pressing stroke may thus be achieved with a relatively reduced output from the pressure fluid pumping means.

10 Claims, 1 Drawing Figure

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HYDRAULIC PRESS

Hydraulic presses having a pressure piston which is displaceable in a cylinder are used for many and varied purposes. To perform a pressing operation a pressure fluid is fed to the cylinder to displace the piston. The maximum force which the piston can exert is proportional to the pressure of the fluid and to the effective surface area of the piston. The maximum volume of fluid to be fed per unit of time is determined as a product of the surface area of the piston and the rate of stroke required. The pump used for the fluid feed must be designed for an output equal to the product of the volume of fluid per unit time multiplied by pressure, or rate of stroke multiplied by maximum force required.

In many uses, for example for glueing or, in certain instances, even for stamping or the like, presses are needed which are required to apply a powerful force over a relatively short pressing stroke only, but are to be able to perform a larger degree of approach travel under much lower power. Known hydraulic presses are not satisfactory in uses of this kind because the pump for the pressure fluid has to be designed for an output which is very much greater than that which is necessary during the approach stroke (with its requirement of small power only) and also very much greater than the output required during a large pressure pressing stroke (with the requirement of small length and rate of stroke).

The subject of the present invention is a hydraulic press comprising two hydraulic pressing units arranged in tandem between a machine frame and a movable pressing member and each comprising a compression chamber and a transfer member which closes the compression chamber and is movable relatively to a fixed wall thereof, characterized by the fact that to cater for the performance of an approach stroke at high speed and under low power and a pressing stroke at a lower speed but greater power in each pressing operation with a reduction in output required from a hydraulic pumping means, the effective surface area of the transfer member defining the compression chamber is substantially greater, and preferably at least five times greater, in one of the pressing units than in the other pressing unit.

With this press, to first perform an approach stroke, pressure fluid can be supplied to the pressing unit with the transfer member of smaller effective surface area. The smaller the effective surface area is, in this unit, the smaller is the quantity of fluid which is used per unit time for a given rate of stroke. The compression chamber of this pressing unit can then be closed and as a result the transfer member concerned will, in practice, be "locked" to the fixed wall. The actual pressing stroke can then be performed under the agency of the other pressing unit, the effective surface area of the transfer member of this unit being dimensioned in accordance with the maximum pressing force required.

The supply of pressure fluid to the two pressing units can of course be automatically controlled very simply, as is explained below.

The pressing units may each comprise a piston which is movable in a cylinder and constitutes the transfer member. It is possible, however, to use a diaphragm instead of a piston as a transfer member, at least in the case of that unit which has the transfer member with the larger effective surface area.

Hydraulic presses with two pressing units arranged in tandem are per se known. In these, however, the two pressing units have effective pressure surfaces of approximately the same size and they are used for purposes which are completely different from those visualized in the present invention. In the case of Swiss Patent Specification No. 409,634 one pressing unit is only operated when there is a change of tool, with the object of varying the length of the press plunger. In British Patent Specification No. 1,086,477 the second pressing unit is not disposed between the first pressing unit aud the movable pressing member, but between the first unit and a table which carries the workpiece, the aim being to apply this resiliently against a workpiece.

Further details of the invention are disclosed with reference to the accompanying drawing. This drawing is a diagrammatic side view, partly in vertical section, of an embodiment of the hydraulic press in accordance with the invention, and in this drawing the pressure fluid feed means are merely diagrammatically depicted.

The press illustrated in the drawing comprises a frame **1** supporting a lower, fixed, press platen **2** with which cooperates an upper movable platen **3**. Platen **3** is held on a press ram **4** which is vertically displaceable in frame **1**. Platen **3** and ram **4** together form a pressing member. Advantageously the frame **1** takes the form of a thick solid steel plate which is such that no thickening thereof is necessary at that part where the press ram is guided through the plate. This means that the fabrication of the plate can be carried out simply and inexpensively.

The press illustrated may for example be intended for glueing of workpieces. This means that it must exert a powerful force on the workpiece but the latter will be compressed only to a very small extent. This means that there must be only a small length of stroke under heavy pressure. In contrast, to cater for a change in workpiece, provision must be made for a comparatively long approach stroke of the press platen **3** and press ram **4**, under very small force.

For this reason the press has two pressing units which are operable in tandem, and one of these is intended for operation under relatively small power but with a relatively long stroke, namely to perform the aforementioned "approach stroke." By shutting off the infeed and outflow of pressure fluid this first pressing unit can, in practice, be locked in any chosen position and the actual "pressing stroke" performed by the second pressing unit.

The first pressing unit referred to comprises a cylinder **5** in which is displaceable a piston **6** formed as part of the upper end of the press ram **4**. Surrounding piston **6** in cylinder **5** is a sealing ring **7** which is pressed between two slip rings **8**. The inner chamber of cylinder **5** closed by piston **6** represents the compression chamber **9** which is connected through a duct with a shut-off valve **10**. This valve **10** to which pressure fluid can be fed through a conduit **11** is attached directly to cylinder **5** so that high pressures which may be set up in compression chamber **9**, as described below, can not become effective in feed ducts and discharge ducts.

The second pressing unit, which is designed only to produce the short actual pressing stroke, in lieu of a pressing piston has a diaphragm **12** as a transfer member. A pressure chamber **14** is incorporated between this diaphragm **12** and a fixed plate **13** which is rigidly connected to the frame **1** of the machine through posts

1a. Pressure fluid can be introduced into chamber **14** through a conduit **15.** A diaphragm plate **16** is arranged as a thrust transmission member between the free upper surface of diaphragm **12** and the upper side of cylinder **5** of the first pressing unit.

The press described is operated as follows:

One or more compression springs **17,** which are supported in frame **1** and applied against a plate **18** rigidly connected to ram **4,** normally urge the ram **4,** and thus also the piston **6,** cylinder **5,** diaphragm plate **16** and the diaphragm, into the upper starting position illustrated in the drawing.

An automatic control unit **21** is used in performance of a pressing operation. This first connects a pump **23** through a valve **22** to the conduit **24** and connects this conduit through a valve **25** with conduit **11.** The shut-off valve **10** is simultaneously opened. Pump **23** therefore pushes pressure fluid into compression chamber **9** of the first pressing unit and forces piston **6,** and consequently ram **4** and platen **3,** downwards. A small force only is required in this first stage of the operation so that, with an effective surface area of piston **6** of say about 50 cm^2, the maximum pressure output of the pump, which may be for example about 20 atmospheres, is not fully utilized. In this way an approach stroke of press platen **3,** of up to about 3 cm for example, can be brought about, In which case a volume of pressure fluid of a maximum of 50 $cm^2 \times 3$ cm = 150 cm^3 would be needed.

Ultimately the platen **3** contacts the workpiece to be pressed. The first pressing unit is to be locked at this stage and the second unit brought into effect. Advantageously the control unit **21** is so designed for this purpose that it responds to a pressure increase in chamber **9** when platen **3** meets resistance. This control unit **21** may for instance be connected to a manometer or pressure switch (not shown) which is coupled to compression chamber **9.**

When control unit **21** has detected contact between platen **3** and the workpiece, it first closes valve **10** and changes over control valve **25.** Closure of valve **10** has a practical effect of locking piston **6** to cylinder **5** and this, as mentioned above, is possible at any position of piston **6** relatively to cylinder **5.** The control unit the opens valve **26** so connecting conduit **24** with conduit **15** and allowing pressure fluid to flow into the compression chamber **14** of the second pressing unit.

The area of the surface of diaphragm **12** defining compression chember **14** is substantially greater than the effective piston surface area of piston **6** of the first pressing unit. For instance the diaphragm **12** may have an effective surface area of about 1600 cm^2. As a result, at a pressure of for example 20 atmospheres the pressure fluid can drive down the diaphragm **12,** and thus through diaphragm plate **16** and cylinder **5** the press ram **4** connected to the latter, with a force of up to about 30,000 kg. With a very small pressing stroke in the order of 1 mm the volume of pressure fluid required for this is of the same order as that required previously for the approach stroke. It is clear that very high pressures are set up in compression chamber **9** when forces of this order are to be transmitted. For example up to somewhere about 30,000 ÷ 50 = 600 atmospheres or more. These pressures are readily tolerable, however, when the valve **10** is arranged directly on cylinder **5** as described. In addition it should be noted that valve **10** is not operated at these high transmission pressures.

To guarantee that no high pressure shall be set up in conduit **11** even if there is a contingent slight leakage at valve **10,** this conduit **11** is connected through the valve **25** and a discharge conduit (not shown) to a sump **27.**

When the pressing operation has been performed, which may be determined for example by the expiry of a predetermined time interval from the opening of valve **26,** the control unit **21** operates valve **26** to separate conduit **15** from conduit **24** and connect it through an overflow conduit (not shown) to sump **27.** Shortly thereafter, when the transmission pressure in chamber **9** has dissipated, control unit **21** opens shut-off valve **10.** Springs **17** return ram **4** to the starting position, the pressure fluid from chambers **4** and **9** discharging into the sump, the valve **25** being changed over.

It will be apparent that for further moderation of the output required from the pump it will be possible to connect a pressure fluid accumulator (not shown) in known manner to the pump delivery or to conduit **24,** this permitting a further reduction in the peak load on the pump and thus the size of the actual pump used.

One or more bolts **19** may additionally be secured to cylinder **5** and arranged to enter openings in plate **18** attached to press ram **4** so as to limit the stroke of ram **4** relatively to cylinder **5.** Furthermore the lower ends or heads of bolts **19** are guided in holes in a plate **20** rigidly connected to frame **1.** In this way the bolts **19** inhibit rotation of cylinder **5.** Projecting lugs **16***a* are provided at the periphery of diaphragm plate **16** for cooperation with the upper ends of posts **1a** to limit the travel of diaphragm **12.**

It will be understood that numerous modifications of the press actually described can be carried out within the scope of this invention. Thus for example valves **22, 25** and **26** may be combined in a single control member. Alternatively the two valves **10** and **25** could be replaced by a single valve. Again, instead of using the changeover valve **22** which serves to return the pressure fluid delivered by pump **23** into sump **27** when it is not needed, a simple pressure relief valve could be employed in a more modest and less expensive construction. Furthermore, if so desired the control unit **21** may be so designed that it initiates the changeover from the first to the second pressing unit when a predetermined volume of fluid has passed into the compression chamber **9** or when the piston **6** has moved a predetermined distance relatively to cylinder **5,** or again if a predetermined period of time has elapsed since pressure fluid was first admitted to compression chamber **9.** Indeed in some situations the automatic control described above could be completely dispensed with and the supply of pressure fluid to compression chambers **9** and **14** be manually controlled by the operation of appropriate valves.

What I claim is:

1. A press having a high speed, low power approach stroke and a higher power, lower speed pressing stroke, which comprises:

a. a stationary machine frame;

b. a moveable pressing member;

c. a first pressing unit comprising a first compression chamber which is displaceable relative to said stationary machine frame and a first transfer member moveable in said first compression chamber having

a first effective surface area and connected at one end to said pressing member;

d. a second pressing unit comprising a second compression chamber which is sealed off from said first compression chamber, having a wall which is rigidly secured to said stationary machine frame, and second transfer means moveable in said second compression chamber having a second effective surface area, said first compression chamber being rigidly secured to said second transfer means and operative to move with said second transfer means, said second effective surface area being greater than said first effective surface area; and

e. means for supplying and withdrawing pressurized fluid to said compression chambers, including means for fluidly locking said first transfer member at any point of its travel during said approach stroke, said first transfer member, when fluidly locked, being operative to move with said first compression chamber.

2. A press as claimed in claim **1,** wherein said second effective surface area of said second transfer means is at least 10 times greater than said effective surface area of said first transfer member.

3. A press as claimed in claim **2,** wherein said second effective surface area is 30 to 100 times greater than said first effective surface area.

4. A press as claimed in claim **1** wherein said means for supplying and withdrawing pressurized fluid comprise a plurality of pressure fluid conduits to said compression chambers, at least one valve in each of said pressure fluid conduits, and a control unit for operating said valves, said control unit being operable first to open at least one valve in a conduit to said first pressing unit, to close this valve again after an approach stroke has been carried out by said pressing member, and then to open a valve in a conduit to said second pressing unit.

5. A press as claimed in claim **4,** wherein said first compression chamber comprises a fixed wall and wherein a valve in said condult to said first pressing unit is arranged directly on said fixed wall of said first compression chamber of said first pressing unit.

6. A press as claimed in claim **4,** wherein at least one spring is provided between a part rigidly connected to said pressing member and a part rigidly connected to said machine frame for the purpose of returning the pressing member to its starting position.

7. A press as claimed in claim **4** wherein said at least one valve to said conduit to said first pressing unit may be closed when said first transfer member is at any point of its travel during said approach stroke.

8. A press as claimed in claim **1,** wherein said first compression chamber comprises a cylinder in which is displaceably arranged said first transfer member, said first transfer member being a press piston.

9. A press as claimed in claim **8,** wherein said second transfer means of said second pressing unit comprises a diaphragm.

10. A press as claimed in claim **9,** wherein said diaphragm is secured to a part which is rigidly connected to said machine frame, this part forming a fixed wall of said second compression chamber of said second pressing unit, said second transfer means further comprising a second transfer member bearing against said diaphragm, and said cylinder bearing against second transfer member, said press piston being rigidly coupled to said pressing member.

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