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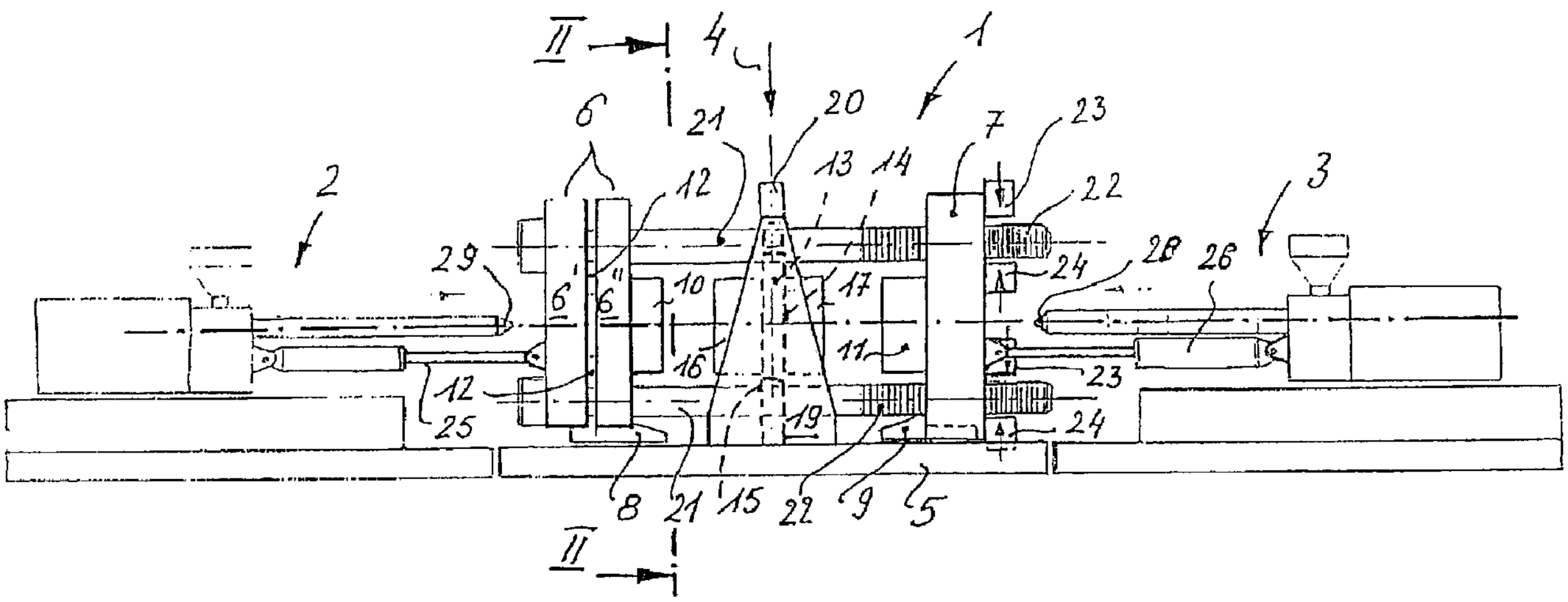

(57) Abrégé/Abstract:
A mold closing device of an injection molding machine for the production of plastic parts made of two or more plastic components is disclosed. A central mold carrier element is arranged between two outer mold mounting plates. The element has two or four opposing mold mounting areas arranged in pairs for affixing two or four mold halves and is fitted with a turning device supported in a supporting frame. Each of the mold halves of the mold carrier element can be closed against the mold halves of the outer mold mounting plates with the aid of a drive mechanism and a mold pressure unit. The outer mold mounting plates are connected to one another by columns that extend through the supporting frame for the central mold carrier element. The outer mold carrier plates and the supporting frame are supported on the machine frame. Stability is enhanced by fixedly connecting the supporting frame to the machine frame and displaceably supporting the outer mold mounting plate on the machine frame.

ABSTRACT

A mold closing device of an injection molding machine for the production of plastic parts made of two or more plastic components is disclosed. A central mold carrier element is arranged between two outer mold mounting plates. The element has two or four opposing mold mounting areas arranged in pairs for affixing two or four mold halves and is fitted with a turning device supported in a supporting frame. Each of the mold halves of the mold carrier element can be closed against the mold halves of the outer mold mounting plates with the aid of a drive mechanism and a mold pressure unit. The outer mold mounting plates are connected to one another by columns that extend through the supporting frame for the central mold carrier element. The outer mold carrier plates and the supporting frame are supported on the machine frame. Stability is enhanced by fixedly connecting the supporting frame to the machine frame and displaceably supporting the outer mold mounting plate on the machine frame.

MOLD CLOSING DEVICE FOR AN INJECTION MOLDING MACHINE

Description

The invention is directed to a mold closing device for an injection molding machine of a type as described in the preamble of claim 1.

A mold closing device of this type is known from GB 2 300 142, wherein each of the two outer mold mounting plates is made of one mold mounting plate that is fixedly secured to the machine frame and another mold mounting plate that is movably supported on the machine frame. The center mold carrier element is also movably supported on the machine frame by way of a supporting frame. Because the center mold carrier element which is rotatably arranged in the supporting frame is moveable, this component is relatively unstable, so that typically only lightweight mold halves can be placed on the mold mounting areas of the rotatable mold carrier element. Since the center mold carrier element and the moveable outer mold mounting plate represent two successively arranged moveable mold carrying units, the large tolerances render the mold closing unit very inaccurate, whereby the parallelism between the plates and the stationery outer mold mounting plate which is stationary in the machine frame is difficult to maintain.

A mold closing device of this type is also known from DE 197 33 667, which have a stationary and a moveable mold mounting plate and a mold half carrier which is supported in support blocks that are moveable relative to the moveable mounting plate and rotatable about a vertical axis. The moveable mold mounting plate and the mold half carrier can be moved towards the stationery mold mounting plate so as to provide a closing pressure when a thermoplastic plastic is injected. This device disadvantageously also suffers from the relative instability of the device due to the large tolerances, as described above with reference to GB 2 300 142.

DE 36 20 175 describes an injection molding machine with at least two plasticizing and injection units as well as a stationary mold mounting plate and a moveable mold mounting plate that is guided by stationary tie bars. Each of stationary tie bars carries one set of the mold halves of injection molding molds. A prismatic core carrying body is arranged between the stationary tie bars which can rotate about its axis and is displaceable in the direction of the stationery tie bars. The axis-parallel side faces of the core carrying body include the other set of mold halves of the injection molding molds. This core carrying body is actually not supported on the machine bed, but is held only by tie bars that are movably supported on the moveable mold mounting plate. In other words, only the core carrying bodies and the associated mold halves which are lightweight are operational. This particular support structure of the core carrying body relative to the moveable mold mounting plate, which is not supported on either the machine bed or the tie bars used for the closing motion, causes the device to be particularly unstable and hence has all the disadvantages described above with reference to GB 2 300 142.

A tie bar pulling device for a 2-platen or 3-platen injection molding machine is described in DE 197 10 412, wherein the tie bars extend through two mold mounting plates which each carries a corresponding mold half. When the mold is opened, the tie bars are pulled out of one mounting plate with which they are interlocked in the closed state, allowing access to the space between the mold mounting plates. This device, unlike the present invention, is directed to an injection molding machine without a turning device for the mold, which makes it difficult to produce multi-component injection molded parts.

DE 196 50 854 describes a method and a device for producing multilayer plastic parts, whereby a plastic injection molded part is coated with at least one layer of 2-component Duroplast and the two components are injection-molded successively in a synchronous cycle in the same mold. For this purpose, a baseplate is used

which supports two mold halves that are arranged side-by-side and rotatably supported for rotation about a horizontal longitudinal machine axis. Female molds of an injection molding machine and a RIM device are arranged opposite to the mold halves. After injecting thermoplastic material with the injection molding machine, the baseplate is rotated by 180°. In the following cycle, a new thermoplastic part is molded while the part produced in the preceding cycle is coated with the 2-component Duroplast. With this device, both injection molding devices are disadvantageously located on the same side of the machine, which poses significant problems at the installation side and for the operation of the injection molding devices. Moreover, this device is suitable only for producing small plastic parts, since the two mold halves could otherwise not be arranged side-by-side. It is not clear from the description how a baseplate that is rotatable about the longitudinal mold axis can be fixedly connected with the female molds of the injection molding machine and the RIM device, which leaves unanswered the question concerning the accuracy of the mold fit and the availability of a sufficiently high closing pressure.

It is therefore an object of the invention to achieve a significant improvement in the stability of a mold closing device of the aforedescribed type by a simple means, so that large high-precision multi-component plastic parts can be produced.

With the attachment according to the invention of the supporting frame for the center mold carrier element on the machine frame, the center mold carrier element can be supported in a more massive and hence more robust rotary device, while on the other hand each of the two outer mold mounting plates moves back and forth directly and with a short displacement, i.e., without an intermediate moveable

mold mounting plate, relative to the stationary supporting frame of the center mold carrier element.

Preferably, the columns of the mold closing device are on one end secured to a support plate that is parallel to one of the outer mold mounting plates and penetrate on the other end the other outer mold mounting plate. The columns are locked behind the mold mounting plate by saw tooth-shaped interlocking elements. Advantageously, the support plate and the associated outer mold mounting plate form a sandwich plate with an interposed hydraulic pressure piston. This plate arrangement has a very short construction and represents a particularly stiff system because the quantity of hydraulic fluid needs to be adequate only for producing the closing pressure. Larger quantities of hydraulic fluid which can increase the compressibility thereby become unnecessary or are only used to operate the actuating drives (closing, loosening and opening), the motion of which is decoupled from the generation of the closing pressure. The aforedescribed two-plate closing system with an interposed center mold carrying unit, which is fixedly supported in the machine frame, further enhances the stiffness of the mold closing device according to the invention substantially. This mold closing device can therefore advantageously be used to produce large multi-component plastic parts which require a highly precise machine, for example automobile glass, interior moldings for automobiles and multi-wall containers.

According to another advantageous embodiment of the invention, the columns are secured on one end in an outer mold mounting plate and are formed on the other end as pistons, which are reversibly guided in cylinders that are fixedly connected with the other mold mounting plate. This two-plate closing system with an interposed center mold carrying unit, which is fixedly supported in the machine frame, advantageously also has a short construction and a high stiffness.

The outer mold mounting plates can be coupled with injection units for producing

multi-layer injection molded parts. In other applications, RIM devices, such as polyurethane (PUR) foaming units or other devices, can be provided instead of the injection units for the production of multi-component plastic parts by a RIM process. Particularly advantageous is a mixed process, whereby a basic component made of a thermoplastic material is injection molded by an injection molding unit, which is then coated with a layer of a 2-component Duroplast, in particular polyurethane, by a RIM process, or vice versa.

According to a particularly advantageous embodiment, the supporting frame which is stationary in the machine frame can have a C-shape, i.e., can be provided with an opening to the operating side. In a mold carrier element shaped as a cube and having four mold halves, the basic component can be injection molded in a first cycle, as referenced to one of the four mold halves of the mold carrier element. In the second cycle, this component can cool down. In the third cycle, the basic component is finished into a two-component plastic part. In the fourth cycle, the mold half with the finished two-component plastic part is located in the open section of the C-shaped supporting frame and can be removed during the fourth cycle. Since the removal occurs during the fourth cycle, the cycle time can be significantly shortened. In addition, inserts, for example metallic threaded sleeves or a plastic part, can advantageously be placed into the mold half after the finished two-component plastic part has been removed. Alternatively, the C-shaped frame can be operated so that the basic component is located during the second cycle on the open side of the frame, making it possible to perform an intermediate processing step during the second cycle which otherwise would have to be performed during the first cycle. An exemplary processing step, which typically can occur only after adequate cool-down of the plastic part, can be a surface treatment of the basic component to improve adhesion between the plastic material molded in the following step and the basic component. Such processing step is useful for bonding a thermoplastic basic component with a 2-component Duroplast coating, in particular a polyurethane coating and other like, and can be

performed, for example, by a robot located on the side of the mold closing device. In particular, a mold carrier element with four or six mold halves shortens the cycle time. The open C-shaped supporting frame can also be used with a mold carrier element that has only two mold halves, since the mold mounting areas can be rotated to the open section of the supporting frame to allow a mold change or for maintenance work. The particularly short construction of the mold closing devices of the invention can overcome the more difficult access to the center mold halves associated with this design.

According to another aspect of the invention, there is provided a mold closing device of an injection molding machine for the production of plastic parts made of two or more plastic components, wherein a central mold carrier element is arranged between two outer mold mounting plates, the element having two or four opposing mold mounting areas arranged in pairs for affixing two or four mold halves and being fitted with a turning device supported in a supporting frame, said turning device capable of associating each of the mold halves of the mold carrier element with the mold halves of the outer mold mounting plates with the aid of a rotary drive, wherein the outer mold mounting plates are connected to one another by columns wherein the outer mold mounting plates and the supporting frame are supported on a machine frame, and wherein the supporting frame is fixedly connected to the machine frame and the outer mold mounting plates are displaceably supported on the machine frame, wherein the columns are secured on one end in one of the outer mold mounting plates and are provided on the other end with pistons, which are reversibly guided in a cylinder unit that is connected with the other mold mounting plate, wherein an actuating unit

comprised of one of the pistons and the cylinder unit is configured to execute the opening and closing motions and to produce the closing pressure of the mold closing device.

According to another aspect of the invention, there is provided a mold closing device of an injection molding machine for the production of plastic parts made of two or more plastic components, wherein a central mold carrier element is arranged between two outer mold mounting plates, the element having two or four mold opposing mounting surfaces arranged in pairs for affixing two or four mold halves and being fitted with a turning device supported in a supporting frame, said turning device capable of associating each of the mold halves of the mold carrier element with the mold halves of the outer mold mounting plates with the aid of a rotary drive further comprising a drive mechanism for movement of the outer mold mounting plates towards and away from the supporting frame and a pressure unit to produce closing pressure when the outer mold mounting plates are in closed position wherein the outer mold mounting plates are connected to one another by columns wherein the outer mold mounting plates and the supporting frame are supported on a machine frame, and wherein the supporting frame is fixedly connected to the machine frame and the outer mold mounting plates are displaceably supported on the machine frame, wherein the supporting frame, which is fixedly secured to the machine frame, is a C-shaped supporting frame with an opening that is open towards the operator side of the injection molding machine.

According to another aspect of the invention, there is provided a mold closing device for producing a plastic part made of two or more plastic components, comprising: two outer mold mounting plates supporting mold

halves; a center mold carrier element rotatably arranged between the two outer mold mounting plates; at least one injection unit operatively coupled with one of the outer mold mounting plates and having an injection nozzle; and at least one reaction injection molding (RIM) device operatively coupled with the other one of the outer mold mounting plates and having a mixing head.

According to another aspect of the invention, there is provided a method of producing a plastic part made of two or more plastic components, comprising the steps of: injection molding a base structure of thermoplastic material with the aid of an injection unit operatively coupled to a first outer mold mounting plate; rotating the injection-molded base structure to face a second outer mold mounting plate; and coating the injection-molded base structure with a coating of 2-component thermoset material using a RIM device operatively coupled to the second outer mold mounting plate.

According to another aspect of the invention, there is provided a mold closing device of an injection molding machine for producing plastic parts made of two or more plastic components, comprising: two outer mold mounting plates supporting mold halves; a center mold carrier element rotatingly arranged between the two outer mold mounting plates; a C-shaped supporting frame supporting the rotating center mold carrier element and including an opening that is open towards a loading/unloading side of the injection molding machine; a machine frame fixedly connected to the supporting frame and displaceably supporting the outer mold mounting plates.

An embodiment of the invention will be described with reference to the appended drawings.

It is shown in

Fig. 1 a side view on an injection molding machine with a mold closing device according to the invention,

Fig. 2 in an enlarged scale, a cross-sectional view along the line II-II in Fig. 1,

Fig. 3 a side view on another embodiment of a mold closing device according to the invention,

Fig. 4 a side view on an injection molding machine with the mold closing device of the invention according to the first embodiment with a RIM device,

Fig. 5 schematically, a top view on the mold closing device of the invention with an injection nozzle and a mixing head,

Fig. 6 schematically, a top view on the mold closing device of the invention

with two mixing heads,

Fig. 7 a side view of an injection molding machine with a C-shaped open supporting frame disposed fixedly in the machine frame,

Fig. 8 a cross-sectional view along the line V-V of Fig. 7, and

Fig. 9 a perspective view of the injection molding machine of Fig. 7.

The injection molding machine depicted in Fig. 1 includes a mold closing device 1 and two injection units 2 and 3. The arrow 4 indicates schematically the injection axis of a third optional injection unit which can be provided on the injection molding machine in a so-called T-arrangement.

The mold closing unit 1 includes a machine frame 5 on which two outer mold mounting plates 6 and 7 are movably supported by slideways 8 and 9. Each of the mold mounting plates 6 and 7 supports a mold half 10 and 11. The mold mounting plate 6 depicted on the left side of Fig. 1 includes a so-called sandwich plate composed of two parallel plates with a small gap therebetween, wherein one plate is a support plate 6' and the other plate is the mold carrier plate 6". Four hydraulic pressure pistons 12 are disposed between the support plate 6' and the mold carrier plate 6". Only the two front pressure pistons are visible in the drawing.

A center mold carrier element 13 with two opposing mold mounting areas 14 and 15 is disposed between the two outer mold mounting plates. A left and a right center mold half 16 and 17 are each secured to a corresponding mold mounting area 14 and 15. The plate-shaped mold carrier element 13 depicted in Fig. 1 therefore has two mounting surfaces 14 and 15. In principle, the mold carrier element can also be shaped as a cube with four mold mounting areas.

The mold carrier element 13 is supported with a vertically oriented rotation axis 18 in a supporting frame 19 that is fixedly connected with the machine frame 5. A rotary drive 20 disposed of the supporting frame 19 can associate the mold carrier element 14 that holds the two center mold halves 16 and 17 with each of the two outer mold halves 10 and 11.

The two outer mold mounting plates 6 and 7 are connected with each other by four columns 21. The columns 21 are attached to the support plate in the left outer mold mounting plate 6. The columns 21 penetrate the right outer mold mounting plate 7 and are locked behind the same. The locking system includes saw tooth-shaped grooves 22 formed in the end region of the columns 21, with the complementary saw tooth-shaped grooves of two mutually displaceable half-shells 23 and 24 engaging with the grooves 22 like ratchets.

The columns 21 penetrate the supporting frame 19 in slideways.

The injection units 2 and 3 are coupled with the outer mold mounting plates 6 and 7 through hydraulic actuating elements 25 and 26 capable of positioning the injection nozzles 29 disposed of the mold mounting plates 6 and 7 into an injection position.

The cross-sectional view of Fig. 2 shows the supporting frame 19 secured on the machine frame 5, with the supporting frame 19 penetrated by the columns 21. The mold carrier element 13 is rotatably supported in the supporting frame 19, with the left center mold half 16 secured to the mold mounting areas 14 of the mold carrier element 13. The rotation axis 18 of the mold carrier element 13 is coupled with the rotary drive 20. Attachment points for hydraulic actuators 27 and 28 (not shown in Fig. 1) are arranged on the outer edge of the supporting frame 19. The hydraulic actuators 27 and 28 can be used to move the outer mold mounting plates 6 and 7 towards and away from the supporting frame that is stationary in

the machine frame, and can thereby perform the mold closing motion that brings the mold half 10 of the left outer mold mounting plate 6 into a closing position with the left center mold half 16 of the center mold carrier element 13. In the same way and simultaneously, the mold halves 11 and 17 are brought into a closing position. The two outer mold mounting plates 6 and 7 are moved towards the mold carrier element 16 that is stationary in the machine frame, with the locking system open. The locking system immediately returns to its locking position at the conclusion of the closing motion, with the two half-shells 23 and 24 engaging with the saw tooth-shaped grooves 22 of the columns 21. The movement into the locking position is indicated in Fig. 1 by the arrows on the half-shells 23 and 24.

Immediate after the system is locked, the pressure piston 12 produces the closing pressure, followed by a first injection process via the injection units 2 and 3 that are docked on the outer mold mounting plates 6 and 7.

After conclusion of the first injection process, the locking system is released and the hydraulic actuators 27 and 28 initially loosen the closed mold halves 10, 12, 16, 17 and subsequently move the outer mold mounting plates 6 and 7 away from the mold carrier element 13 that is stationary in the machine frame, or the supporting frame 19.

The mold carrier element 13 is then rotated by 180°, so that the outer mold halves 10 and 11 face the turned-around center mold halves 16 and 17. With new pairing of the mold halves, the partially injection molded parts produced in the first injection molding process are completed in a following second injection molding process to produce a finished two-component plastic part.

Fig. 3 shows an embodiment of a mold closing device 30 that is different from the mold closing device 1 depicted in Fig. 1, wherein elements performing the same or similar functions are referenced with the same referenced characters as in Fig. 1.

The mold closing device 30 includes a one-piece outer mold mounting plate 6 having two columns 31 attached thereto. The columns 31 penetrate both the supporting frame 19 and the right outer mold mounting plate 7, which has four hydraulic cylinders 32, in which cylinders the ends of the columns 31 which are formed as pistons 33 are reversibly guided. These piston-cylinder units 32, 33 can be used to perform the travel motions of the mold closing device 30, such as opening and closing the mold halves 10, 11, 16, 17. On the other hand, they can also be used to produce the closing pressure. A required pressure boosting device is integrated in the pistons 33 and is not separately shown. Unlike in the embodiment of Fig. 1, the closing pressure is not supported by a locking system, but is maintained hydraulically by the piston-cylinder unit 32, 33. Also, unlike the embodiment of Fig. 1, the functions are not separated. Whereas the closing pressure in the mold closing device 1 of Fig. 1 is produced by the pressure pistons 12 and the travel motion (opening, closing, loosening) is performed by the hydraulic actuators 25, 26, both of these major functions (travel motions and generation of the closing pressure) is performed in the mold closing device 30 by the piston-cylinder unit 32, 33.

Two possible additional applications for a mold closing device 1 are shown in Figs. 4 to 6, wherein the same elements have the same referenced characters. Fig. 4 shows the mold closing device 1, with an injection unit 34 coupled to the support plate 6' from the left side via a hydraulic actuator 25. An associated injection nozzle can be positioned on the mold mounting plate 6 in an injection position. A RIM device 35 (RIM: Reaction Injection Molding) is located on the right side of the mold closing device 1 and is used, for example, for processing polyurethane (PUR). This device is known in the art and will not be described in detail. It includes essentially feeder and measuring mechanisms for the chemicals to be processed, such as polyol, poly isocyanate and optional additives. The RIM device is coupled to the mold closing device 1 via a mixing head (not shown in Fig. 4).

Fig. 5 shows schematically a top view of the arrangement of Fig. 4, whereby two possible handling robots 38, 39 are located on either side of the opened mold halves 10, 16 and 11, 17, respectively. These can be a processing robot 38 and a removal robot 39. The RIM device (which is not shown in Fig. 5) is coupled via a mixing head 37 to the right mold mounting plate 7, with this mixing head 37 forming an injection-molding-connection with the right outer mold half 11. With the arrangement depicted in Fig. 4, the basic component is produced as described above. When the molds are open, the surface of the previously molded basic component is machined, which can be done by the processing robot 38. The mold carrier element 13 is then rotated by 180°, whereafter the mold halves are again closed. In the following step, a new basic component is injection-molded on the left side, whereas of the right side the PUR reactive mixture is injected into the mold through the mixing head 37, forming a PUR layer on the surface of the basic component. When the molds are subsequently opened, the finished component can be removed by a removal robot 39 or another removal device, while the surface of the basic component can be simultaneously machined.

Fig. 6 shows schematically an arrangement similar to that of Fig. 5, with the only difference that the left injection unit 34 with the injection nozzle 36 is replaced by an additional RIM device (not shown) which is coupled via a mixing head 40 to the left mold mounting plate 6. This arrangement can be used to manufacture by a similar manufacturing process multi-component plastic parts, wherein both the basic component and the coating are made of PUR.

A mold closing device 30 according to Fig. 3 can advantageously be used to manufacture a multi-component plastic parts that is made at least partially of PUR.

Supporting the closing pressure via the locking system according to the embodiment of Fig. 1 provides a particularly stable system that can tolerate a higher stress, so that the mold closing device 1 according to Fig. 1 is particularly

suitable for producing high-precision large-sized multi-component plastic parts.

Conversely, the embodiment of the mold closing device 30 of Fig. 3 is particularly suited for economically producing midsize to small sized multi-component plastic parts.

The injection molding machine according to Figs. 7 to 9 includes a mold closing device 50 and two injection units 51 and 52. The mold closing device 50 corresponds essentially to the mold closing device 30 of Fig. 3, but uses instead of the closed supporting frame 19 a C-shaped supporting frame 53 which is open to the operating side of the injection molding machine. The C-shaped supporting frame 53 is fixedly connected with the machine frame 54 and supports a rotatably supported mold carrier element 55, on which four center mold halves 56, 57, 58 and 59 are clamped. The rotation axis 60 of the mold carrier element 55 is supported in both legs of the C-shaped supporting frame 53 and can be driven by a rotary drive 61 arranged in the machine frame 54 to perform the aforedescribed cycle. Four columns 62 guided in slideways extend through the C-shaped supporting frame 53. The four columns 62 are secured on one end in a left outer mold mounting plate 63 and extend on the other end through slideways disposed in a right outer mold mounting plate 64. They are also reversibly guided by pistons 65 moving in four hydraulic cylinders 65. Both outer mold mounting plates 63 and 64 include attachment points 67 and 68 for the injection units 51 and 52, which can be moved by hydraulic actuators 69 and 70 to approach the injection through-passageways of the mold mounting plates 63 and 64.

The outer mold mounting plates 63 and 64 are slidably supported on the machine frame 54 on side rails 71 and 72. The outer mold mounting plate 63 and 64 can therefore be moved by two hydraulic actuators 73 which are located on the two diagonally opposed corners of the mold mounting plate 64. Only the upper actuator is visible in the Figs. 7 and 9. The left outer mold mounting plate 63 is

moved by the hydraulic piston-cylinder unit 65, 66.

The four center mold halves 56, 57, 58 and 59 can be closed cyclically with the mold halves 74 and 75 arranged on the two outer mold mounting plates 63 and 64.

The injection process will be described hereinafter with reference to the operating cycle of the center mold half 56. The four cycle positions 1 to 4 of the cubic mold carrier element 55, which are offset relative to each other by 90°, are indicated in Fig. 9 relative to the rotation axis S. In the first cycle, the two mold halves 56 and 75 are closed and a basic component is injection-molded. In the second cycle, the mold half 55 faces the vertical leg of the C-shaped supporting frame 53. The previously injection-molded basic component can then cool down. In the third cycle, the mold half 56 is closed with the mold half 74 of the left outer mold mounting plate 63, and the basic component is finished into a two-component injection molded part. In the fourth cycle, the mold half 56 is rotated into the opening of the C-shaped supporting frame 53. In this position, the finished two-component injection molded part can be easily removed and inserts can optionally be placed in the empty mold halves 56. In this operating cycle, the part is removed during the cycle as determined by the processes closing, closing pressure build-up, injection, after-pressure phase. No additional time is required for removing the injection molded part. The multi-component injection molding machine can be operated with a shortened cycle time, since the part can be simultaneously removed from the open rotated mold half.

A mold closing device 50 according to Figs. 7 with a C-shaped frame 53 can advantageously also be employed with one or several RIM devices. In this case, the mold half with the basic component can be rotated during the second cycle into the opening of the C-shaped frame 53, whereby the component first cools down and then receives a surface treatment. In the third cycle, the mold half with the basic component is closed against the mold half that is connected with the

mixing nozzle, and the component is finished by applying a PUR coating while a new basic component is injection molded on the other side of the supporting frame. During the next mold opening, the finished component is removed and a new cycle begins. Alternatively, the component can be removed during the fourth cycle, which requires sufficient space between the perpendicular leg of the C-shaped supporting frame 53 and the finished component to allow use of a removal device. Alternatively, the processing step can occur during the second cycle on the closed side of the C-shaped supporting frame 53, whereby sufficient space must be provided for the processing device, while the completed component is removed on the open side during the fourth cycle.

The mold mounting plates 6, 7 and 62, 63 of the aforedescribed mold closing devices 1, 30, 50 can be displaced hydraulically or electromechanically via spindle drives. In principle, a C-shaped supporting frame 53 that is fixedly secured in the machine frame and has an opening that is open towards the operator, can also be used in the mold closing device 1 where the two mold mounting plates 6 and 7 can be moved (opening, closing, loosening) hydraulically or electromechanically when the locking system (saw tooth-shaped grooves 22, half-shells 23, 24) is open and where the closing pressure is produced via hydraulic pressure pistons 12 in the left mold mounting plate 6 that is formed as a sandwich plate.

LIST OF REFERENCE CHARACTERS

1	mold closing unit (1st embodiment)
2	injection unit
3	injection unit
4	optional injection unit (Arrow 4)
5	machine frame
6	outer mold mounting plate (left)
6'	support plate
6"	mold carrier plate
7	outer mold mounting plate (right)
8	Slideway
9	Slideway
10	mold half (outer left)
11	mold half (outer right)
12	pressure piston
13	mold carrier element
14	mold mounting area
15	mold mounting area
16	center mold half (left)
17	center mold half (right)
18	rotation axle
19	support frame
20	rotary drive
21	column
22	saw tooth-shaped grooves
23	half-shell
24	half-shell
25	hydraulic actuator
26	hydraulic actuator

27 hydraulic actuating drives

28 hydraulic actuating drives

29 injection nozzle

30 mold closing unit (2nd embodiment)

31 column

32 hydraulic cylinder

33 piston

34 injection unit

35 RIM device

36 injection nozzle

37 mixing head

38 processing robot

39 removal robot

40 mixing head

50 mold closing unit (3rd embodiment)

51 injection unit

52 injection unit

53 C-shaped supporting frame

54 machine frame

55 mold carrier element

56 center mold half

57 center mold half

58 center mold half

59 center mold half

60 rotation axle

61 rotary drive

62 column

63 mold mounting plate left

64 mold mounting plate right

65 piston

66 hydraulic cylinder

67 support

68 support

69 hydraulic actuator

70 hydraulic actuator

71 slideway

72 slideway

73 hydraulic actuating drive

74 mold half left

75 mold half right

31254-27

CLAIMS:

1. A mold closing device for producing a plastic part made of two or more plastic components, comprising:

two outer mold mounting plates supporting mold halves;

a center mold carrier element rotatably arranged between the two outer mold mounting plates;

at least one injection unit operatively coupled with one of the outer mold mounting plates and having an injection nozzle; and

at least one reaction injection molding (RIM) device operatively coupled with the other one of the outer mold mounting plates and having a mixing head.

2. The mold closing device of claim 1, wherein the mixing head is operatively coupled with the mold half of the other one of the outer mold mounting plates.

3. The mold closing device of claim 1, wherein the RIM device is implemented as a PUR foaming unit.

4. The mold closing device of claim 1, wherein the center mold carrier element includes two or four opposing mold mounting areas arranged in pairs for affixing two or four corresponding mold halves, the center mold carrier element further including a turning device capable of closing each of the mold halves of the center mold carrier element against the mold halves of the outer mold mounting plates.

5. The mold closing device of claim 4, further comprising at least one member selected from the group consisting of injection unit and RIM device, and arranged on

the center mold carrier element, wherein the member is connected for injection with at least one of the mold halves attached to the center mold carrier element.

6. The mold closing device of claim 1, further comprising a supporting frame fixedly connected to a machine frame for rotatably supporting the center mold carrier element, wherein the outer mold mounting plates are constructed for slidable support on the machine frame and movement to and away in relation to the center mold carrier element.

7. The mold closing device of claim 1, wherein the center mold carrier element is plate-shaped and constructed with two mold mounting areas for two center mold halves.

8. The mold closing device of claim 1, wherein the center mold carrier element is constructed in the form of a cube and provided with four mold mounting areas for four center mold halves.

9. A method of producing a plastic part made of two or more plastic components, comprising the steps of:

injection molding a base structure of thermoplastic material with the aid of an injection unit operatively coupled to a first outer mold mounting plate;

rotating the injection-molded base structure to face a second outer mold mounting plate; and

coating the injection-molded base structure with a coating of 2-component thermoset material using a RIM device operatively coupled to the second outer mold mounting plate.

10. The method of claim 9, wherein the 2-component thermoset material is polyurethane.

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11. The method of claim 9, and further comprising the step of injection molding a further base structure during the coating step.

12. The method of claim 9, wherein the coating step involves injection of a PUR reactive mixture and formation of a PUR skin on a surface of the base structure.

FETHERSTONHAUGH & CO.

OTTAWA, CANADA

PATENT AGENTS

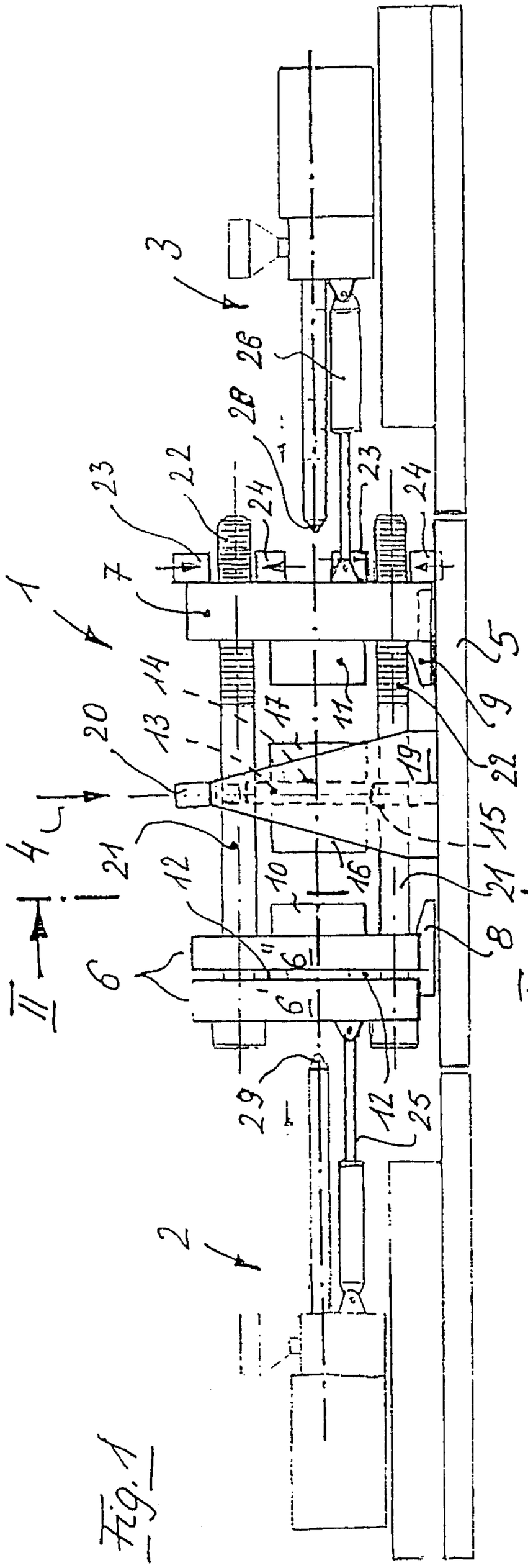


Fig.1

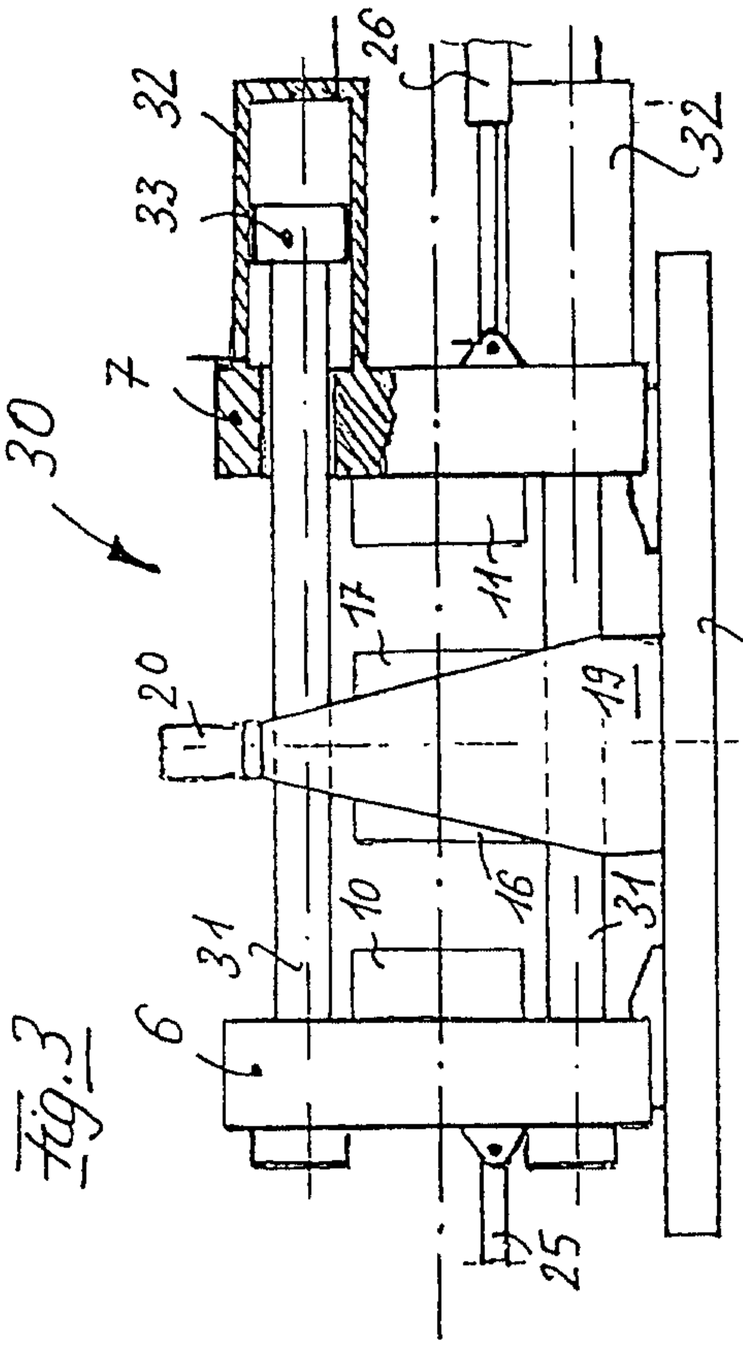


Fig.3

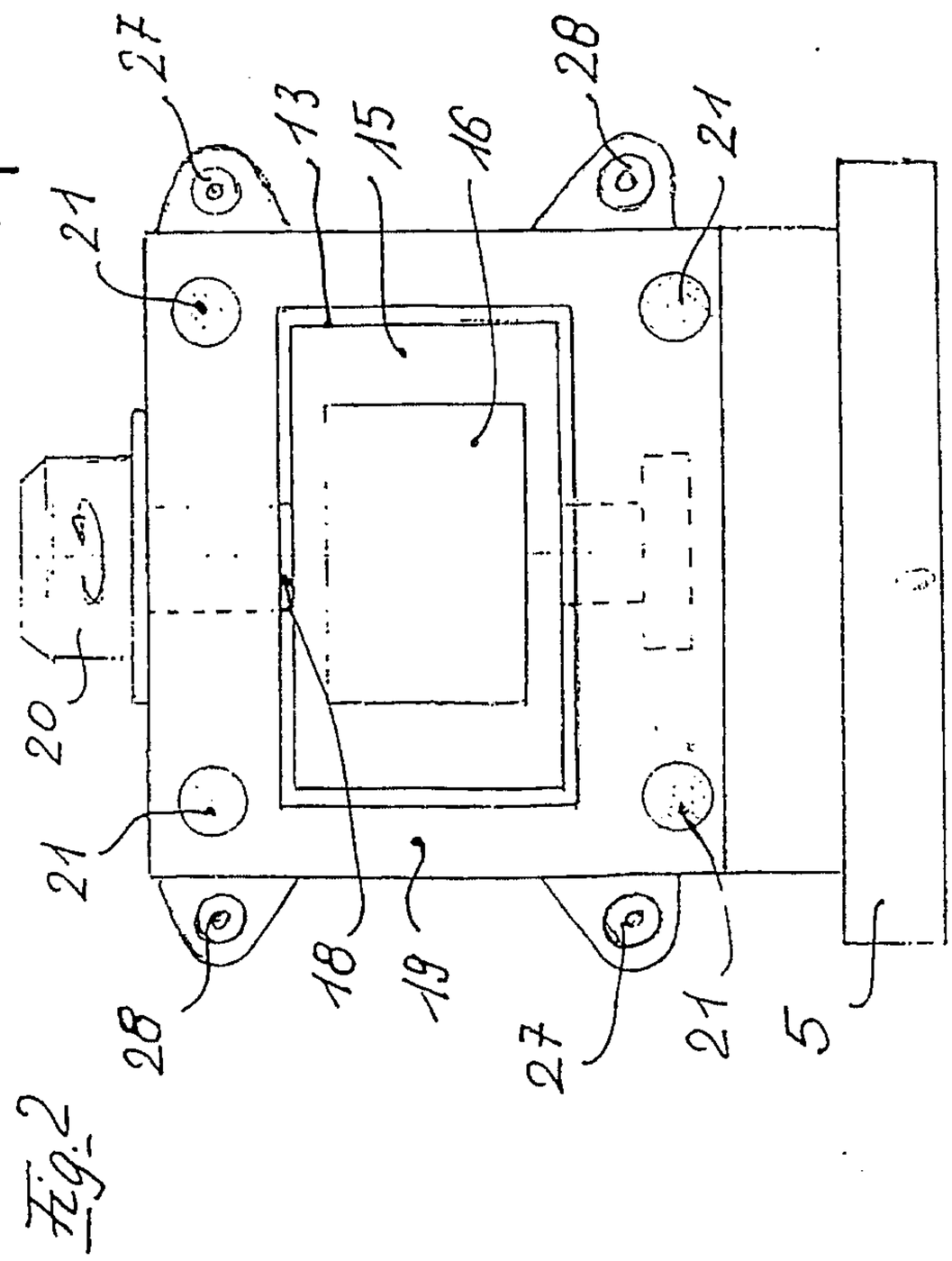


Fig.2

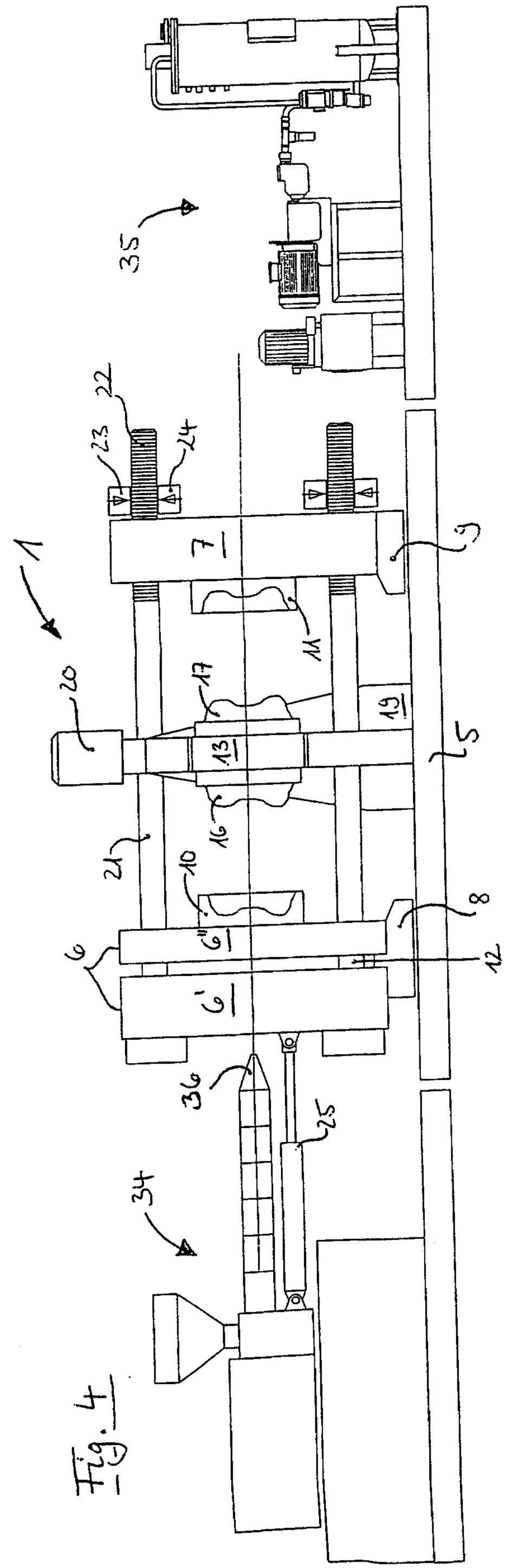


Fig. 4

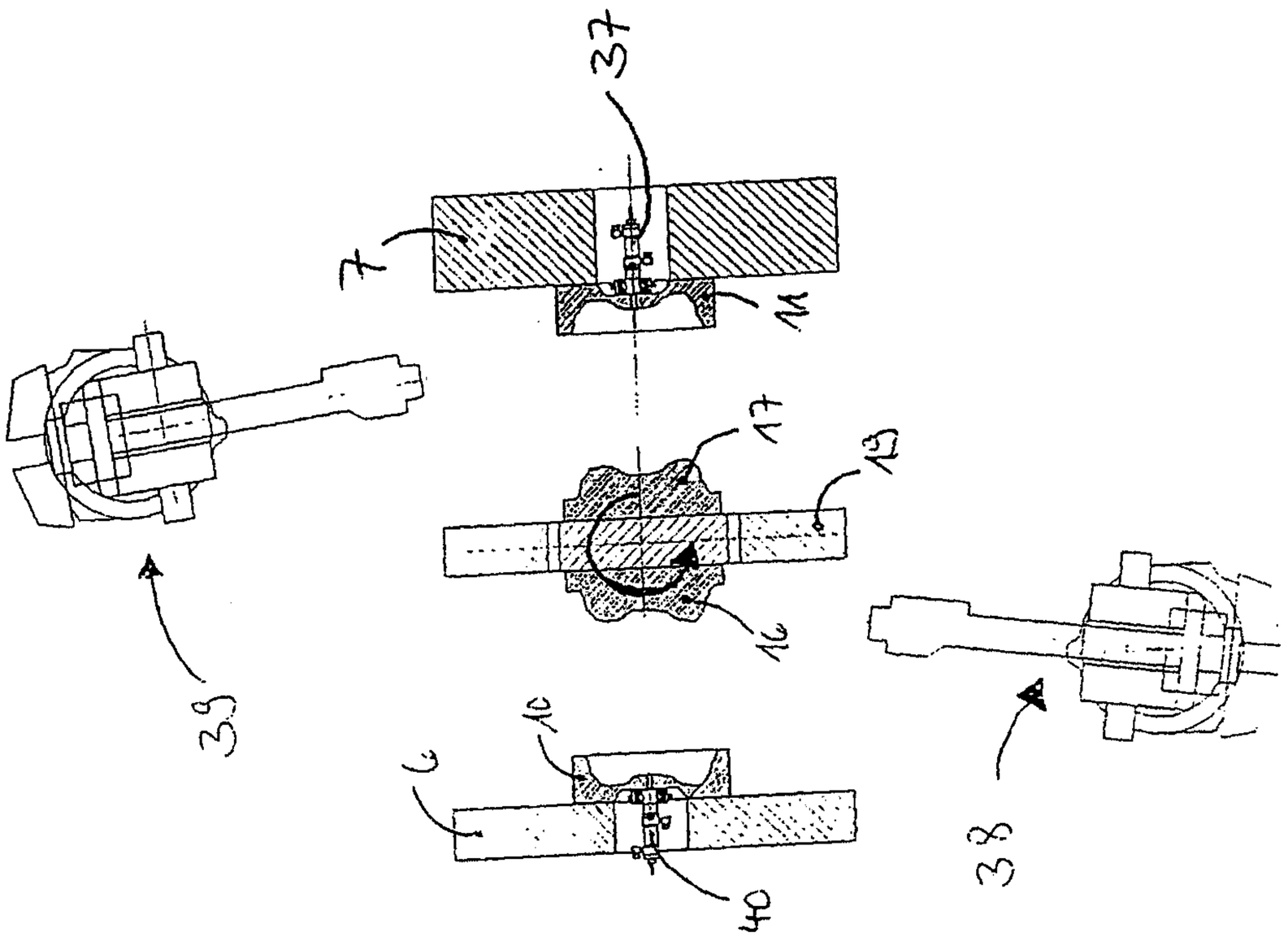


Fig. 4

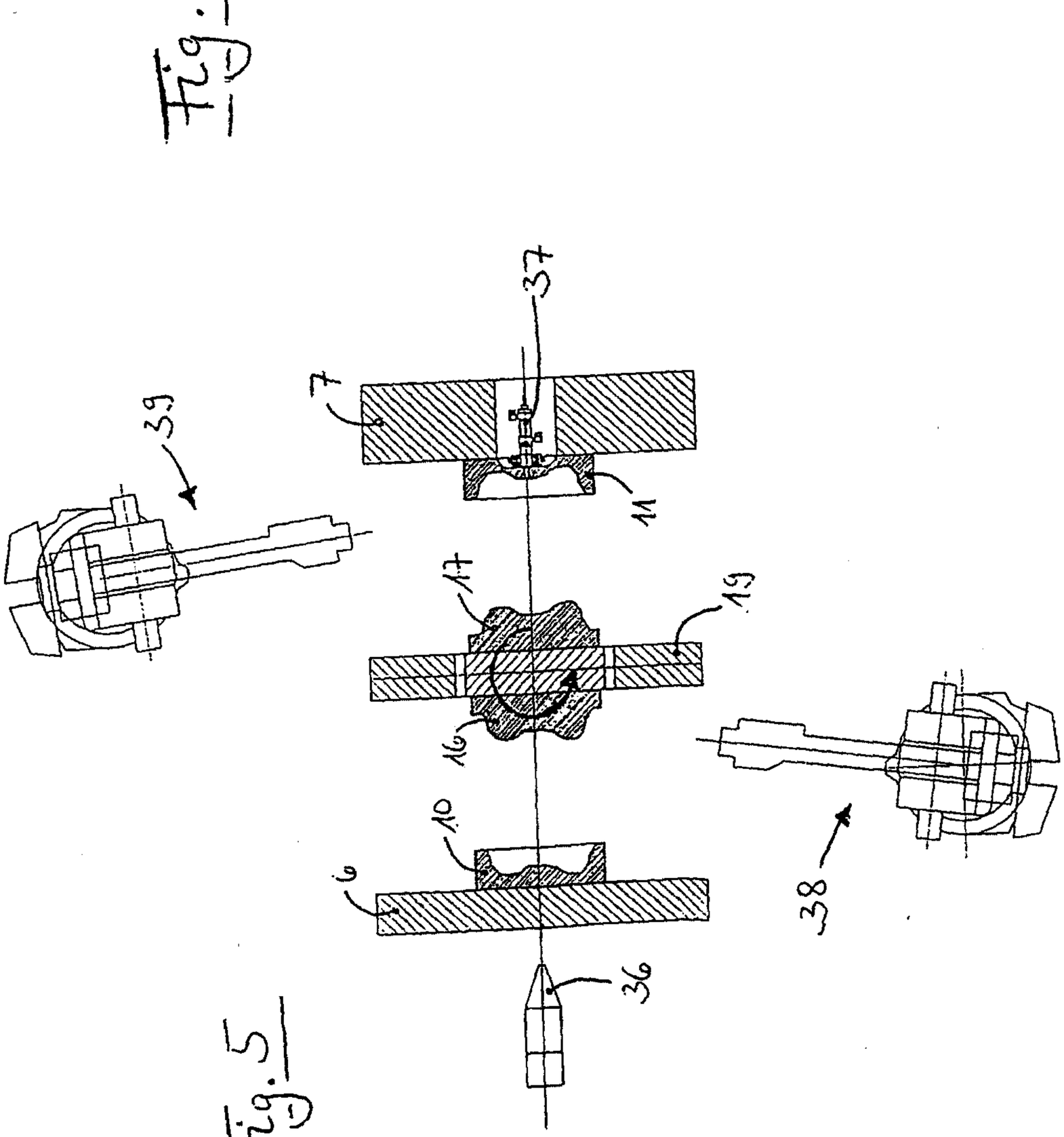


Fig. 5

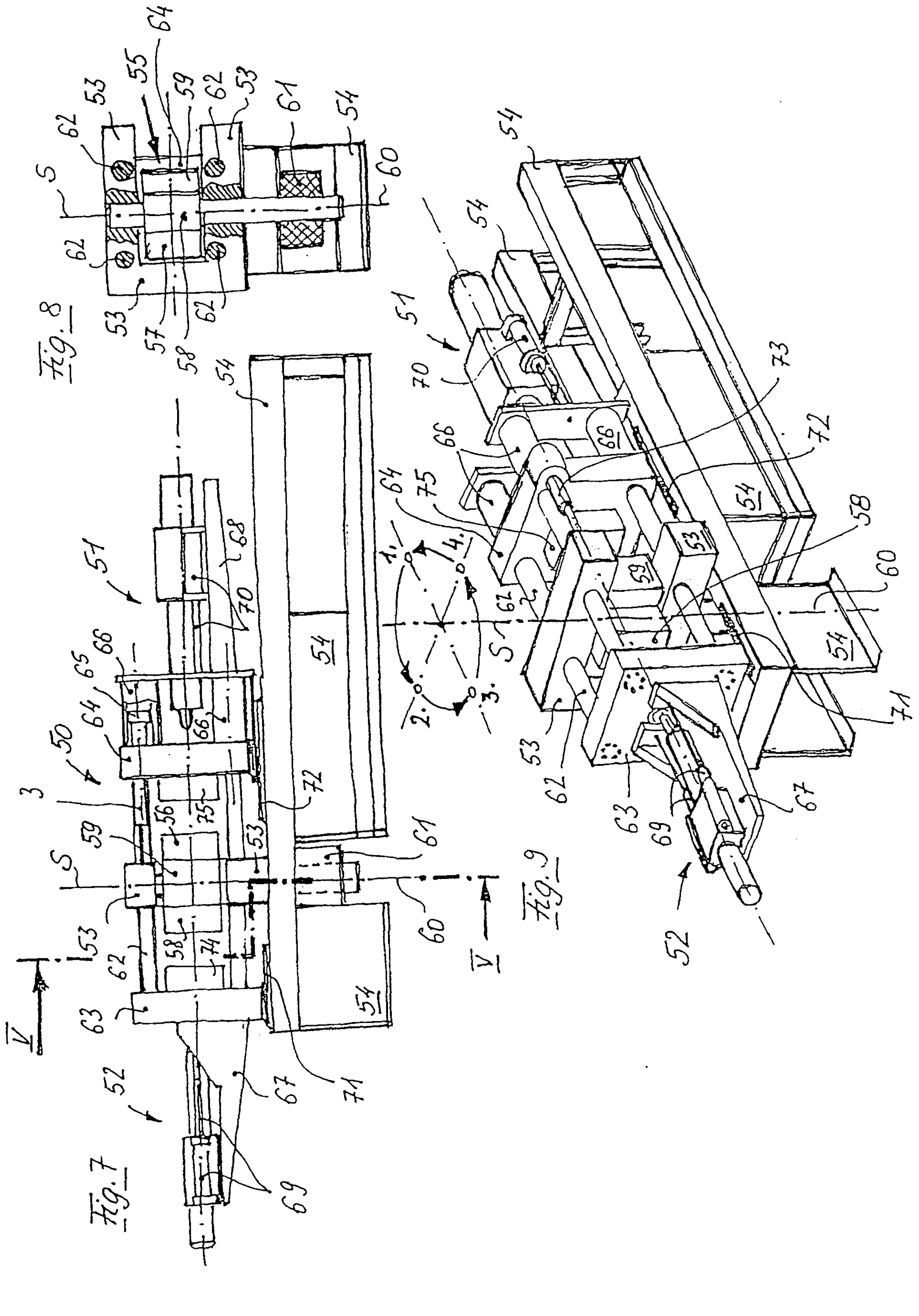
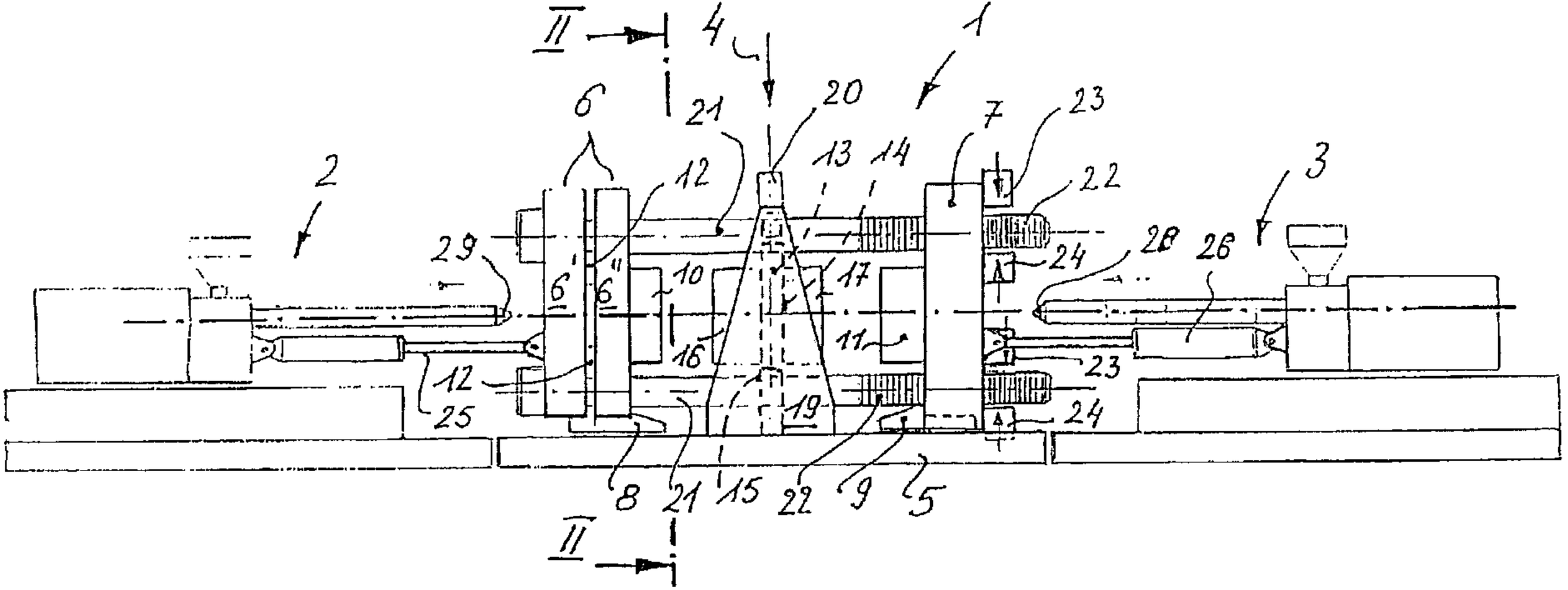


Fig. 8
Fig. 7
Fig. 9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