

Press with plate-like frame parts, and method for operating such a plate press

The present invention relates to a press for encapsulating electronic components with encapsulating material, comprising: two opposite mould parts displaceable relative to each other, feed means for encapsulating material, and a drive mechanism connecting onto at least one of the mould parts, which drive mechanism is provided with a fluid bed connecting on one side onto a displaceable mould part and a first fluid feed connecting onto the fluid bed. The present invention also relates to a method for encapsulating electronic components with encapsulating material in such a press.

In the encapsulating of electronic components mounted on a carrier, and more particularly in the encapsulating of semiconductor circuits (chips), use is generally made according to the prior art of encapsulating presses provided with two mould parts, into at least one of which are recessed mould cavities. After placing the carrier with the electronic components for encapsulating between the mould parts, the mould parts are moved toward each other such that they clamp the carrier. Encapsulating material is then supplied to the mould cavities and, after at least partial curing of the encapsulating material, the carrier with encapsulated electronic components is taken out of the encapsulating press. To limit the processing cycle of an encapsulating press it is desirable to move the mould parts toward each other rapidly and to reduce the speed only shortly before engaging on the products for encapsulating. A press is thus obtained which operates quickly but is also provided with soft close and therefore reduces the risk of damage to the products for processing. For this purpose various constructions have been developed in the past, such as for instance EP 0 935 520 in the name of the present applicant. Although a drive as described in this European patent provides the desired functionality it has the drawback that the drive is voluminous and heavy. This leads to a relatively expensive press which also takes up a considerable amount of space during use.

Object of the present invention is to provide a press of the type mentioned in the preamble which can be embodied in compact and light manner while it can still be closed at different speeds in a secure manner.

To this end the invention provides a press for encapsulating electronic components with encapsulating material, comprising: two opposite mould parts displaceable relative to each other, feed means for encapsulating material, and a drive mechanism connecting onto at least one of the mould parts, which drive mechanism is provided with a fluid bed  
5 connecting on one side onto a displaceable mould part and a first fluid feed connecting onto the fluid bed, with the feature that the connection of the first fluid feed onto the fluid bed can be interrupted by a displacer, by means of which displacer the displaceable mould part is also operable with interposing of the fluid bed. A fluid bed is understood to mean a piston-like construction; a container open on one side and filled  
10 with a fluid which is covered by a replaceable wall part. Such a device has the advantage that for the rapid mutual displacement of the mould parts (the so-called "high speed movement") an effective fluid drive requiring relatively little pressure can be used. Such a drive can take a very compact form and components are commercially available as inexpensive standard trade items. Another advantage of a fluid bed is that it  
15 can be assembled very compactly with a displaceable mould part. The displaceable mould part can connect directly onto the fluid bed, but in practice it is desirable for the exchangeability of mould parts that the fluid bed is covered by a displaceable wall part adapted for releasable coupling of a mould part. The drawback of a normal drive making use of a fluid bed for the high speed movement is however that it cannot be  
20 combined in a simple and reliable manner with a separate drive facility for the (slower) closing movement of the mould parts which moreover usually requires a greater pressure to be able to provide the desired closing pressure. The present invention now enables combining the advantages of the use of a fluid bed with the advantages of a press that can be operated at different speeds for different parts of the path of movement  
25 and has a drive which provides the required higher pressure only where this is necessary (when actually closing the press). Use is herein made of a displacer operable independently of the first fluid feed. In addition to the desired functionality of a different transmission ratio to facilitate the soft close of the mould parts with greater pressure the displacer also guarantees in inventive manner that when the displacer is  
30 activated the action of the high speed movement (first fluid feed to the fluid bed) is forcibly blocked. This means that the press has a forced process protection.

In a preferred embodiment variant the press also comprises a frame, which frame is provided with at least two plate-like frame parts placed substantially vertically adjacent

to the displaceable mould parts. Such a construction of the press with plate-like frame parts situated on opposite sides of the mould parts, also designated as "plate press", increases the possibilities for a compact construction of the press still further.

Furthermore, the press can thus be manufactured in a relatively light and yet very stable manner. Another advantage is that a press with plate-like frame parts can be  
5 manufactured simply and thus relatively inexpensively.

In yet another embodiment variant the press is provided with a plurality of mutually adjacent displaceable mould parts, wherein for instance a separate fluid bed connects  
10 onto each of the mutually adjacent displaceable mould parts. By means of such a multiple press several products can be processed simultaneously (multi-strip) allowing for the press to compensate possible differences in height between the products for simultaneous processing. The capacity of the press can also be expanded in this manner without very heavy and large drive means being required. This again contributes to the  
15 possibility to embody the press compactly (even when it has a greater processing capacity).

It is possible to opt for embodying the displacer such that it is operable by a cylinder onto which a second fluid feed connects, there are however also other options for  
20 driving the displacer such as an electrical drive, for instance in the form of a servomotor and/or a linear drive. If a cylinder is opted for it is desirable that the transmission ratio of the first fluid feed to the fluid bed is smaller than the transmission ratio of the cylinder to the fluid bed. In this manner the desired higher pressure level when closing the press can be easily achieved. The cylinder can be embodied as desired and  
25 depending on the circumstances as a pneumatic cylinder (air cylinder) or a hydraulic cylinder. When processing sensitive products such as semiconductors a pneumatic drive is generally preferred because this reduces the risk of contamination of the products. With added advantage the press can be embodied such that the fluid bed and the cylinder are fed by a common first fluid feed.

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In a specific embodiment variant the fluid bed is filled with solid particles. Alternatively it is of course also possible to fill the fluid bed with a liquid (such as for instance a liquid which is used in hydraulic systems). The advantage of solid particles is that the risk of leakage and therefore contaminations of the fluid bed is reduced.

In yet another embodiment variant the displaceable mould part forms part of the fluid bed. This means that the displaceable mould part also forms the displaceable part (the piston) of the fluid bed or is at least integrally formed with the displaceable cylinder part of the fluid bed. The displacer can likewise be embodied movable parallel to the contact surface of the displaceable mould part.

The displacer is preferably movable on the side of the displaceable mould part remote from the contact side and can furthermore be embodied such that it is displaceable parallel to the contact surfaces. This means that the displacer directly compresses the fluid bed. The pressure exerted by the displacer will thus be transmitted uniformly to the displaceable mould part. The construction height of the press can thus be kept particularly limited. The displacer can be embodied such that it can be forced completely into the fluid bed such that it is then situated under the displaceable mould part. The cylinder can also be situated under the displaceable mould part but it is easier to allow it to protrude from the rear side (or front) of the press, since this space is available under normal operating conditions and in this manner the components of the press remain very easily accessible, for instance for check-up and maintenance.

The invention also provides a press for encapsulating electronic components with encapsulating material, comprising: two opposite mould parts displaceable relative to each other, feed means for encapsulating material, and a drive mechanism connecting onto at least one of the mould parts for mutual displacement of the mould parts, with the feature that at least one of the mould parts is provided with a displacer whereby the encapsulating material fed between the mould parts by the feed means can be placed under an increased pressure. Such a press also has the advantage that a feed of encapsulating material at relatively low filling pressure can be combined with a separately acting mechanism supplying the actual final filling pressure. The displacer can be embodied very compactly since placing a liquid encapsulating material under final filling pressure only requires very little compression. The displacer can thus be easily integrated in one of the mould parts.

In a preferred embodiment the displacer is formed by a displaceable pin integrated in a mould part and the displacer further preferably connects onto drive means for displacing

the displacer. Such a displacer can be realized in a structurally very simple manner and at relatively very limited costs.

The displacer can moreover be embodied such that it is also adapted for releasing an encapsulated electronic component from the mould. Such a displacer is thereby directly provided with the functionality of a pusher pin or ejector pin. Conversely a known ejector pin (including the drive of such an ejector pin) can also be employed as displacer according to the present invention provided the actuation of the drive is adapted for this purpose. The drive mechanism of one or more ejector pins can thus also be used as drive of one or more displacers.

In yet a further embodiment variant it is possible that the displacer connects onto a passage for encapsulating material arranged in the mould parts. It is of course necessary that the displacer engages directly on (respectively acts on) the fed encapsulating material. When activating the displacer (this means that the displacer is moved into the encapsulating material) the connection between the feed means and the mould cavity determined by at least one of the mould parts around an electronic component for encapsulating can in this manner be impeded which makes flow-back of the encapsulating material from the mould cavity to the feed means impossible. In this manner it is also possible to realize that only the encapsulating material in the mould cavity is placed under an increased pressure. There is therefore no need to embody the feed means such that they can also withstand the higher final pressure required in the mould cavity. This for instance has the advantage that the contamination of the feed means becomes better controllable (such as leakage of encapsulating material between a plunger and an associated plunger housing).

The present invention also provides a method for encapsulating electronic components with encapsulating material in a press according to any of the foregoing claims, comprising the processing steps: A) placing an electronic component for encapsulating on a mould part, B) moving the two opposite mould parts toward each other at relatively great speed, C) after processing step B) making the opposite mould parts connect onto each other at a lesser speed such that the electronic component for encapsulating is enclosed between the mould parts, and D) feeding the encapsulating material to the electronic component, wherein the processing steps B) and C) are forcibly mutually separated in that during processing step C) a safeguard prevents that processing step B)

also takes place simultaneously. For the advantages of applying this method reference is made to the advantages as discussed above with reference to the device according to the invention.

- 5 In addition, the invention also provides a method for encapsulating electronic components with encapsulating material in a press with displacer, comprising the processing steps: P) placing an electronic component for encapsulating on a mould part, L) moving the two opposite mould parts toward each other such that the electronic component for encapsulating is enclosed between the mould parts, M) feeding liquid  
10 encapsulating material to the electronic component under a determined pressure, and N) placing the liquid encapsulating material fed to the electronic component according to the processing step M) under an increased pressure by means of the displacer. By means of this method the advantages can be realized as elucidated above with reference to the press with displacer according to the present invention.

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The present invention will be further elucidated on the basis of the non-limitative exemplary embodiments shown in the following figures, in which:

figures 1A and 1B show perspective views of a plate press according to the present invention,

- 20 figures 2A and 2B show cross-sections through an operating mechanism of a press with a fluid bed drive which engages on a lower mould part of a press respectively in a situation for a high speed movement and a situation for placing the encapsulating material under operating pressure, and

- figures 3A and 3B show cross-sections through a part of a press with a displacer  
25 respectively in a situation during feeding of encapsulating material to a mould part and a situation in which the encapsulating material arranged in the mould part is placed under increased pressure.

- Figures 1A and 1B show two views of the same plate press 1 according to the present invention with a frame 2 having two plate-like frame parts 3, 4 between which two  
30 mutually displaceable mould parts 5, 6 are situated. Situated under the lower mould part is a mechanism 7, not further specified, whereby plungers in the lower mould part 6 can be displaced such that encapsulating material can be displaced with the plungers. For a further elucidation of the operation of the plate press 1 reference is made to the figures below.

Figure 2A shows a cross-section through an operating mechanism 10 according to the invention which connects onto a lower mould part of a press. Herein a fluid 13 containing space 14 is present between a base part 11 and an operating part 12  
5 displaceable relative to the base part 11. When moving the operating part 12 at relatively great speed relative to the base part 11 a fluid is brought into the space 14 via a fluid feed 15 according to arrow F1 respectively removed from the space 14 in opposite direction. This fluid can optionally be introduced with interposing of a fluid container (fluid buffer) out of which fluid can be pressed into the fluid feed 15 by  
10 means of gas pressure (for instance compressed air). This enables driving of the high speed movement in a very simple manner with for instance compressed air. To prevent unwanted interaction between the gas and the fluid a flexible membrane can be placed between the fluid and the gas allowing displacement of fluid without direct contact between the fluid and the gas. As soon as a mould half, connected to the displaceable  
15 operating part 12 and not shown in this figure, connects onto an opposite mould half (or almost connects onto the opposite mould half) a displacer 16 can be activated by means of an operating cylinder 17.

Figure 2B shows the situation of the operating mechanism 10 in which the displacer 16  
20 is displaced relative to figure 2A such that the fluid feed 15 is now separated from the fluid 13 containing space 14. By pressing the displacer 16 into the fluid 13 the pressure in the space 14 will increase with the result that the pressure exerted by the displaceable body 12 will also increase (of course provided that it encounters resistance for instance because mould parts (not shown) connect onto each other). For displacing the displacer  
25 17 an operating pressure P1 will have to be applied on the cylinder 17.

Figure 3A shows a cross-section through two mutually connecting mould parts 20, 21 wherein a carrier 22 with an electronic component 23 mounted thereon is clamped  
between these mould parts 20, 21. By means of displacement according to arrow P2 of a  
30 plunger 24 displaceably accommodated in the lower mould part liquid encapsulating material 25 is pressed through a feed channel 26 (also designated as runner 26) to a mould cavity 27 recessed in the upper mould part 20. This manner of encapsulating electronic components 23 is also designated as transfer moulding.

After the mould cavity 27 is completely filled with encapsulating material 25, as is shown in figure 3B, a displacer 28 can be pressed into the encapsulating material 25. In this case the displacer 28 is situated at a position in the feed channel 26 but the displacer can be arranged as desired at a different location in the upper or lower mould part 20 respectively 21. For displacing the displacer 28 it is operable by a drive 29, in this case an operating cylinder.

## Claims

1. Press for encapsulating electronic components with encapsulating material, comprising:
  - 5 -two opposite mould parts displaceable relative to each other,
  - feed means for encapsulating material, and
  - a drive mechanism connecting onto at least one of the mould parts, which drive mechanism is provided with a fluid bed connecting on one side onto a displaceable mould part and a first fluid feed connecting onto the fluid bed,
- 10 characterized in that the connection of the first fluid feed onto the fluid bed can be interrupted by a displacer, by means of which displacer the displaceable mould part is also operable with interposing of the fluid bed.
2. Press as claimed in claim 1, characterized in that the press also comprises a
- 15 frame, which frame is provided with at least two plate-like frame parts placed substantially vertically adjacent to the displaceable mould parts.
3. Press as claimed in claim 1 or 2, characterized in that the press is provided with a plurality of mutually adjacent displaceable mould parts.
- 20 4. Press as claimed in claim 3, characterized in that a separate fluid bed connects onto each of the mutually adjacent displaceable mould parts.
5. Press as claimed in any of the foregoing claims, characterized in that the
- 25 displacer is operable by a cylinder onto which a second fluid feed connects.
6. Press as claimed in claim 5, characterized in that the transmission ratio of the fluid bed is smaller than the transmission ratio of the cylinder.
- 30 7. Press as claimed in claim 5 or 6, characterized in that the cylinder is a pneumatic cylinder.
8. Press as claimed in claim 6 or 7, characterized in that the fluid bed and the cylinder are fed by a common first fluid feed.

9. Press as claimed in any of the claims 1 - 4, characterized in that the displacer is operable by means of an electrical drive.
- 5 10. Press as claimed in any of the foregoing claims, characterized in that the fluid bed is disposed parallel to the contact surfaces of mould parts.
11. Press as claimed in any of the foregoing claims, characterized in that the displacer is displaceable parallel to the contact surfaces of mould parts.
- 10 12. Press as claimed in any of the foregoing claims, characterized in that the displaceable mould part forms part of the fluid bed.
13. Press as claimed in claim 12, characterized in that the displacer is movable  
15 parallel to the contact surface of the displaceable mould part.
14. Press as claimed in claim 13, characterized in that the displacer is movable on the side of the displaceable mould part remote from the contact side.
- 20 15. Press for encapsulating electronic components with encapsulating material, comprising:  
-two opposite mould parts displaceable relative to each other,  
-feed means for encapsulating material, and  
-a drive mechanism connecting onto at least one of the mould parts for mutual  
25 displacement of the mould parts,  
characterized in that at least one of the mould parts is provided with a displacer whereby the encapsulating material fed between the mould parts by the feed means can be placed under an increased pressure.
- 30 16. Press as claimed in claim 15, characterized in that the displacer is formed by a displaceable pin integrated in a mould part.
17. Press as claimed in claim 15 or 16, characterized in that the displacer connects onto drive means for displacing the displacer.

18. Press as claimed any of the claims 15 -17, characterized in that the displacer is also adapted for releasing an encapsulated electronic component from the mould.

5 19. Press as claimed in any of the claims 15 - 18, characterized in that the displacer connects onto a passage for encapsulating material arranged in the mould parts.

20. Method for encapsulating electronic components with encapsulating material in  
10 a press according to any of the claims 1 - 14, comprising the processing steps:

A) placing an electronic component for encapsulating on a mould part,  
B) moving the two opposite mould parts toward each other at relatively great speed,  
C) after processing step B) making the opposite mould parts connect onto each other at  
a lesser speed such that the electronic component for encapsulating is enclosed between  
15 the mould parts, and

D) feeding the encapsulating material to the electronic component, wherein the  
processing steps B) and C) are forcibly mutually separated in that during processing  
step C) a safeguard prevents that processing step B) also takes place simultaneously.

20 21. Method for encapsulating electronic components with encapsulating material in  
a press as claimed in any of the claims 15 - 19, comprising the processing steps:

P) placing an electronic component for encapsulating on a mould part,  
L) moving the two opposite mould parts toward each other such that the electronic  
component for encapsulating is enclosed between the mould parts,

25 M) feeding liquid encapsulating material to the electronic component under a  
determined pressure, and

N) placing the liquid encapsulating material fed to the electronic component according  
to the processing step M) under an increased pressure by means of the displacer.