

The invention relates to a mould-closing device according to the concept of patent claim 1.

A coupling chamber, arranged asymmetrically to the injection axis in the meaning of the concept, is understood to be a coupling chamber, arranged asymmetrically to a vertical plane of symmetry of the mould-closing device, in that it extends predominantly towards one side, starting from said plane of symmetry.

In a known mould-closing device of this type (DE-C-32 43 991), the piston rod with its rearwardly engaging members can be axially driven into the coupling chamber during transverse conveying of the injection-moulding die, without danger of collision with the rearwardly engaging members of the injection-moulding die.

It is also known to equip a vertical mould-closing device with a slide table for horizontal displacement of two moulding-die halves, which are to be alternately fitted with insert members and alternately displaced, with the aid of a piston-cylinder unit, from the slide table to the horizontal die area of the displaceable die carrier. For this purpose, the piston rod of the piston-cylinder unit is coupled by laterally entering its free end, arranged to be a coupling head, into a horizontal groove of a coupling member, arranged onto the moulding-die half. Thereby, coupling is achieved with free-standing coupling members outside the body of the moulding-die half (DE-A-24 21 811).

Furthermore, it is known to arrange mould-closing devices on plastics-material injection-moulding machines in such a way that the sprue pieces of the

casts can be separated from one another by means of a separating device by timewise offset ejection from the injection-moulding die. For this, a separate ejecting member for the sprue pieces is provided in the injection-moulding die, with which the ejector plate of the ejector of the injection-moulding die makes contact as late as in a final displacement phase, sliding into a position for ejection. The ejection member, arranged to be an ejector pin, terminates at the rear side in a guide plate, arranged in the displacement area of the injection-moulding die in front of the ejector plate, the return of which into its inoperative position requires special devices. A substantial change of dimensions, in particular the construction depth of the injection-moulding die, is unavoidable with such an arrangement (US-A-3, 776, 675).

In a further known separating device for the separation of the sprue pieces from the casts (DE-A-2 516 917), the sprue piece is ejected by an 'ejector in the ejector', provided with a separate drive.

There are also known devices in different arrangements for timewise offset ejection of sprue piece and cast (for example DE-C-752 458), whereby a separate ejector pin for the sprue piece, free ending in the displacement area of the ejector plate and caught by means of a radial flange in a pocket bore of a cylindrical die of the injection-moulding die, can also be used ("Plastverarbeiter" 1957/1, p. 13-15, in particular Ill. 4).

Based on the mentioned state of the art, it is the object of the invention to further develop a mould-closing device so as to facilitate both interruption-free transverse conveying of the injection-moulding die, which effects the coupling, and separation of the

sprue pieces from the casts by axial displacement phases of the piston rod in dependence on a simple control device, which includes a displacement-measuring device, without any need for significant changes in dimensions of the injection-moulding die, which is made of standard construction members.

This object is achieved according to the invention by the features mentioned in the characterising part of patent claim 1.

Coupling results from transverse conveying of the injection-moulding die, which conveying is required in any case for changing the injection mould. Thereby, the axial drive-in movement of the piston rod and the transverse conveying of the injection-moulding die may timewise overlap. Thereby, a collision between piston rod and injection-moulding die is impossible, even with slight asymmetry of the coupling chamber, if the speed of transverse conveying in the last or first phase respectively is reduced relative to the speed of the piston rod. However, transverse conveying of the injection-moulding die can be performed continuously at relatively high speed with a coupling chamber, which is either severely asymmetrical or even open on one side of the injection-moulding die. The sprue piece is ejected by means of the ejector pin in the last displacement phase of the piston rod.

A further advantage of the inventive arrangement lies in that the injection-moulding die can be constructed or modified respectively for the separation of the sprue pieces from the casts, without substantial constructional alterations to its standard construction components, in particular without significant changes in its dimensions.

In the following, the invention is explained, supported by the drawings.

Shown are, in

- Fig. 1: a section of the mould-closing device in the region of a shown position of the coupling chamber of a injection-moulding half, which is secured to the displaceable die carrier;
- Fig. 2: a section of the mould-closing device in the region of the closed injection-moulding die, which is secured between the die carriers, horizontally cut and placed in its working position;
- Fig. 3: the section of Fig. 2 during transverse conveying of the injection-moulding die, with the injection-moulding die just entering into its last displacement phase, which overlaps timewise with the drive-in movement of the rearwardly engaging members of the piston rod;
- Fig. 4: a cross-section along line IV-IV in Fig. 3;
- Fig. 5: a section of the opened, vertically cut mould-closing device during ejection of the casts;
- Fig. 6: a part of the section as in Fig. 5 during ejection of the sprue piece;
- Fig. 7: A path-time diagram, illustrating the operating method of the control device;
- Fig. 8: a variant of the mould-closing device in an illustration as in Fig. 2; and

Fig. 9: the arrangement as in Fig. 8 in a view from direction Y.

The mould-closing device, arranged on a plastics-material injection-moulding machine with central computer 31, is equipped with a moulding-die change-over arrangement. The latter includes a moulding-die change-over table 36, arranged next to the die area, and a conveying track on which injection-moulding die 18 is horizontally transported (transverse conveying) adjacent to the die surface of the movable die carrier 20 from the moulding-die change-over table into the die area. The conveying track is formed by support elements 37, 37', which are mounted to the die carriers 20, 19. During transverse conveying, the movable die carrier 20 is set to such a minimal distance relative to the stationary die carrier 19 that just one transverse conveying of injection-moulding die 18 is possible without significant hindrance by friction to the die surfaces of the die carriers. The moulding-die change-over arrangement further includes a coupling for coupling and uncoupling the injection-moulding-die ejector to/from its piston-cylinder-unit drive, attached in the injection axis on the movable die carrier 20. The coupling is formed by rearwardly engaging members 25a at the injection-moulding die 18 and rearwardly engaging members 24a at piston rod 24 of the piston-cylinder unit. The rearwardly engaging members 25a and 24a rearwardly engage one another in the course of transverse conveying in a coupling chamber 35 inside the adjacent mounting plate 18i, which is armed with an insulating plate 18i'. Coupling chamber 35 is arranged asymmetrically to the injection axis so that the rearwardly engaging members 24a of coupling rod 24 can be driven into coupling chamber 35 along with the rearwardly engaging members 25a of

injection-moulding die 18. As is particularly clear in Figs. 1, 9, injection-moulding die 18, constructed of standard construction components, is provided with its insulating plates 18a' and 18i' reinforced mounting plates 18 and 18i', which slightly extend beyond the body of the injection-moulding die at the bottom and the top. These mounting plates are rearwardly engaged by tension bolts 27, by which the moulding-die halves are held at the die carriers 19, 20 by hydraulic means.

Injection-moulding die 18 further includes a form plate 18b, which abuts against mounting plate 18a and is adjacent to separation plane a-a, which plate defines the die hollow spaces 22, distributor channels 23a and sprue channel 23 in the working area. A configuration plate 18c, stabilised by support plate 18d, is on the other side adjacent to separation plane a-a, and is equipped with die cores 13, which define the core hollow spaces 22. Between mounting plate 18i and support plate 18d are arranged spacers 18e to form a displacement area 32. In displacement area 32 is displaceably arranged ejector plate 18f with cover plate 18g on guide pins 18k in the closing direction of the injection-moulding die and fitted with ejector bars 18h, which pass through support plates 18d, configuration plate 18c and die cores 13. The displacement of ejector plate 18f with cover plate 18g is defined by stop elements 21, 21'. The ejector device, formed by ejector plate 18f with cover plate 18g and ejector rod 18h, is driven via piston rod 24 of a hydraulic piston-cylinder unit in timewise separated displacement phases. Piston rod 24 is detachably connected via the coupling to ejector plate 18f. The coupling includes a radial-symmetrical coupling element 25, which is bolted via a threaded pin 25c to ejector plate 18f and secured by a counternut 26. In the

coupling position, a coupling head (rearwardly engaging members 24a) of the coupling element 25 is rearwardly engaged in the region of its neck 25b by horizontal rearwardly engaging shanks (rearwardly engaging members 24a) of coupling rod 24 in coupling chamber 35, which is formed by an asymmetrical recess in mounting plate 18i with insulating plate 18i'. Uncoupling takes place during a moulding-die change-over by transverse conveying of the injection-moulding die, in which respect coupling head 25a arrives beyond the range of the a rearwardly engaging shank 24a, and with a subsequent backward displacement of piston rod 24.

Coupling is achieved by analog displacement steps in reverse order.

The ejector member for sprue piece 14 is a separate ejector pin 10, guided in configuration plate 18c and support plate 18d, which pin terminates free in the displacement area 32. Ejector pin 10 is caught, by means of a radial flange 10a, in a pocket bore 11 of the configuration-support plate 18c with axial play for the ejector displacement. The pocket bore 11 terminates in the junction between configuration plate 18c and configuration-support plate 18d. The cylindrical ejector pin 10 has in front of, and behind radial flange 10a an equal diameter of approximately 18 mm. It defines, with its forward face edge, distributor channel 23a, which is provided with a rearward cut 12, the distributor channels of which terminate, via tunnel 15 for tunnel sprues, in mould hollow spaces 22.

In the example of Figs. 3 and 4, ejector pin 10 is encapsuled by a coiled spring 29, serving as return spring. The latter is on one end supported on configuration plate 18c, and on the other end abuts against radial flange 10a. The ejector pin 10 is

controllable by a device, which includes a displacement-measuring device 30 and a computer 31, which controls a displacement-measuring device 30 and a piston-cylinder unit, the stored time programs of which are available in dependence on signals from the displacement-measuring device 30. All displacement phases of the ejector device are detectable by displacement-measuring device 30. For this purpose, it is associated with piston rod 24.

The electrical signals of the displacement-measuring device 30 are supplied by a rotation potentiometer, which is driven by the axial displacement of piston rod 24. Such displacement-measuring devices are already known (DE-AS 28 34 415.2).

The displacement-time diagram of Fig. 7 clearly shows the course of displacement phases B, C, D of the ejector device, each preceded by time laps E, F, G of a standstill (pause). The pauses are required to perform operations which are placed between the displacement phases.

Displacement phase A contains an operation of moulding-die change-over H, whereby displacement phases B, C, D serve the timewise offset ejection and subsequent separation of casts and sprues in injection cycle K. The displacement-time diagram is based on a point of operation in which an automatic moulding-die change-over has not been completed, i.e. there is not yet an injection-moulding die 18 between die carriers 19, 20. In the course of the last phase of moulding-die change-over H, piston rod 24 is driven into coupling chamber 35, and the transversely displaced injection-moulding die is coupled on. The end of drive-in movement is determined in dependence on displacement by the displacement-measuring device 30, delivering a

corresponding signal to computer 31. By said signal, the pre-programmed pause E is recalled from the memory of computer 31, and displacement phase B is initiated, resulting in ejection of the first casts, and again completed in dependence on the displacement from the displacement-measuring device 30 by a signal to computer 31. By said signal, the pre-programmed pause F is recalled from the memory, in which the first casts are directed via a mechanical branch into a first collector vessel. At the end of the pause, displacement phase C is program-dependently diverted in that the piston of the piston-cylinder unit is again loaded by pressure medium. This displacement phase is again terminated dependent on the displacement of the displacement-measuring device 30, which initiates the programmed pause G by means of a signal. Said pause is sufficiently long to divert casts of different shape (deviating from example of embodiment in Figs. 1-4) via a branch into a second container. Then, computer 31 initiates, in dependence on the program, displacement phase D, in the course of which the sprues are ejected (Fig. 6) for collection in a third container via the mechanical branch.

In the variant of Fig. 2, ejector pin 10 is returned into its inoperative position exclusively by the static pressure of the plastics material, in the variant of Figs. 3, 4 with co-action of return spring 29.

The automatic moulding-die change-over is initiated by computer controlled transverse conveying of injection-moulding die 18, by which the rearwardly engaging members 24a are freed from rearward engagement of rearwardly engaging members 24a, resulting in decoupling of piston rods 24 from ejector plate 18f. This is followed by a controlled displacement phase,

which is directed in opposition to the direction of displacement phase A and controlled by displacement-measuring device 30 in conjunction with computer 31, by which phase the rearwardly engaging members 24a during continuing transverse conveying of the injection-moulding die are axially removed from coupling chamber 35. Control device 30, 31, consisting of displacement-measuring device 30 and computer 31, is thus equally capable of controlling the ejector device and of controlling at least a basic operation of the moulding-die change-over, namely the coupling or decoupling of the ejector of injection-moulding die 18 from the driving piston rod 24 with uninterrupted transverse conveying of injection-moulding die 18. In the displacement-time diagram (Fig. 7) is shown, by way of point M, shown as a small circle, the starting point and the time of start of piston rod 24 from its initial position. Said point M in the diagram is also the switch-over point, where transverse conveying L (dotted line) is controlled to a substantially lesser speed, in which respect this transverse conveying in the example of the diagram is, in any case, performed at somewhat reduced speed relative to the axial displacement of the piston rod in displacement phase A. In point M, injection-moulding die 18 and piston rod 24 are virtually in the position shown in Fig. 3, wherein the axial displacement of piston rod 24 is just about to commence and injection-moulding die 18 is just about to be switched over to reduced speed.

The period d-d, in which piston rod 24 completes displacement phase A, can never be greater than the period required by injection-moulding die 18 for section b-b of lower speed. This is revealed in particular in a comparison of Figs. 7, 3 with section b-b shown to be the same. The opposing rearward

engagement of rearwardly engaging members 24a and 24a of injection-moulding die 18 and piston rod 24 is realised by the second section c-c of lesser speed of injection-moulding die 18.

The example of embodiment according to Figs. 8, 9 differs from example of embodiment of Figures 1 to 7 in that coupling chamber 35' freely terminates in the lateral wall S, placed vertically to the transverse-conveying direction of injection-moulding die 18, of the body of injection-moulding die 18, and in that piston rod 24 also terminates inside coupling chamber K' in rearward initial position. However, such an arrangement causes a certain static weakening of the injection-moulding die, so that the plates of the injection-moulding die have to be stronger in construction, if required.

The required driving in of coupling rod 24 into the coupling chamber, as required for coupling in example of embodiment of Figures 1 - 7, becomes obsolete, since in the example of embodiment of Figures 8, 9 the rearwardly engaging members 24a of coupling rod 24 are within coupling chamber 35' in a coupling-suitable position even during transverse conveying of injection-moulding die 18. Thus, the rearward inoperative position of coupling rod 24 also represents its coupling position.

Claims

- 1: Mould-closing device for a plastics material injection-moulding machine, including a central computer (31) and a moulding-die change-over arrangement, which comprises a moulding-die change-over table (36), which is disposed adjacent the die area and from which the injection moulding die (18) is horizontally conveyable (transverse conveying) into the die area directly at the clamping surface of the displaceable die carrier (20), and said moulding-die change-over arrangement additionally comprises a coupling means (K) for disconnecting the ejector of the injection moulding die (18) from a piston-and-cylinder unit (piston rod 24), which is mounted on the displaceable die carrier (20), said coupling means (K) being formed by rearwardly engaging members (25a, 24a), which are disposed on the injection moulding die (18) and on the piston rod (24) of the piston-and-cylinder unit and engage behind one another as a result of the transverse conveying of the injection moulding die (18) in an asymmetrical coupling chamber (35), which is situated internally of the injection moulding die (18), characterised in that a control arrangement (30, 31) is provided, which is formed by the computer (31) and a displacement measuring device (30), and by means of which control arrangement the transverse conveying of the injection moulding die (18) and the axial displacement of the piston rod (24) are adaptable to each other, and by means of



which control arrangement sprue pieces (14) are dischargeable in the final displacement phase (D) by means of an ejector pin (10), which is secured in the bore (11) provided in a plate (18d) of the injection moulding die (18) by means of a radial arm (radial flange 10a) and terminates some distance from the ejector plate (18f, 18g), which is in its initial position, the coupling chamber (35; 35') having such asymmetry that continuous transverse conveying terminates in the rearwardly engaging members (25a, 24a) being in their rearwardly engaged position.

- 2: Mould-closing device according to claim 1, **characterised in that** the blind bore (11) is disposed in the configuration-supporting plate (18b) and the configuration-supporting plate (18c).
- 3: Mould-closing device according to claim 2 or 3, **characterised in that** the piston rod (24) of the piston-and-cylinder unit is connectable to the ejector plate (18f, 18g) by means of a coupling element (25), the coupling head (rearwardly engaging member 25a) of which coupling element is rearwardly engageable by horizontal, rearwardly engaging legs (rearwardly engaging members 24a) of the piston rod (24).
- 4: Mould-closing device according to one of the preceding claims, **characterised in that** the displacement-measuring device (30) includes a potentiometer, which is drivable by means of the piston rod (24) and supplies the signals.
- 5: Mould-closing device according to one of the preceding claims, **characterised in that** the coupling chamber (35' in Figs. 8, 9) opens-out freely in the



lateral wall (S) of the body of the injection-moulding die (18), which wall extends at right angles to the transverse conveying direction of the injection mould die (18), and in that the piston rod (24) terminates internally of the coupling chamber in its rear initial position.

