

The invention relates to a mould-closing unit with associated injection-mould-exchanging apparatus according to the concept of patent claim 1.

"Conditioning" within the meaning of the concept is the thermal adaptation of the injection mould to intended operating conditions, which adaptation is carried out outside the working position and, as a rule, during the injection-moulding operation with another injection mould.

In a known injection-moulding unit with associated injection-mould-exchanging apparatus of this type (DE-PS 33 23 353), the supply coupling is constructed for an injection mould which is placed in the vertical direction, i.e. from the top, onto the conditioning table. This vertical setting-down movement is then utilised for the mutual approach of the coupling heads or the coupling halves respectively for their abutment against one another, and also for coupling of the supply lines. The machine-side coupling half is connected to the conditioning table via a coupling rod, which is displaceably mounted in a guide of the conditioning table and driven with the injection mould into the mould-clamping area of the mould-closing unit. The mould-side coupling head is connected via a connecting member to the injection mould, which is placed on the conditioning table, in such a manner that it is always in the same spatial relation to the conditioning table. With respect to differently dimensioned mould bodies of the injection mould, this is achieved by a connecting member of reciprocal dimension. It is then ensured that the connecting couplings of both coupling heads are always vertically

flush during the vertical setting-down movement of the injection mould.

It is also known to provide injection moulds with abutment plates which extend beyond the square-shaped injection-mould body on both sides at the ends (DE-OS 23 32 205; DE-GM 1 965 313; European Patent Application 0 092 686 A1).

It is the object of the invention to further develop a mould-closing unit with associated injection-mould-exchanging apparatus of the initially described type, so as to establish, with a little technical effort, the structural pre-conditions for automatic coupling of the supply lines, controlled by the computer of the injection-moulding machine, when the injection mould is driven, horizontally and transversely to the closing direction of the mould-closing unit, onto the conditioning table.

This object is achieved by the features of patent claim 1.

An arrangement of this type offers the additional advantage that the lower entrance to the mould-clamping area of the mould-closing unit is no longer restricted by a guide mount for the coupling rod, which mount is attached to the adjacent mould carrier. This makes the inclusion of special devices easier. During the transport of the injection mould from the conditioning table into the mould-clamping area, and during the injection moulding, i.e. when the injection mould is in the working position, the machine-side coupling half is exclusively carried by the mould-side coupling half, so that no further support members for the machine-side coupling half are required during the transport and during injection moulding.

It is already known from the DE-OS 32 28 434 and EP 0 069 221 and with respect to an injection-moulding unit with injection-moulding apparatus, pre-heating station and supply couplings for coupling flexible supply lines of a synthetic-material injection mould to machine-side supply lines, to provide a machine-side coupling half with a coupling drive, comprising a piston-cylinder arrangement. However, this machine-side coupling half cannot be moved between the pre-heating station and the mould-closing unit. Instead, the pre-heating station and the mould-closing unit are each associated with a fixed machine-side coupling half.

In an arrangement according to patent claims 2-6, the transport movement of the injection mould, when driven onto the conditioning table, is utilised in a simple manner to establish an alternate rearwardly engaging connection of the machine-side coupling half with the mould-side coupling half and with the conditioning table. If the injection mould is driven backwards onto the conditioning table, then a rearwardly engaging connection between the machine-side coupling half held at the conditioning table and the mould-side coupling half results. If the injection mould is driven onto the conditioning table from the front, i.e. from the mould-clamping area, then a rearwardly engaging connection of the machine-side coupling half with the conditioning table results. When coupling the supplies, the connecting couplings of the machine-side coupling half are driven onto the connecting couplings of the mould-side coupling half, so as to establish the coupling connection. A negative coupling profile of the machine-side coupling half corresponds to a respective positive profile of the mould-side coupling half.

In an arrangement according to patent claim 7, injection moulds of different sizes can be exchanged in

a standardised injection-mould-exchanging apparatus, as mould bodies of different sizes can be combined with identically dimensioned, i.e. standardised abutment plates. By attaching the mould-side mould body exclusively to the abutment plate of the injection mould, a constant spatial relation between the mentioned coupling half and the conditioning table is ensured, if the injection mould is placed on the associated setting-down place. A particularly space-saving construction of the machine-side coupling half results from an arrangement of the coupling drive according to patent claims 8-12.

Below, the inventive mould-closing unit will be described based on the drawing and two exemplary embodiments.

Shown are, in

- Fig. 1, 2: a cut open injection mould before and after the coupling stroke in a side view (without the flexible conditioning connections 33');
Fig. 3: an injection mould as in Fig. 2 from the direction A of Fig. 2;
Fig. 4: an injection mould without machine-side coupling half in a top view;
Figs. 5, 6: an injection mould on the conditioning table before and after the coupling stroke in a view corresponding with Fig. 3;
Figs. 7, 8: a variant of the injection mold in an illustration corresponding with Figs. 3, 4.

Figs. 9, 10: sections of Figs. 1 and 2 in the area of the vertically cut coupling halves, in enlarged illustration; and

Figs. 11, 12: cross-sections along the lines XI-XI and XII-XII of Figs. 9 and 10.

The injection mould S, comprising the mould-side coupling half, and the associated automatic injection-mould-exchanging apparatus at the mould-closing unit are functionally aligned. The coupling device of a supply coupling, which device comprises the mould-side coupling half 30 and a machine-side coupling half 31, serves the automatic coupling of flexible supply lines for the injection process and the pre-heating (conditioning) of the injection mould to the operating temperature on a conditioning table 19. It is characteristic of the automatic injection-mould-exchanging apparatus that the injection mould S is transported, without decoupling the machine-side supply lines 35 leading to and from the tempering devices from the conditioning table 19, horizontally and vertically to the closing direction into the mould-clamping area in the working position and vice versa. The coupling half (30 or 30' respectively in Figs. 7, 8), which is mounted to the injection mould S, is arranged in front of the rear end surface 40f of the mould body 40 of injection mould S, which body is defined by the abutment plates 41. The corresponding machine-side coupling half (31 or 31' respectively in Figs. 7, 8), which is at times connected to the conditioning table 19, is arranged above the injection mould S and equipped with a coupling drive in the form of a piston-cylinder unit 34 for the coupling stroke of the supply coupling. During the coupling stroke, the machine-side coupling half 31 or 31' respectively is guided on vertical coupling pins 60. The coupling pins 60 reach

alternately behind a holding means 63b of the conditioning table 19 and the mould-side coupling half 30 or 30' respectively in dependence of the transport movement of the injection mould S, when this injection mould is transported on the conditioning table alternately from opposite directions. The coupling pins 60, which on both sides project from the table-side coupling half 31, comprise cylindrical coupling heads 60b, 60a, as is particularly clearly shown in Figs. 9-12. During the transport movement of the injection mould S, the upper coupling heads 60b are driven into a corresponding T-groove 63c of the holding means 63b of the conditioning table 19, and the lower coupling heads 60a are driven into a T-groove 30a of the mould-side coupling half 30. The coupling pins 60 and the corresponding T-grooves 30a, 63c are arranged symmetrically to the vertical plane of symmetry s-s of coupling halves 30, 31 or 30', 31' respectively. The holding means 63c, which is provided with the T-groove 63c, is mounted to the horizontal support beam 63a of a bridge 63 of the conditioning table 19, as is illustrated in Figures 5, 6. The lower T-groove 30a is arranged in a T-groove rib 30b of the mould-side coupling half 30 or 30' respectively. This T-groove rib is flanked on both sides by the in-line connecting couplings 32; 32' of the conditioning connections 30 or 31' respectively. The conditioning connections 33 connect the mould half, which is clamped to the stationary mould carrier of the mould-closing unit, of the injection mould with the mould-side coupling half 30. The conditioning connections 33' connect the mould half, which is clamped onto the movable mould carrier, with this coupling half 30. As can be seen particularly clearly in Figures 11 and 12, the step-shaped positive abutment profile of the mould-side coupling half 30

corresponds with a respective negative abutment profile of the body 31a of the machine-side coupling half 31.

The coupling unit, composed of the coupling halves 30, 31 or 30', 31' respectively, of a supply coupling is mounted by means of bolts 67 to the upper edge of an abutment plate 41 and flush with the rear face 40f of mould body 40 and with the outside surface of their receiving abutment plate 41. As is shown in Figures 5 and 6, the injection mould is guided by guide rails 19a, 19b in its transport path from the conditioning table 19 into the mould-clamping area. These guide rails abut in the area of an abutment plate 41, which area projects downwards from the mould body 40, against it or against an insulating plate 42 of the abutment plate 41, which is attached to the mould body 40 by means of a centering pin 43.

A hydraulic piston-cylinder unit 34 is provided to serve as a coupling drive. The horizontal stroke of this piston-cylinder unit 34 is converted into a vertical coupling stroke by means of a curve control. The curve control comprises two parallel control ledges 65, which are connected via a connecting pin 64 to the piston rod 34c of the piston-cylinder unit 34. The plane inner sides of the control ledges 65 abut against diametral flattenings 60d of the coupling pins 60. These are always at the same distance above the transport path of injection mould S. The outer surfaces of the control ledges 65 abut against the inner guide surfaces of the body 31a of the machine-side coupling half. Both control ledges 65 are provided with congruent control curves 65a. Into these dip diametral control pins 60c of the adjacent coupling pins 60. During the coupling stroke of the piston-cylinder unit 34, which is supported against the body 31a, the piston 34b pulls, via its piston rod 34c, the control ledges

65 from a position as in Fig. 9 into a position as in Fig. 10. Thereby, the control ledges 65 slide with their lower edges on horizontal shoulders 31b of the body 31a. Guide pins 66 of the body 31a project into horizontal oblong holes 68 of the body 31a of the machine-side coupling half 31, thus ensuring that there is no relative movement between the control ledges 65 and the body 31a in the vertical direction. During the displacement of the control ledges 65 from the position as in Fig. 9 into the position as in Fig. 10, the stationary pins 60c of the coupling pins 60 force, due to the control curves 65a, the vertical coupling stroke of the entire machine-side coupling half 31.

In this coupling stroke, the control ledges 65 are guided both on the diametral flattenings 60d and the inner guide surfaces of the body 31a and the guide pins 66.

During the coupling stroke, the centering pins 61 of the mould-side coupling half 30 or 30' respectively dip into respective centering bores of the machine-side coupling half 31 or 31' respectively for exact centering. At the same time, at least one centering pin 62 of the machine-side coupling half 31 or 31' respectively is released from the centering aperture of the holding means 63b during this coupling stroke.

In an area which rearwardly projects from the abutment plate, the coupling halves 30, 31 or 30', 31' respectively also have corresponding probe connections 32a and electrical connections 32b and a coding 32c. A connecting body 36 with connecting couplings 37 is arranged at the front end edge of this abutment plate 41, which abuts against the movable mould carrier when the injection mould S is in its working position. These connecting couplings correspond with connecting couplings of a stationary connecting body 38. Lines 39,

which do not serve the conditioning of the injection mould (for example electrical lines for probes or lines for the detection of certain dimensions and/or hydraulic connections for the movement of core or slides or for driving unbolting units), are connected via said connecting bodies 36, 38.

In the exemplary embodiment of Figures 1-6, both mould halves of the injection mould are supplied during conditioning via a single machine-side coupling half 31 and an associated single mould-side coupling half 30. In the exemplary embodiment of Figures 7, 8, each injection-mould half of the injection mould is associated with a machine-side coupling half 31' and an injection-mould side coupling half 30'. Accordingly, two holding means 63b are provided. If the injection moulds S or of different length, then the coupling half 30' is attached to the abutment plate 41 in such a manner that its connecting couplings 32 are flush in the vertical with the connecting couplings 32', the position of which is constant. During an automatic mould exchange, the injection mould and the associated injection-mould-exchanging apparatus functionally co-operate as follows: Fig. 2 or Fig. 7 respectively illustrates the coupling state of the injection mould in the working position in the mould-clamping area of the mould-closing unit, i.e. during injection moulding. The injection mould S is supplied via coupling halves 30, 31 or 30', 31' respectively as well as via the connecting bodies 36, 38.

After releasing the clamping bolts 15, the injection mould S to be exchanged is transported from the mould-clamping area to the conditioning table 19. During this transport movement, the connecting bodies 36, 38 are separated from one another. In the last phase of this transport movement, the coupling heads 60b of coupling

pins 60 of the machine-side coupling half 31 or 31' respectively drive into the T-groove 63c of the holding means 63a of bridge 63 of the conditioning table 19. This results in a position as is illustrated in Figures 6, 10 and 12. Then, the coupling heads 31, 30 or 31', 30' respectively are separated from one another by means of a stroke of the piston-cylinder unit 34, which stroke is initiated by the computer of the synthetic-material-injection-moulding machine or path dependently. This results in a position as is illustrated in Figures 5, 9, 11. In this position, the machine-side coupling half 31; 31' is centered by means of the centering pin 62 at the holding means 63b.

In the course of a further horizontal transport movement, which runs vertically to the closing direction of the mould-closing unit, the injection mould S is moved with its mould-side coupling half 30 or its mould-side coupling half 30' respectively onto a transport table (not illustrated), and moved together with the latter into the injection-mould depot. The machine-side coupling half 31 or the machine-side coupling half 31' respectively remain at the holding means 63b of the conditioning table 19. The exchanging injection mould arrives in an opposite transport path from the injection-mould depot via the transport table and the conditioning table 19 in the mould-clamping area in the working position. During the transport movement of the injection mould from transport table onto the conditioning table 19, the T-groove 63c of the mould-side coupling half 30 or 30' respectively is driven over the lower coupling heads 30a of the machine-side coupling halves 31 or 31' respectively, which is suspended from the holding means 63b. This results in a position as is illustrated in Figures 5 or 10 or 12 respectively. By means of a coupling stroke,

the coupling halves 30, 31 or 30', 31' respectively are now placed in opposing abutment, i.e. in a position as in Figures 6, 10, 12, in which position the injection mould is connected to all supply lines required for conditioning. The injection mould is then conditioned, which can take up a period of time of varying length. It has to be mentioned in this context that, as a rule, the conditioning is carried out whilst the injection mould to be exchanged is still being injection-moulded in the mould-clamping area. This time-saving method made possible in that the conditioning table 19 is provided with two setting-down places and is displaceable in the closing direction of the mould-closing unit. Thus, the injection mould to be exchanged can arrive, via the second setting-down place of the conditioning table 19, at the transport table (as described above), whilst the exchanging injection mould is conditioned on the first setting-down place.

After completed conditioning, the injection mould is transferred with both coupling halves 30, 31 or 30', 31' respectively into the working position in the mould-clamping area, whereby the coupling heads 60b of the machine-side coupling half 31 or 31' respectively are driven out of the T-groove 63 of the holding means 63c. In the last phase of the drive-in movement into the mould-clamping area, the connecting bodies 36, 38 arrive in opposing abutment. In this way, the supply lines 39, which do not serve the conditioning but are required exclusively during the injection moulding, are connected to the injection mould.

In conclusion it may be mentioned that a breakdown of the coupling drive, in particular of the hydraulic drive force of the piston-cylinder unit 34, does not result in a release of the mutual abutment of the coupling halves 31, 30 or 31', 30' respectively,

because the identical control curves 65a in the control ledges 65 comprise each an upper end section of an angle of incline which is so low that in the coupling position (Fig. 10) self-locking of the control pins 60c in the associated control curves 65a is ensured. Thus required greater release force during the release of the clutch is made available by a respective construction of the piston 34b of the piston-cylinder unit 34. During the release stroke, this piston 34b is to be loaded with a larger piston surface than during the coupling stroke.

Patent Claims

- 1: Mould-closing unit with an injection-mould-exchanging apparatus, a conditioning table and a supply coupling with coupling halves, which are separable along a horizontal parting plane, for coupling of flexible supply lines of a synthetic material injection mould to machine-side supply lines of the mould-closing unit for the purpose of pre-heating (conditioning) the injection mould on the conditioning table, from where the injection mould is transportable without removal of the supply lines horizontally and vertically to the closing direction of the mould-closing unit into its operative position in the mould-clamping area of the mould-closing unit,

with a fixed arrangement of the mould-side coupling half in front of the rear-end side of the mould body, which is facing away from the mould-clamping area and defined by the abutment plates, of the injection mould, and with the machine-side coupling half being arranged to be movable between the conditioning table and the mould-clamping area,

characterised in that the machine-side coupling half (31;31'), which is arranged above the injection mould (S), is provided with a coupling drive for the coupling stroke of the supply coupling, and which is guided during the coupling stroke by vertical coupling pins (60), which alternately reach behind a holding means (63b) of the conditioning table (19) and the



injection-mould-side coupling half (30, 30') in dependence on the transport movement of the injection mould (S).

- 2: Mould-closing unit according to patent claim 1, characterised in that the coupling pins (60), which extend on both sides beyond the machine-side coupling half (31), have coupling heads (60, 60a) at their two ends, and in that during the transport movement of the injection mould the upper coupling heads (60b) are driven into a corresponding T-groove (63c) of the holding means (63b) of the conditioning table (19), and the lower coupling heads (60a) are driven into a T-groove (30a) of the mould-side coupling half (30).
- 3: Mould-closing unit according to patent claim 1 or 2, characterised in that the coupling pins (60) and the corresponding T-grooves (30a, 63c) are arranged symmetrically to the vertical plane of symmetry (s-s) of the coupling halves (30, 31).
- 4: Mould-closing unit according to one of the patent claims 1 - 3, characterised in that the holding means (63b) including the T-groove (63c) is mounted to the horizontal holding element (63a) of a bridge (63) of the conditioning table (19).
- 5: Mould-closing unit according to one of the above patent claims, characterised in that the lower T-groove (30a) is arranged in a T-groove rib (30b) of the mould-side coupling half (30), and said T-groove rib is flanked on both sides by individual line terminals (32, 32'), arranged in



series, of the conditioning connections (33, 33').

- 6: Mould-closing unit according to patent claim 5, characterised in that the negative coupling profile of the body (31a) of the machine-side coupling half (31) corresponds to a positive coupling profile of the mould-side coupling half (30).
- 7: Mould-closing unit according to one of the above patent claims, characterised in that the supply coupling (Fig. 2), composed of the two coupling halves (30, 31), rests on the top edge of an abutment plate (41) injection mould (S) and is flush with both the rear face-side (40f) of the mould body (40) of the injection mould (S) and the outside surface of the abutment plate (41).
- 8: Mould-closing unit according to one of the above patent claims, characterised in that the coupling is driven by a hydraulic piston-cylinder unit (34), the horizontal stroke of which is convertible into a vertical coupling stroke by means of a cam control.
- 9: Mould-closing unit according to patent claim 8, characterised in that the cam control includes cam tracks, which are connected to the piston rod (34c) of the piston-cylinder unit (34), with follower pins (60c) of the coupling pins (60) engaging into its cam curves (65a).
- 10: Mould-closing unit according to patent claim 8 or 9, characterised in that the cam tracks (65) of the cam control are guided both on diametrically flattened areas (60d) of the coupling pins (60), which are always arranged at the same distance above the transport path of



the injection mould (5), and on inner guide surfaces and by means of elongate holes (68) on guide pins (66) of the body (31a).

11: Mould-closing unit according to one of patent claims 8-10, characterised in that the identical control curves (65) have each one upper end section of such small angle of inclination that selflocking of the control pins (60c) in their respective cam curves (65a) whilst in the coupling position (Fig. 10) is guaranteed.

12: Mould-closing unit according to one of patent claims 8-11, characterised in that the piston (34b) of the piston-cylinder unit (34) is loaded by a lesser piston surface during the coupling stroke than during the uncoupling stroke.

