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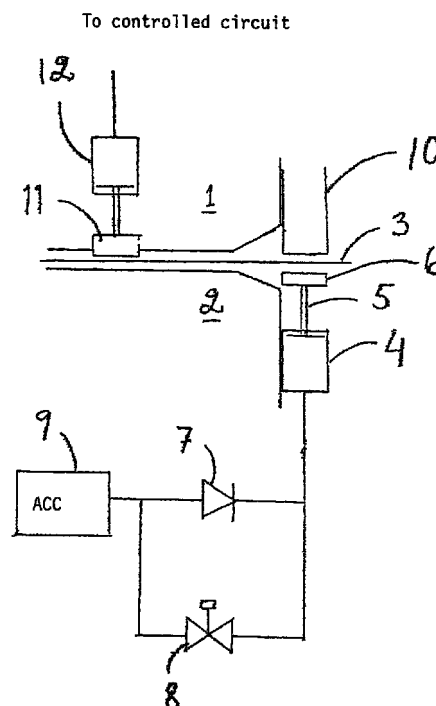
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(54) **Machine with hydraulically controlled counterpressure holding element**

(57) The invention relates to a machine with a hydraulically controlled counterpressure element. The machine comprises a frame and top and lower machine parts (1, 2) in a conventional way for performing the embossing. According to the invention the counterpressure element (6, 11) is connected to a hydraulic cylinder (4, 12), said counterpressure element engaging the plate (3). The hydraulic cylinder (4, 12) is connected to a hydraulic circuit having a controllable hydraulic pressure, so that the counterpressure element is pressed back at the controlled pressure during an embossing operation. The counterpressure element may be included in a holding means to hold the plate securely during the embossing. According to the invention a machine part (1) is then connected to a positive counterpressure element (10) and another machine part (2) is connected to a hydraulic cylinder (4), said hydraulic cylinder (4) having a plunger and a stem (5) connected to a gripping means (6) holding the plate (3) together with the positive counterpressure element (10), such that the plunger during an embossing operation is pressed back at a controlled pressure. The holding means provides a secure holding through the whole press operation. The counterpressure element may also be included in an embossing counterpressure element, in which the counterpressure may be set in order to achieve a pre-embossing or a pressure controlled embossing. The invention may be applied to all types of machines in which counterpressure elements are required.



FIG

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Description

Field of invention

[0001] The present invention relates to a machine with a hydraulically controlled counterpressure element and more particularly a machine having means for holding a plate to be embossed. The holding means holds the plate at a hydraulically controlled constant pressure. The holding means provides a secure holding throughout the whole embossing step. The invention may be applied to all types of machines or tools in which a holding is required. The invention also relates to a machine having a hydraulically controlled embossing counterpressure element in which the counterpressure may be set to achieve a pre-embossing or pressure controlled embossing.

State of the art

[0002] The present invention may e.g. be applied to machines for embossing plates of a heat exchanger. In the embossing operation, a top machine part is moving towards a lower machine part with the plate to be embossed placed in between. When the material of the plate is deformed, inwardly directed tension forces are created. Because of this, the plate is held by a holding means at the edges. The holding means has previously comprised spring biased jaws arranged at the machine part. A problem with this type of holding means is to obtain sufficient force from the springs. In addition, at the start of the embossing operation, the force from the springs is lower since they have been compressed less. If the holding means fails to hold the plate it will collapse inwards and has to be rejected.

[0003] The present invention solves this problem by providing a holding of the plate with a hydraulically controlled counter pressure element. The jaws are biased by a hydraulic circuit which may be set to a constant high pressure during the embossing operation. This provides a secure and adjustable holding.

Summary of the invention

[0004] Thus, the present invention provides a machine conventionally comprising a frame and top and lower machine parts to perform the embossing.

[0005] According to the invention, a counterpressure element is connected to a hydraulic cylinder, the counterpressure element engaging the plate. The hydraulic cylinder is connected to a hydraulic circuit having a controllable hydraulic pressure, such that the counterpressure element is pushed back at a controlled pressure during an embossing operation.

[0006] The counterpressure element may be included in a holding means to hold the plate during the embossing. According to the invention one machine part is connected to a positive counterpressure element and

the other machine part is connected to a hydraulic cylinder, the hydraulic cylinder having a plunger with a stem connected to a gripping means holding the plate together with the positive counterpressure element, so that the plunger is pressed at a controlled pressure during an embossing operation. The holding means provides a secure holding through the whole press step.

[0007] The counterpressure element may also be included in an embossing counterpressure element, in which the counterpressure may be set to obtain a pre-embossing or a pressure controlled embossing.

[0008] The invention is defined by the attached claim 1 while advantageous embodiments of the invention are set forth in the dependent claims.

Brief description of the drawings

[0009] The invention will be described in detail below with reference to the accompanying drawings of which the only figure schematically is showing mechanical and hydraulic components of the invention.

Detailed description of a preferred embodiment

[0010] As is mentioned in the introduction, a machine generally comprises a frame with machine parts which are brought towards each other with the blank to be embossed therebetween. The blank to be embossed must be held securely to avoid movement and collapse. A person skilled in the art is familiar with various kinds of embossing machines and, therefore, these are not described more in detail here. The invention is not limited to any particular machine but may be applied to all machines using counterpressure elements.

[0011] Thus, the mechanical and hydraulic components of the invention are only shown schematically in the figure. The top portion shows the mechanical components of the machine with various counterpressure elements. The machine has a top machine part 1 and a lower machine part 2. A plate 3 is placed therebetween. In the embossing of a plate the top machine part 1 enters downwards into the plate to form a valley while the lower machine part 2 enters upwards into the plate to form a crest. Thus, the machine parts reach into each other.

[0012] A holding means is attached to the machine parts 1, 2. The holding means comprises a counterpressure cylinder 4 and a positive counterpressure element 10. The cylinder is connected by means of its stem 5 to a gripping means to hold the plate 3 against the positive counterpressure element 10. The gripping means may comprise jaws 6 or some kind of frame engaging the edge of the plate. A suitable number of cylinders are provided. In the figure only a lower cylinder 4 and a top positive counterpressure element 10 are shown as an illustration of the principle of the invention. It is possible to combine top and lower cylinders with respective top and lower positive counterpressure ele-

ments in the same machine in order to obtain special embossings, as will be explained below.

[0013] All cylinders are suitably connected to one and the same hydraulic circuit. The circuit comprises a one-way valve 7, a controlled valve 8 and an accumulator tank 9.

[0014] The holding means operates as follows. We assume that the machine has been opened and a plate 3 is inserted for embossing. The embossing starts when the machine parts 1, 2 are brought together and starts to engage the plate 3. At the same time, the jaw 6 and the positive counterpressure element 10 start to grip the plate. The plunger in the cylinder 4 is then at its end stop. The pressure LP from the accumulator tank 9 now prevails in the hydraulic circuit. The pressure LP may be a comparatively low pressure, e.g. 2 bar.

[0015] When the machine parts 1,2 move further towards each other, the pressure in the cylinder 4 is increased immediately since the hydraulic fluid is incompressible. The controlled valve 8 is set to a pressure P_{\max} , e.g. 700 bar, and the hydraulic fluid is pressed out to the accumulator tank 9 at this pressure as the machine parts 1, 2 move towards each other. Thus, the holding pressure is created by the machine itself by means of the machine parts 1, 2. It will be appreciated that the force required for the embossing itself is much higher than the holding force created by the pressure P_{\max} . However, P_{\max} is generally set to a pressure such that the embossing may be obtained. The positive counterpressure element 10 thus move together with its machine part 1 and achieves an embossing against the jaw 6 at the same time as this is pushed downwards.

[0016] When the embossing is done the machine parts 1, 2 start to be separated from each other. The pressure in the cylinder 4 immediately sinks to the pressure LP supplied by the accumulator tank 9 through the one-way valve 7. As the machine parts are separated the cylinder 4 is filled. When the plunger has reached the end stop of the cylinder, the plate 3 is released and may then be removed.

[0017] A hydraulically controlled counterpressure cylinder may also be used to perform an embossing at an inner part 11 of the machine. A first possibility is to perform a pre-embossing, e.g. for embossing a ring portion on a plate before the rest of the plate is embossed. The inner part of the machine part or counter element 11 then carries the pre-embossing pattern and is placed at a level below the rest of the machine part 1 (or a raised level at the machine part 2). A cylinder 12 is connected to a corresponding or the same controlled hydraulic circuit which is set to a suitable embossing pressure. As long as the pressure in the cylinder 12 is below the set pressure the counterpressure element 11 is immobile and the pre-embossing operation may be performed. When the pre-embossing operation is done and the tool has reached the bottom at the inner part, the pressure in the cylinder 12 increases, so that the inner part 11

starts to move into the main part 1 of the machine and the rest of the embossing may be performed.

[0018] An alternative possibility is to perform a pressure limited embossing. The pressure in the cylinder 12 is then set by means of the controlled circuit, such that a lower maximum embossing pressure prevails at the inner counterholding element 11. When embossing is performed the inner counterholding element will yield at this pressure irrespective of a full embossing depth has been reached. This is an advantage with patterns having a portion with a weak profile. The embossing pressure is then set to a suitable level below the breaking stress limit of the plate. The main parts of the machine emboss simultaneously or a short time thereafter with normal pressure.

[0019] The controlled valve 8 may be a simple over-flow valve keeping the pressure constant during the whole embossing operation. With a completely controllable valve there is also a possibility to control the force (the counterpressure) during the press operation.

[0020] Thus, the present invention provides a counterholding device presenting great advantages over the prior art. The counterholding device provides a high holding and clamping pressure which may be set in a simple way by means of the controlled valve. The pressure is constant or controllable during the whole embossing operation. When the machine is unloaded, i.e. it does not perform any embossing operation, there is no high pressure in the holding means. Strong springs which have to be pre-set to a high load already before the embossing operation start are avoided.

[0021] The counterpressure device may also provide an adjustable embossing pressure in order to perform a re-embossing or a pressure limited embossing. This is not possible to achieve with springs which cannot provide such pressure-distance-characteristics with constant pressure independent of the embossing depth or with a suitably controlled counterpressure which may be controlled during the press operation.

[0022] Specific embodiments of the invention have described in the specification. A person skilled in the art will realise that the mechanical and hydraulic components of the invention may be varied in many ways without departing from the scope of the invention. For instance the low pressure LP may be supplied from a hydraulic pump or a central hydraulic system instead of an accumulator tank and a controlled valve may release hydraulic fluid to a sump or the like. The mechanical and hydraulic components are known separately and the invention is not limited to any particular configuration of these. The scope of the invention is only limited by the claims below.

Claims

1. A machine comprising a frame and top and lower machine parts for embossing e.g. a plate, and a counterpressure means to provide a counterpres-

sure element for the plate during the embossing, **characterised in** that the counterpressure element (6, 11) is connected to a hydraulic cylinder (4, 12) the counterpressure element engaging the plate (3), and in that the hydraulic cylinder (4, 12) is connected to a hydraulic circuit having a controllable hydraulic pressure, so that the counterpressure element is pressed back at the controlled pressure during an embossing operation.

2. A machine according to claim 1, **characterised in** that the controlled pressure is constant.

3. A machine according to claim 1, **characterised in** that the controlled pressure is controllable under the embossing operation.

4. A machine according to anyone of the preceding claims, **characterised in** that the counterpressure element is included in a holding means for holding the plate securely during the embossing, that one machine part (1) is connected to a positive counterpressure element (10) an another machine part (2) is connected to a hydraulic cylinder (4), said hydraulic cylinder (4) having a plunger with a plunger stem (5) connected to a gripping means (6) holding the plate (3) together with the positive counter pressure element (10), and in that the hydraulic cylinder (4) is connected to a hydraulic circuit having an adjustable maximum hydraulic pressure (P_{max}), such that the plunger is depressed at the maximum pressure during an embossing operation.

5. A machine according to claim 1, 2 or 3, **characterised in** that the counterpressure element is included in an embossing counterpressure means for providing an embossing counterpressure (11) having a controllable embossing pressure.

6. A machine according to claim 5, **characterised in** that the counterpressure element (11) is arranged at a different level from the rest of a machine part (1) to be brought in contact with the plate (3) before the rest of the machine part and thus provide a pre-embossing.

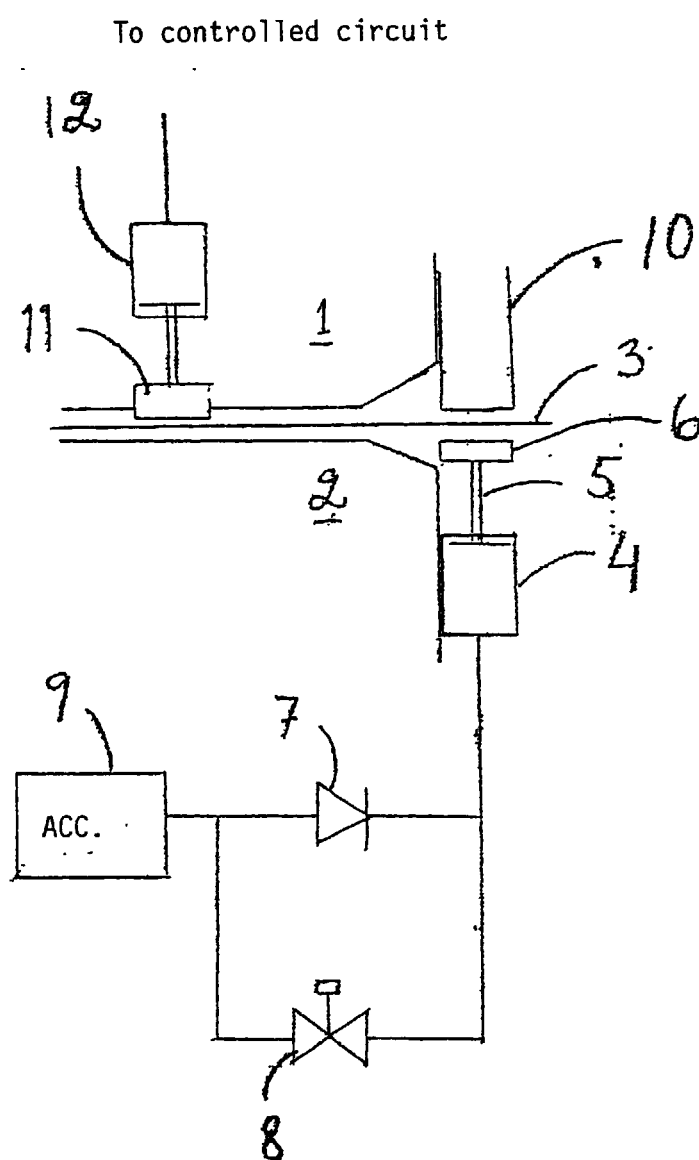
7. A machine according to claim 5 or 6, **characterised in** that the maximum embossing pressure is set lower than a breaking stress for that portion of the plate being embossed at the embossing counterpressure element (11).

8. A machine according to anyone of the preceding claims, **characterised in** that the hydraulic circuit comprises a controlled valve (8) for releasing hydraulic fluid from the hydraulic cylinder (4, 12) at a controllable pressure during the embossing operation.

9. A machine according to claim 8, **characterised in** that the controlled valve (8) releases hydraulic fluid to an accumulator tank (9).

10. A machine according to claim 9, **characterised in** that the accumulator tank (9) is connected to the hydraulic cylinder (4) through a one-way valve (7).

11. A machine according to claim 8, **characterised in** that a hydraulic pump or a central hydraulic system is connected to the hydraulic cylinder (4) through a one-way valve (7) and tat the controlled valve (8) releases hydraulic fluid to a sump.



FIG