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(54) A PRESS FOR PRODUCING PLATES AND SIMILAR ARTICLES

(71) We, DORST-KERAMIKMASCHINENBAU OTTO DORST UND DIPL.-ING. WALTER SCHLEGEL, a German company, of Mittenwalderstrasse 61, 8113 Kochel am See, Germany, do hereby declare the invention,

for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to a press for the production of such articles as plates comprising a rigid upper pressing member, which is shaped in accordance with the interior shape of the plate to be pressed, and with an elastically deformable membrane, which seals the top of a recess of a mould member. The membrane is held at its edge corresponding to the dimensions of the plate to be pressed, and the pressing member is provided with a first profiled face-part corresponding to the foot of the plate, and pulverulent preferably ceramic, more preferably porcelain composition is distributed on the surface of the membrane remote from the recess. The recess is filled under the membrane with a fluid under pressure, and the membrane, after lowering of the pressing member, can cause its pulverulent composition, distributed on the membrane, to be placed under pressure, when the pressing member is in the pressing position.

One previous construction is described in British Patent No. 1,451,523. In this Patent the membrane is held perpendicularly to the direction of movement of the upper pressing punch flatwise and on lowering this pressing punch is deformed downwards to assume the desired eventual shape under the action of the pressure exerted on it. It is however found in this respect that even if this downward movement is supported from below by suction forces, it is not possible to ensure precisely defined and precisely definable stresses within the membrane, which are transmitted to the piled pulverulent composition, something which leads to an irregular plate or similar article. Furthermore on demoulding, when the pressed plate becomes detached from the mould owing to the membrane returning into its initial position, that is to say into its flat position, forces are exerted on the pressed plate, which owing to its low inherent strength lead to damage of the plate, at least in its foot-part, even if they do not lead to complete destruction of the plate.

One aim of the present invention is to improve the prior art press to produce and remove more satisfactorily pressed plates.

To this end there is provided a press for pressing a plate from a composition comprising an upper rigid pressing member having a first pressure profiled face-part corresponding to one face of the plate to be pressed, a lower mould member having a second pressure face-part opposing said first face-part, the second pressure face-part being shaped to correspond to at least part of the other face of the plate to be pressed and being covered by an elastically deformable membrane on which the composition is placeable in a plate forming area so that, on bringing the pressing member and mould member together to form a sealed chamber between the opposed first and second face-parts pressing of the plate is performed by the application of fluid under pressure to the surface of the membrane facing the lower mould member; the elastically deformable membrane being of substantially uniform thickness over the plate forming area and being deformable from an initial relaxed or unstrained condition to a strained condition before placing the composition on the membrane.

A press constructed and operated as indicated is capable of being used practically irrespective of the shape of the plate to be pressed, that is to say irrespective of whether it is a question of a flat or bowled plate.

For pulverulent porcelain compositions which have a low bulk density, there is a danger, when the upper pressing member is lowered, that the pulverulent porcelain composition can easily be blown out and an uneven plate thickness will be produced, more particularly at the rim of the plate. It is advantageous, in accordance with a further development of the invention, to surround the upper pressing member by a resiliently mounted ring, which on downward travel of the upper pressing member comes to rest on a rim which in turn

surrounds the membrane, of the mould member and accordingly prevents any blowing out of the pulverulent porcelain composition from the space between the upper pressing member and the membrane.

At the contact surfaces between this ring and the upper pressing punch it is convenient to provide grooves, which co-operate together in forming a hollow annular cavity, which if required can be placed under vacuum.

In this respect it is advantageous to make the arrangement in such a manner that when the ring comes to engage the rim, surrounding the membrane, of the mould member the vacuum connection is connected with the second face-part and is then automatically switched off on further lowering of the upper pressing punch as soon as two grooves are displaced one over the other.

The membrane is preferably provided at its rim with a hook-shaped cross-section in the form of a lip, into which the rim of an insert of the lower mould member can fit. The whole arrangement is then capable of being fixed by mounting a ring, surrounding the membrane provided with a step, on the upper terminal surface of the mould. After detachment of this ring, which can be held with a few screws on the terminal surface of the mould, the membrane can readily be removed and if the shape of the plate to be pressed is to be changed it can be replaced by a membrane with a suitably different shape or, if wear should have occurred, it can be replaced by a new membrane.

Before the lowering of the upper pressing member and after deformation of the membrane into its filling position in accordance with a further development of the invention a dressing member is caused to act on the top side of the material used for filling and it so shapes the top surface of the material that the desired filling height is achieved. It is therefore necessary to take into consideration the filling ratio and the shape of the article to be produced. The filling ratio is in this respect to be understood to mean a ratio between the volume for the pressing operation and the volume of the plate after pressing.

In the case of the production of flat plates as in a further embodiment according to the invention the profile of an insert provided in the recess of the mould corresponds to the membrane on filling in the pulverulent ceramic material. In the insert it is in this respect convenient to provide channels, which not only serve for supply of the fluid pressure to the hydraulic presses but also serve for causing the membrane to lie snugly on top of the insert owing to removal of pressure medium. The removal of the pressure medium is carried out using a substantial degree of vacuum of for example 0.3 to 0.4 atmospheres so that under this suction action the membrane is caused to rest snugly on the top profile of the insert but, however, in the vicinity of the supply channels space is still left which makes it possible for the pressure medium to become applied to the lower surface of the membrane on application of the hydrostatic pressure.

If there is an angle at any position in the filling profile which is larger than the angle or repose of the composition to be pressed then according to a further development of the invention an embodiment which is also suitable for the manufacture of flat plates is provided.

In this modified embodiment of the press according to the invention the insert is subdivided into an outer part and an inner part which unlike the outer part can be vertically adjusted and which, for example in the form of a plate, lies against the central lower part of the membrane. This lower part must be capable of being shifted, preferably against the force of a spring and the shifting displacement can be chosen so as to be adjustable.

In the filling condition the inner part is raised as compared with the outer part of the insert. As a result the membrane is raised out of its resting position, which is the same as the pressing position, into a pre-stressed position, which is equivalent to the filling position. The filling and dressing of the top surface so as to be smooth of the filled in pulverulent porcelain composition is carried out in the same manner as is the case with the press in accordance with the invention in accordance with the above described form of embodiment.

After the filling the lower part is pressed downwards against the action of the spring acting upon it by the upper pressing member via the pulverulent procelain composition. When this is done the membrane is also moved out of its prestressed position into its relaxed rest position, which corresponds to the pressing position.

In this position the pressure fluid is caused to act against the lower side of the membrane.

In this manner it is possible to ensure reliably that in the case of plates, which have parts having a steep angle above the angle of repose, the composition does not slide inwards, because even on causing the upper pressing punch to come into position the composition is trapped between this pressing member and the membrane.

With this design it is readily possible to change over from one type of plate to another type of plate. It is only necessary to provide for vertical adjustability of the inner part, replacement of the membrane by another one and naturally also replacement of the profile of the upper pressing member and of the pressing device without the basic design of the press itself having to be subject to any modifications.

In the case of the last-mentioned embodiment an effect which occurs with normal presses operating with hydrostatic counter-pressure - the so-called "water bed effect" - is completely avoided. When this effect does occur application of the pressure by the upper pressing punch causes the liquid sometimes to move out of the way unevenly and the result is uneven pressing

within the plate. In the case of the press in accordance with the invention on the other hand in the filling position on dressing the composition there is a precisely defined position of the membrane even although the flag part of the plate is not supported in the case of the second embodiment.

In the case of the firstly described form of embodiment this "water bed effect" does not occur in principle because in this case in the filling position on dressing the composition the membrane is supported over its whole lower surface.

Two embodiments according to the invention will now be described by way of example only, with reference to the accompanying illustrative drawings, in which:

Figure 1 is a vertical section through the upper pressing member and the mould of a first embodiment of a press according to the invention in the filling position;

Figure 2 is a sectional side view of a part of the embodiment of Figure 1;

Figure 3 is a sectional side view of the embodiment of Figure 1 in the pressing position;

Figure 4 is a sectional side view of a second embodiment of a press according to the invention for pressing deep-bowled plates;

Figure 5 is a sectional side view of a part of the construction of Figure 4, and

Figure 6 is a sectional side view of the embodiment of Figure 4 in the pressing position.

In Figure 1 reference numeral 1 denotes the tup, which on its lower face has the upper pressing member 2 attached to it in a removable manner. This pressing member 2 has at its rim a peripheral groove 3. The rim 4 of the pressing member 2 moves towards a ring 5 carried on the tup 1 resiliently (at 23). This ring 5 is also provided with a peripheral groove 6 which cooperates with the peripheral groove 3. The annular duct or channel so formed by the annular grooves 3 and 6 can be brought into connection with a source of vacuum, not particularly shown in the drawings, in a manner (which is not shown) via the upper pressing member 2 or via the ring 5. The ring 5 comes to rest on a ring 7 on lowering the upper pressing member 2. The ring 7 lies on the mould 8 which is carried by the press frame which is not specially shown. The ring 7 is held in place by a further ring 9 and can for example also be attached by means of screws 10 on the mould 8. The ring 7 has a projection 11, more particularly indicated in Figure 2, which fits over the outer rim 12 of the membrane 13. The rim 12 is so constructed that it has a hook-shaped cross-section, into which the edge 14 of an insert 15 fits. The upper surface of this insert 15 defines the filling position of the membrane 13, in which it is supported practically over its whole lower surface on the upper surface of the insert 15 and it is only in the vicinity of the outlet of the channels 16 and 17, which are connected with a central duct or channel 18, that a small space 19 (see Figure 2) is provided, which makes it possible for the supply depressure medium to become distributed over the whole lower surface of the membrane.

For filling the press firstly vacuum is connected with the channels 16 and 17 via the channel 18 so that the membrane 13, which in its relaxed condition has its upper surface in a shape practically identical with the lower surface of the plate to be pressed, is deformed and brought into engagement with the insert 15, and then the pulverulent porcelain composition 20 to be pressed is filled in in a conventional manner which is not shown and described in detail, and with the aid of a dressing member, not shown either in detail, is distributed in accordance with the desired filling height generally in accordance with the shape of the lower surface 21 of the pressing member 2 on the membrane 13 which is prestressed into the filling position. The pressing member 2 is then moved downwards with the help of the tup 1 until the ring 5 comes to rest on the ring 7 and then the rim 22 comes to rest on the ring 5, the spring 23 being compressed. Following this the mould is closed and completely sealed off from the outside (Figure 3). By applying vacuum to the annular channel formed by the two grooves 3 and 6 it is then possible to provide for an extremely substantial removal of air from the space, located under the lower pressing punch, before the two grooves 3 and 6 are shifted one over the other.

Now pressure fluid is supplied via the channel 18 and the channels 16 and 17 so that the membrane 13 is moved clear of the insert 15 in the manner indicated in Figure 3 and is returned into its relaxed initial condition. When this is done the space 22' is filled with pressure fluid and the pressure fluid acts completely evenly on the lower surface of the membrane 13 so that the pulverulent porcelain composition 20 is pressed completely evenly against the lower surface 21 of the pressing member 2. It is thus possible to ensure that the completely evenly compacted plate is produced. In the case of the present embodiment of the invention it is generally a flat plate.

For opening the press it is not only necessary to release the pressure in the space 22 and the channels 16, 17 and the supply channel 18 but also to apply a vacuum again so that the membrane 13 returns to its pre-stressed filling and initial position, releases the pressed plate and can be charged with pulverulent porcelain composition 20 again.

In the case of the embodiment of the invention as shown in Figures 4 to 6 the insert is subdivided into two parts, that is to say an outer part 15*a* screwed on to the mould 8 and an inner part. The inner part has, in the case of the embodiment illustrated, the shape of a plate or platen 15*b*, which comes to rest against the inner lower part of the membrane 13. Furthermore the plate 15*b* can be moved against the force of a spring 24, which has one end 24*a*

resting against the mould 8 while its other end 24*b* rests against a hood-shaped sleeve 25 surrounding it and attached to the platen 15*b*. The construction of the upper pressing punch 2 is selected in accordance with the desired shape of the plate. Its attachment to the tup 1 is just the same as with the pressing punch 2 on the tup 1 in accordance with Figures 1 to 3 so that more detailed explanations are not called for.

Furthermore the attachment of the membrane by means of the insert, consisting in this case of two parts 15*a* and 15*b*, using the rings 7 and 9 is entirely in accord with the design in accordance with Figures 1 to 3 so that in this respect as well it is not necessary to provide a repetition of the explanation.

In the filling position as shown in Figure 4 the membrane 13 is deformed by means of the platen 15*b* under the action of the spring 24 out of its relaxed condition corresponding to the final shape of the plate to be produced, as can be seen clearly from Figure 4.

It is in this pre-stressed condition of the membrane 13 that the filling and dressing of the pulverulent porcelain composition occurs as was indicated in conjunction with Figures 1 to 3 though in the present case this filling operation is not explained and shown in detail. After the filling operation the tup 1 and accordingly also the upper pressing punch 2 are lowered and the platen 15*b* is pressed downwards against the action of the spring 24 acting on it, by the upper pressing punch 2 via the pulverulent porcelain composition. When this is done the membrane is also moved out of its pre-stressed filling position into its relaxed resting condition which corresponds to the pressing position as shown in Figure 6. In this position the pressure fluid can be caused to act on the lower side of the membrane 13 in the manner described in conjunction with Figures 1 to 3 via the channel 18 and the channels 16 and 17 which in the present case are suitable shortened. Owing to the raising of the membrane into the filling position as is indicated in Figure 3, it is therefore possible to ensure reliably that in the case of plates which have parts so steeply angled as to lie above the angle of repose, the composition does not slide inwards because even when the upper pressing member 2 comes into position the composition is trapped between the pressing punch 2 and the membrane 13.

It is to be pointed out once again that the membrane is to be made of the same even minimum thickness over substantially its whole area though, however, it should have a sufficient inherent stability or strength.

WHAT WE CLAIM IS:—

1. A press for pressing a plate from a composition comprising an upper rigid pressing member having a first pressure profiled face-part corresponding to one face of the plate to be pressed, a lower mould member having a second pressure face-part opposing said first face-part, the second pressure face-part being shaped to correspond to at least part of the other face of the plate to be pressed and being covered by an elastically deformable membrane on which the composition is placeable in a plate forming area so that, on bringing the pressing member and mould member together to form a sealed chamber between the opposed first and second face-parts pressing of the plate is performed by the application of fluid under pressure to the surface of the membrane facing the lower mould member; the elastically deformable membrane being of substantially uniform thickness over the plate forming area and being deformable from an initial relaxed or unstrained condition to a strained condition before placing the composition on the membrane.

2. A press as claimed in Claim 1 in which the composition is a pulverulent ceramic composition.

3. A press as claimed in Claim 2 in which the composition is a porcelain composition.

4. A press as claimed in any one of the preceding claims in which the upper pressing member is surrounded by a resiliently mounted ring which on downward travel of the upper pressing member comes to rest on a rim surrounding the membrane of the mould.

5. A press as claimed in Claim 4 in which at the contact surfaces between the ring and the upper pressing member, a groove is provided for forming a hollow annular cavity which if required can be placed under vacuum.

6. A press as claimed in Claim 4 or Claim 5 in which the rim is provided with a groove.

7. A press as claimed in Claim 6 in which when the ring comes to engage the rim, surrounding the membrane, the vacuum connection is connected with the second face-part and is then automatically switched off on further lowering of the upper pressing member as soon as the two grooves are displaced one over the other.

8. A press as claimed in any one of the preceding claims in which the lower mould member includes an insert and the membrane is provided at its rim with a lip having a hook-shaped cross-section, into which the rim of the insert can be fitted, and in which the whole arrangement can be fixed by mounting in position a ring, surrounding the membrane and provided with a step, on the upper terminal surface of the mould.

9. A press as claimed in any one of the preceding claims in which a dressing member is located above the composition material located on the membrane and is elastically deformed and the dressing member shapes the top surface of the composition before lowering of the upper member.

10. A press as claimed in Claim 8 or Claim 9 when appendant to Claim 8, for producing flat plates, in which the profile of the insert corresponds to the initial profile of the membrane.

11. A press as claimed in any of Claim 8 and Claims 9 and 10 when appendant to Claim 8, in which insert channels are provided for supplying

and removing the fluid to the recess.

12. A press as claimed in Claim 11 in which a suction device is provided in which applies the membrane against the top profile of the insert but, in the vicinity of the channels a residual space is provided, which makes it possible for the pressure medium to reach the lower side of the membrane on application of the hydrostatic fluid to the recess.

13. A press as claimed in any one of Claim 8 and Claims 9 to 11 when appendant to Claim 8, in which the insert is subdivided into an outer part and an inner part which unlike the outer part can be adjusted vertically and which in the form of a platen rests against the central lower part of the membrane.

14. A press as claimed in Claim 13 in which the inner part can be displaced against the force of a spring.

15. A press as claimed in Claim 14 in which the shifting displacement of the inner part can be adjusted.

16. A press as claimed in Claim 14 or Claim 15 in which the inner part of the insert is raised in relation to the outer part in the filling position and as a result the membrane is raised from the pressing profile to the filling profile.

17. A press substantially as herein described with reference to the accompanying illustrative drawings.

18. A method for pressing a plate from a plate forming composition comprising:

placing the composition on an elastically deformable membrane located in or over a recessed portion of a first die member in a plate forming area, the membrane having previously been deformed from an initial or unstrained condition to a strained condition, the membrane in the plate forming area being of substantially the same thickness;

bringing a second die member into contact with the first die member to seal the composition between the dies on the membrane in the plate forming area, and

applying fluid under pressure to the recessed portion beneath the membrane to cause the membrane to deform from the strained condition to the unstrained condition and to press the composition into a plate.

19. A method as claimed in Claim 18 in which the composition is smoothed by a dressing member before the second die is brought into contact with the first die member.

20. A method as claimed in Claim 18 or Claim 19 in which pressing of the plate is applied on a press as claimed in any one of Claims 1 to 17.

21. A method substantially as herein described with reference to the accompanying illustrative drawings.

22. A plate when formed on a press as claimed in any one of Claims 1 to 17.

23. A plate when formed by a method as claimed in any one of Claims 18 to 21.

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1589666 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1

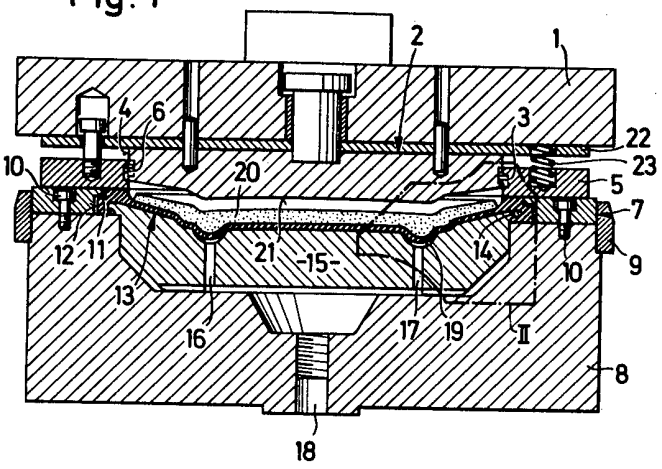

Fig. 2

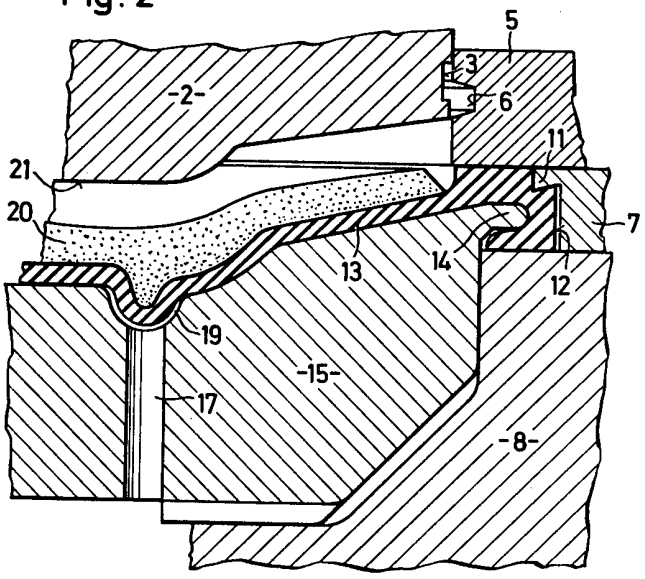

Fig. 3

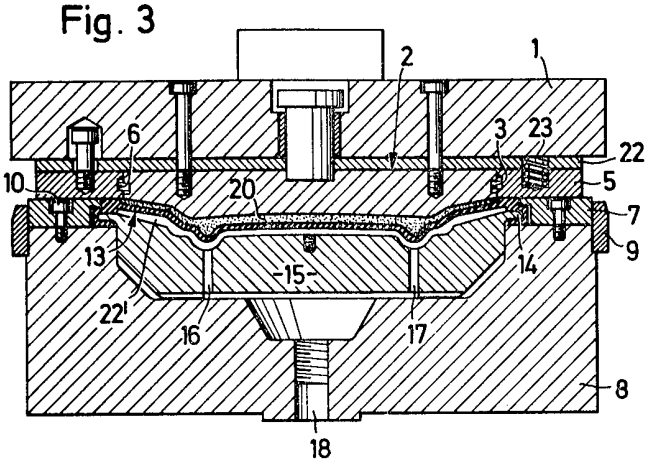
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Fig. 4

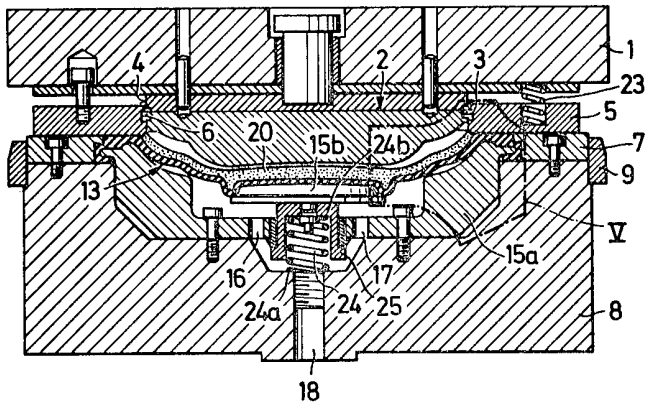
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Fig. 5

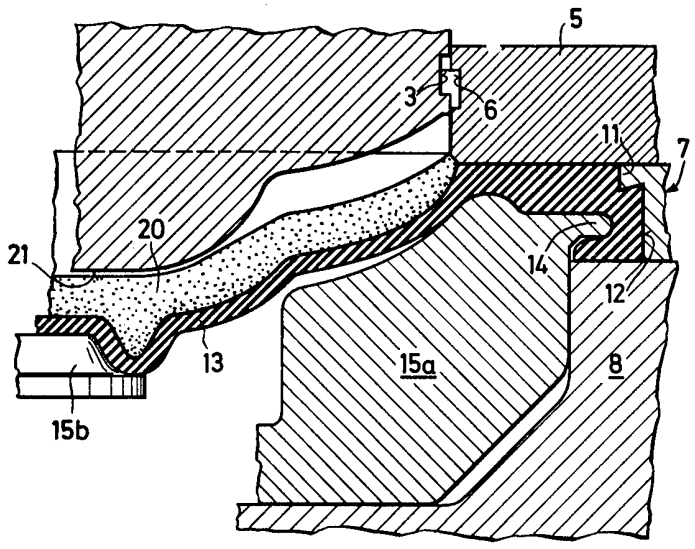

Fig. 6