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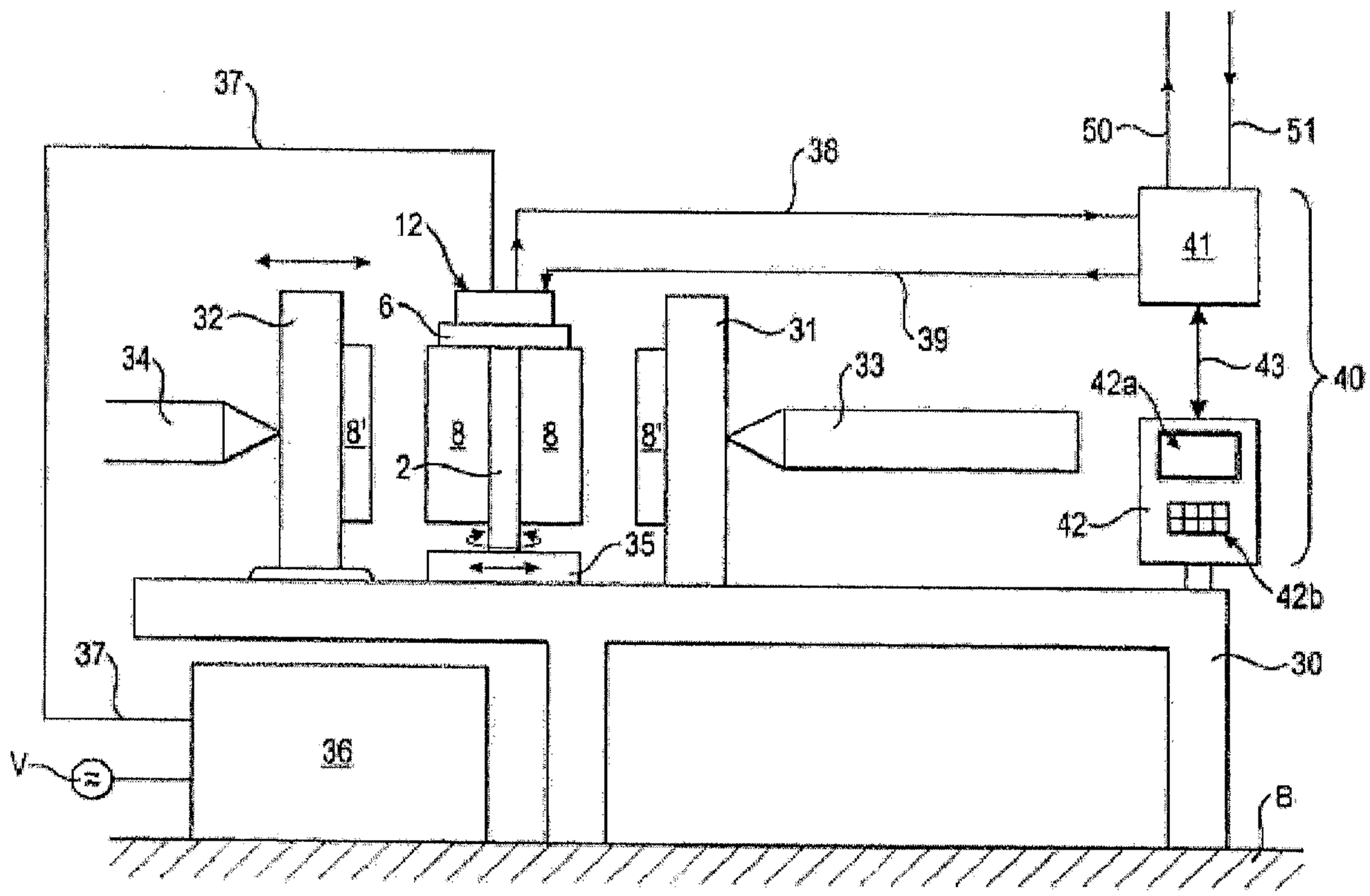
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(54) **Titre : MACHINE DE MOULAGE PAR INJECTION A PLAQUES REVERSIBLES MUNIE D'UN APPAREIL DE COMMANDE ET DE REGULATION DECENTRALISE**

(54) **Title: TURNING PLATE INJECTION MOLDING MACHINE COMPRISING A DECENTRALIZED CONTROL DEVICE**



(57) **Abrégé/Abstract:**
The invention relates to an injection molding machine, comprising two outer die platens (31, 32) and at least one further mold carrier (2) which is arranged therebetween and can be rotated about a rotational axis located perpendicularly to the longitudinal machine axis. The mold carrier (2) and/or the mold halves (8) that can be attached thereto can be supplied with media by means of

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(57) **Abrégé(suite)/Abstract(continued):**
a rotary distributor (12), the rotatable part of which is located coaxially with respect to the rotational axis of the mold carrier (2) and to the rotationally fixed part of which lines (37, 38, 39) can be connected According to the invention, a control console (6), which can be coupled to the mold halves (8) and which rotates along with the mold carrier (2) during the operation of the injection molding machine, is provided as a decentralized control device which processes signals from sensors and/or actuators of the mold halves. Data can be exchanged with the control boards (19) in the co-rotating control console (6) via a bus connection (38, 38) from the co-rotating control console (6) to the central control unit (40) of the injection molding machine.

Turning Plate Injection Molding Machine Comprising a Decentralized Control Device

(57) Abstract: The invention relates to an injection molding machine, comprising two outer die platens (31, 32) and at least one further mold carrier (2) which is arranged therebetween and can be rotated about a rotational axis located perpendicularly to the longitudinal machine axis. The mold carrier (2) and/or the mold halves (8) that can be attached thereto can be supplied with media by means of a rotary distributor (12), the rotatable part of which is located coaxially with respect to the rotational axis of the mold carrier (2) and to the rotationally fixed part of which lines (37, 38, 39) can be connected. According to the invention, a control console (6), which can be coupled to the mold halves (8) and which rotates along with the mold carrier (2) during the operation of the injection molding machine, is provided as a decentralized control device which processes signals from sensors and/or actuators of the mold halves. Data can be exchanged with the control boards (19) in the co-rotating control console (6) via a bus connection (38, 38) from the co-rotating control console (6) to the central control unit (40) of the injection molding machine.

Turning Plate Injection Molding Machine Comprising a Decentralized Control Device

Description

The invention relates to an injection molding machine.

Injection molding machines of this type are known in the prior art in various embodiments in which one or more turnable mold carriers are provided between the outer die platens (DE102005016239A1, EP1155802B2, WO2005/077637A1). In known injection molding machines, each of the rotatable mold carrriers is assigned a rotary distributor, via which the molds can be supplied with media such as water, hydraulic fluid or electrical power. Two mutually opposing rotary distributors can optionally be provided on one mold carrier. Furthermore, via suitable interfaces, signals or data can be exchanged between sensors and actuators on or in the mold carrier or on or in the mold halves on one side and the central control unit of the injection molding machine on the other side. Depending upon the complexity of the mold carrier or the mold halves, a plurality of actuators and sensors may be provided. In that case, a costly wiring of the mold halves via the rotary distributor to the central control unit is necessary. This increases the risk of a cable break. Distortions in measured values can also occur.

Also known are injection molding machines in which bus systems are used to transmit data and signals (DE19958790C2, DE10302878B4).

In light of the prior art described in the introductory portion, the invention addresses the problem of further developing an injection molding machine of the generic type so as to make it particularly suited for the use of complex molding tools with molding halves that are equipped with a plurality of sensors and actuators.

Some embodiments disclosed herein relate to an injection molding machine comprising two outer die platens and at least one additional mold carrier which is arranged between these and is rotatable about a rotational axis aligned perpendicularly to the longitudinal machine axis, wherein a rotary distributor is provided, the rotatable part of which is arranged coaxially in relation to the rotational axis of the mold carrier and to the non-rotatable part of which lines are connectable for the purpose of supplying at least one of the mold carriers and mold halves that are attachable to the mold carriers with media, and wherein the injection molding machine comprises a central

control unit, wherein a control console, which is couplable to at least one of the mold carrier and to the mold halves that are attachable to the mold carrier and which co-rotates with the mold carrier during operation of the injection molding machine, is provided, in which control boards are provided for processing signals from at least one of sensors and actuators and for sending signals to at least one of the sensors and the actuators, and wherein at least one bus connection from the co-rotating control console to the central control unit of the injection molding machine is provided, via which data is exchangable between the central control unit of the injection molding machine and the control boards in the co-rotating control console.

Because a control console which can be coupled to the mold carrier and/or to the molds and/or mold halves that can be attached to the mold carrier, and which co-rotates with the mold carrier during operation of the injection molding machine is provided, in which control boards are provided for processing signals from sensors and/or actuators and for transmitting signals to the sensors and/or the actuators, and because at least one bus connection from the co-rotating control console to the central control unit of the injection molding machine is provided, via which data can be exchanged between the central control unit of the injection molding machine and the control boards in the co-rotating control console, the cost of wiring is significantly reduced. The signals are processed in a decentralized manner directly on the mold carrier in the co-rotating control console or in the control boards housed therein. This also results in better control quality due to shortened signal transmission paths or shortened data transfer paths and reduced transfer interfaces, and allows lower measured value tolerances to be specified. Depending upon the extent of the equipment in the injection molding machine, particularly depending upon the fittings of the molding tools, this can also result in a significant reduction in costs.

In a further embodiment of the decentralized control technology according to the invention, additional electric and/or electronic elements for operating the molds or the mold halves and/or the mold carrier can be housed in the co-rotating control console.
These can be input and output boards for digital and/or analog inputs/outputs, for example.
Electric servo elements for actuating valves, core pulls, etc. can also be provided.
Furthermore, in the co-rotating control console, controlled and/or uncontrolled power packs and/or fusing for supply and signal voltages can be provided.

Electrical power (supply voltages, signal voltages) and/or electrical signals or data can preferably be exchanged via a manual and/or automatic multicoupler with a plurality of coupler interfaces, wherein coupler interfaces are provided on the mold carrier and/or on the mold halves attached to the mold carrier such that said interfaces can be engaged with the coupling points of the multicoupler on the control console.

To supply power to the electric power consumers of the injection molding machine, a central supply control console is customarily provided, which is connected to a voltage source. The electric power consumers provided in the rotating mold halves or on the rotating mold carrier

can therefore be supplied with electric power by this central supply control console. For this purpose, the electric voltage or power supplied by the voltage source (V) can optionally be provided in the central supply control console and can be conducted via one or more supply lines to the rotating distributtor. The supply voltages can be conducted via high-performance slip rings of the rotary distributor into the rotatable part of the rotary distributor and from there to the co-rotating control console. From there, the voltage can be distributed to the consumers in the mold halves and/or on the mold carrier.

For the exchange of data between the central control console or the control boards therein and the central control unit, one or more bus connections can be provided, which can be formed by a slip ring via the rotary distributor or wirelessly, for example, via radio or bluetooth.

Advantageously, one or more linear drives can be provided, with which the control console can be moved toward and away from the center mold carrier. This is advantageous particularly when the rotary distributor is mounted on a crossbar between the columns of the injection molding machine. The control console can then be moved through beneath the crossbar in the operating position, when said console is coupled to the mold halves. In a retracted position, maintenance and installation operations can be performed, therefore this can also be referred to as the maintenance position.

Depending upon the configuration of the injection molding machine, multiple rotatable mold carriers can be provided between the outer die platens. In that case, for each rotatable mold carrier a co-rotating control console and a rotary distributor are provided. The central control unit is connected to the multiple control consoles via one or more bus connections and the rotataing distributor.

In what follows, the invention will be specified in greater detail within the context of one embodiment example and with reference to figures 1-6.

Figure 1 schematically illustrates a section of a known turning plate injection molding machine having two outer die platens and one center rotatable mold carrier, as is described, for example, in DE102005016239A1 and as is illustrated schematically in figure 6 of the

present application. Between the outer die platens, which are not visible in figure 1, four columns extend for receiving and/or transferring closing force, with only the two upper columns 1a and 1b being partially shown. A center mold carrier 2 is attached to a turntable which is rotatably mounted on the machine bed, as is illustrated and described, for example, in the above-cited DE102005016239A1 (see also figure 6). The center mold carrier 2 is embodied in the present case as a so-called turning plate 2 with two die platens for mounting molds or mold halves. However, it can also be embodied as cubic or prismatic with more than two die platens. On both sides of the turning plate 2, mold halves are attached, of which in figure 1 only the front mold half 8 is visible. During operation, these mold halves can be joined with matching mold halves on the outer die platens, in order to form suitable cavities for plastic molded parts. Above the turning plate 2, between columns 1a and 1b, a crossbar 3 is arranged, with each of the ends thereof being attached to a sliding bushing 5 via an intermediate piece 4. The crossbar 3 can be moved along columns 1a and 1b by means of suitable linear drives 9a, 9b. A control console 6, comprising a front control console part 6a and a rear control console part 6b, can be moved by means of two linear drives 7a and 7b from the upper position (maintenance position) shown in figure 1 downward to an operating position and back again. In the operating position, an automatic multicoupler provided on the underside of the control console 6 is engaged with or coupled to a matching automatic multicoupler 10 on the mold half 8. Moreover, in the operating position the control console 6 is lowered far enough that it can move freely beneath the crossbar 3. When the turning plate 2 rotates, the control console 6 rotates with it. Above the crossbar, the non-rotatable outer part of a rotary distributor is located in a housing 11, while the inner rotatable part of the rotary distributor projects downward out of the outer part or out of the housing 11 and has connectors, from which electrical lines run to and into the control console 6. The connecting lines between the non-rotatable part of the rotary distributor and the central control unit for data transfer and an additional control console, specifically a central supply control console for the central voltage supply or electric power supply, are not shown.

Additional details about the control console and the rotary distributor will be described in what follows in reference to figures 2 to 5. The electric rotary distributor 12 is illustrated in a side view in figure 2 and in a perspective view in figure 3, specifically at an angle from below. The housing 11 comprises a lower cubic housing part 11a and an upper cylindrical housing part 11b. Multiple connectors 13.1 – 13.7 are provided, to which cables can be connected for desired purposes. Said connectors could be assigned as follows:

13.1 = supply voltage 400V

13.2 = signal voltage 24V

13.3 = first Varan cable (first Varan bus)

13.4 = second Varan cable (second Varan bus)

13.5 = first CAN bus

13.6 = second CAN bus

13.7 = reserved for future applications

By means of slip ring transformers, electrical connections can be produced between the non-rotatable part of the electric rotary distributor 12, not shown here, and the rotatable part 14 thereof. The rotatable part 14 projects somewhat away from the housing 11 on the underside thereof and has a plurality of connectors 15, from which cables or lines extend for transferring electric power or a supply voltage or a signal voltage and for transmitting data and/or signals to the control console 6.

Figure 4 shows a perspective illustration of the control console 6 of figure 1, specifically at an angle from below with the housing wall removed, so that it is possible to view the interior of at least the right, front part of the control console 6. The control console 6 can therefore be divided into a first, front control console part 6a and a second, rear control console part 6b. Each of these parts 6a, 6b is assigned to a mold half 8. It can also be said that two control consoles 6a and 6b are provided, which are connected to one another via a support plate 16. A centering pin 17 extends through a hole in the center of the support plate 16 and enables a precise centering of the control consoles 6a and 6b in relation to the mold halves. Each of the control consoles 6a and 6b has an automatic multicoupler 10' on its underside, which in the operating position is engaged with or coupled to matching automatic multicouplers 10 on the mold halves 8. Multicouplers of this type are known in the prior art and therefore will not be specified in greater detail at this point. Inside the control consoles 6a and 6b, a row of control boards are arranged, along with additional electric and electronic components.

Figure 5 shows a modified embodiment of a co-rotating control console 6 according to the invention with a housing wall 18 pivoted open. Inside the control console 6 a plurality of receiving devices 19 (in this case six) for receiving and securing control boards are provided. The following boards can be accommodated there, for example:

- temperature control boards (e.g., for temperature sensors and heating elements),

- power electronics boards (e.g., for regulating and controlling the heating of the mold halves),
- boards with digital inputs/outputs
- boards with analog inputs/outputs
- boards with charge amplifiers (e.g., for internal tool pressure)

In addition to an automatic multicoupler 10', a manual multicoupler 20 can also be provided. Control transformers 21 are also provided, for example, controlled and/or uncontrolled power packs and fusing 22, for example, for fusing the supply voltages. The supply voltages can be high-volt (400V, 230V) and low-volt (24V) voltages. They may be direct current (DC) or alternating current (AC). The electric rotary distributor 12 is illustrated schematically, and can also have an automatic or manual multicoupler 23. The electric rotary distributor is used to transfer or supply, for example: electric power supply, various bus interfaces, safety-relevant signals. Via the multicoupler 23, the aforementioned electric components can be fed in the rotary distributor and can project outward as far as is necessary. The latter applies particularly to the transmission of signals and data between the control console 6 and the central control unit of the injection molding machine. In the CPU or the data processing unit of the central control unit, the data can be further processed. However, the CPU of the central control unit serves primarily to manage the control boards in the control console 6. The control console 6 therefore forms a decentralized control device that co-rotates with the turning plate or with the rotatable mold carrier for operation of the sensors and actuators provided on or in the mold halves. The signals detected by the sensors are processed in the co-rotating control console and not, as is customary, in the central control unit of the injection molding machine. In the latter, however, the process data are further visualized, and target and actual values are input as preset parameters for the control boards in the control console 6. Furthermore, additional operating parameters for other parts of the injection molding machine are input into the central control unit. Data are exchanged between the central control unit and the decentralized control console. For example, it can be determined in the control console 6 whether and when all cores of a core pull system are inserted, and this information can be forwarded via the bus system to the central control unit. The decentralized, co-rotating control device can also be managed by a higher-order control system to which, for example, multiple injection molding machines are connected, rather than by the central control unit of the injection molding machine. This higher-order control

system is therefore in a data exchange with multiple decentralized control devices of the type described here.

The connection between the co-rotating decentralized control device 6 on the turning plate 2 and the central control unit and a central supply control console will be described In reference to figure 6. Figure 6 schematically illustrates an injection molding machine of the type disclosed in DE102005016239A1, standing on a floor B of a factory. A stationary die platen 31, a movable die platen 32 and two plasticizing and injection units 33 and 34 are supported on a machine bed 30. Between the two outer die platens, a turning plate 2 is attached to a turntable 35, which can be displaced longitudinally. In the interest of clarity, the columns and the crossbar between the upper columns have been omitted. On the turning plate 2, mold halves 8 are fastened, which can be joined to matching mold halves 8' on the outer die platens. The control console 6 or the decentralized control device 6 and the rotary distributor 12 are located above the turning plate 2. Under or in the machine bed 30, a central supply control console 36 is provided, which is connected to a voltage source V and from which a supply line 37 leads to the rotary distributor 12. From there, the supply voltages are fed to the control console 6 as described above and then on to the consumers in the mold halves 8 and/or to the turning plate 2. Of course, additional supply lines for other consumers, such as electric drives or electric strip heaters of the plasticizing and injection devices 34, 35, are provided. By means of additional lines 38 and 39, the control console 6 or the control boards located therein are connected to a central control unit 40. Said unit comprises a data processing unit 41 having at least one central processor (CPU) and an input and output device 42 with a display component 42a and an operating component 42b. The data processing unit 41 can be connected by means of a bidirectional data line 43 to the input and output device 42. Via line 39, data and commands, for example, are transmitted to the control boards in the control console 6. Via line 38, data and signals can be transmitted in the opposite direction from the control boards to the central control unit 40. Of course, additional lines (e.g, 50, 51) are also provided, which are connected to sensors and actuators that are not rotated during operation and therefore need not be connected via the rotary distributor 12 to the central control unit 40.

List of Reference Signs

1a, 1b	Upper columns
2	Turning plate
3	Crossbar
4	Intermediate pieces
5	Sliding bushings
6	Decentralized control console
6a	Front control console part
6b	Rear control console part
7a, 7b	Linear drives for control console
8, 8'	Mold halves
9a, 9b	Linear drives for crossbar
10	Multicoupler on mold halves
10'	Multicoupler on control console
11	Housing of rotary distributor
11a	Lower housing part
11b	Upper housing part
12	Rotary distributor
13.1 - 13.7	Electrical connectors
14	Rotatable part of rotary distributor
15	Electrical connection points
16	Support plate
17	Centering pin
18	Housing wall
19	Receiving devices for control boards
20	Manual multicoupler
21	Control transformers
22	Electric fusing
23	Multicoupler
30	Machine bed

31	Stationary die platen
32	Movable die platen
33	First plasticizing and injection unit
34	Second plasticizing and injection unit
35	Turntable
36	Central supply control console
37	Supply line
38	First data line
39	Second data line
40	Central control unit
41	Data processing unit
42	Input and output device
42a	Display part
42b	Operating part
43	Bidirectional data line
50, 51	Additional data lines
B	Floor
V	Supply voltage source

CLAIMS:

1. An injection molding machine comprising two outer die platens and at least one additional mold carrier which is arranged between these and is rotatable about a rotational axis aligned perpendicularly to the longitudinal machine axis, wherein a rotary distributor is provided, the rotatable part of which is arranged coaxially in relation to the rotational axis of the mold carrier and to the non-rotatable part of which lines are connectable for the purpose of supplying at least one of the mold carriers and mold halves that are attachable to the mold carriers with media, and wherein the injection molding machine comprises a central control unit, wherein
a control console, which is couplable to at least one of the mold carrier and to the mold halves that are attachable to the mold carrier and which co-rotates with the mold carrier during operation of the injection molding machine, is provided, in which control boards are provided for processing signals from at least one of sensors and actuators and for sending signals to at least one of the sensors and the actuators, and wherein at least one bus connection from the co-rotating control console to the central control unit of the injection molding machine is provided, via which data is exchangable between the central control unit of the injection molding machine and the control boards in the co-rotating control console.

2. The injection molding machine according to claim 1,
wherein
input and output boards for at least one of digital and analog inputs/outputs are provided in the co-rotating control console.

3. The injection molding machine according to claim 1 or 2,
wherein
electric servo elements for actuating valves are provided in the co-rotating control console.

4. The injection molding machine according to any one of claims 1 to 3,
wherein
at least one of controlled power packs, and uncontrolled power packs and fusing for supply and signal voltages are provided in the co-rotating control console.

5. The injection molding machine according to any one of claims 1 to 4,

wherein
the co-rotating control console has at least one of a manual and an automatic multicoupler having a plurality of coupler interfaces, and wherein on at least one of the mold carrier and the mold halves attached to the mold carrier, such coupler interfaces are provided that are engagable with the coupling points of the multicoupler on the control console.

6. The injection molding machine according to any one of claims 1 to 5,
wherein
a separate, central supply control console is provided, in which the electric power supplied by a voltage source is provided and is conducted via one or more supply lines to the rotary distributor.

7. The injection molding machine according to any one of claims 1 to 6,
wherein
the bus connection between the co-rotating control console and the central control unit is formed by a slip ring via the rotary distributor or wirelessly, via radio or Bluetooth.

8. The injection molding machine according to any one of claims 1 to 7,
wherein
the supply voltages are conducted via high-performance slip rings of the rotary distributor into the co-rotating control console, and are distributed from there to the consumers in at least one of the mold halves and the mold carrier.

9. The injection molding machine according to any one of claims 1 to 8,
wherein
one or more linear drives are provided, with which the control console is movable toward and away from the center mold carrier.

10. The injection molding machine according to any one of claims 1 to 9,
wherein
a plurality of rotatable mold carriers are provided between the outer die platens, and wherein for each rotatable mold carrier a co-rotating control console and a rotary distributor are provided, and wherein the central control unit is connected to the control consoles via one or more bus connections.

Fig. 1

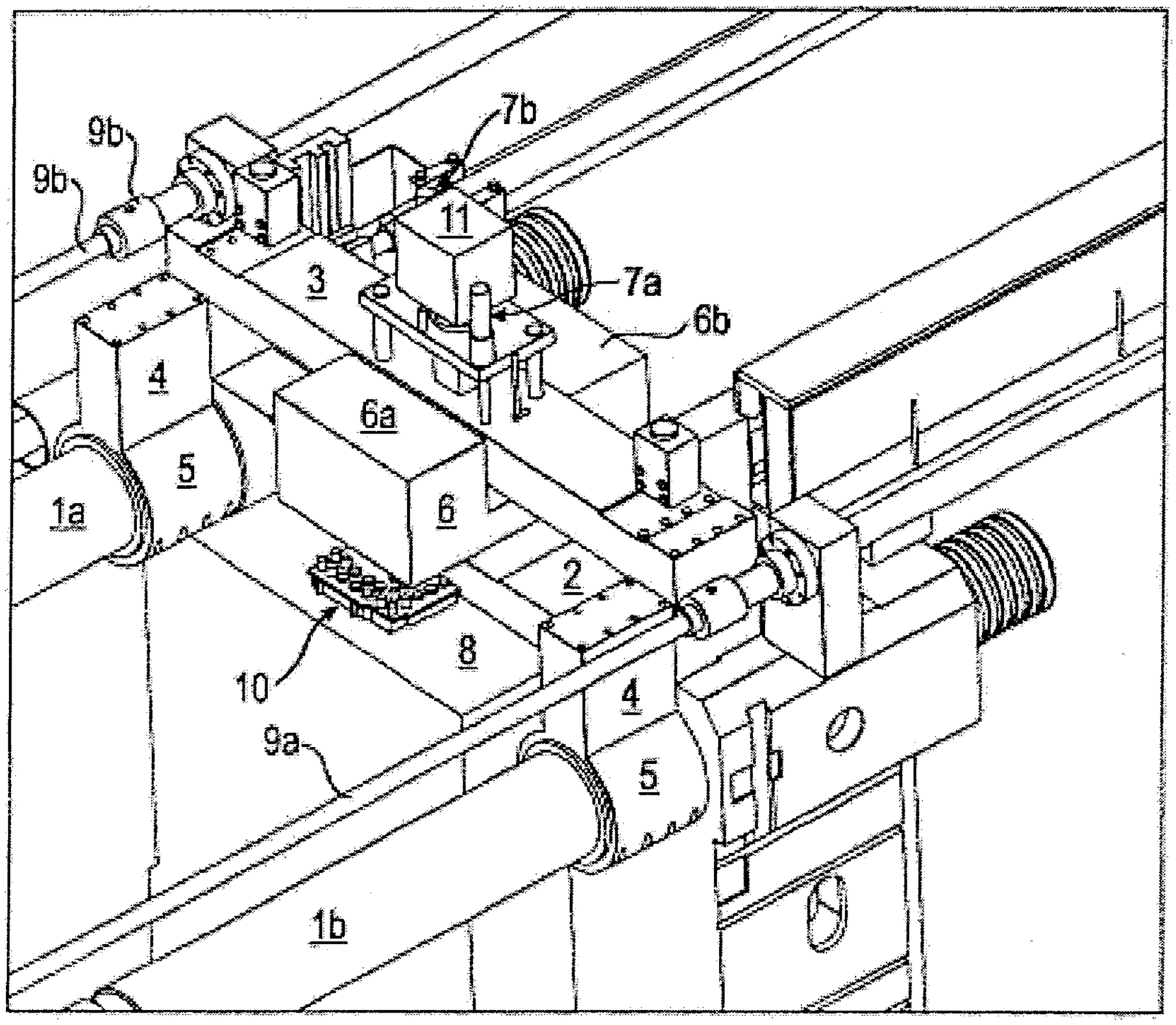


Fig. 2

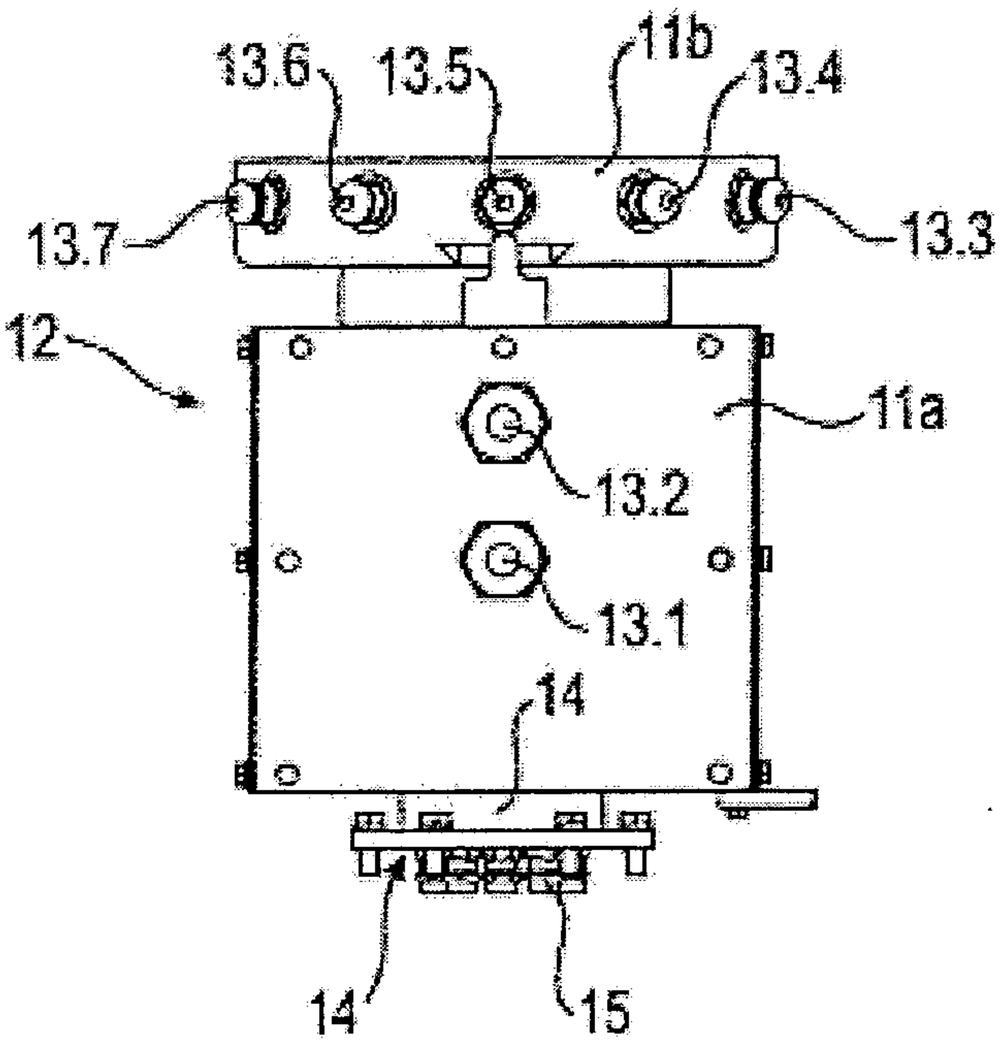


Fig. 3

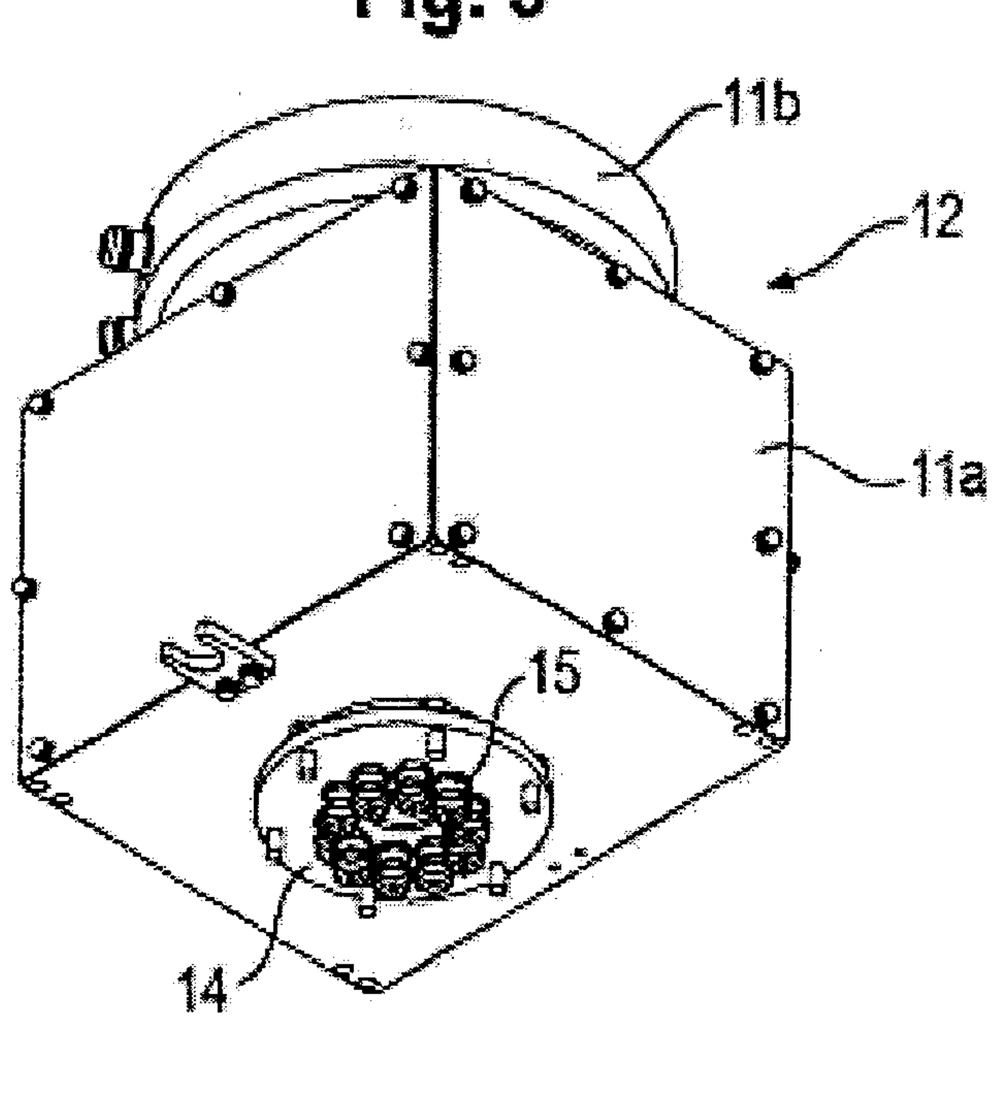


Fig. 4

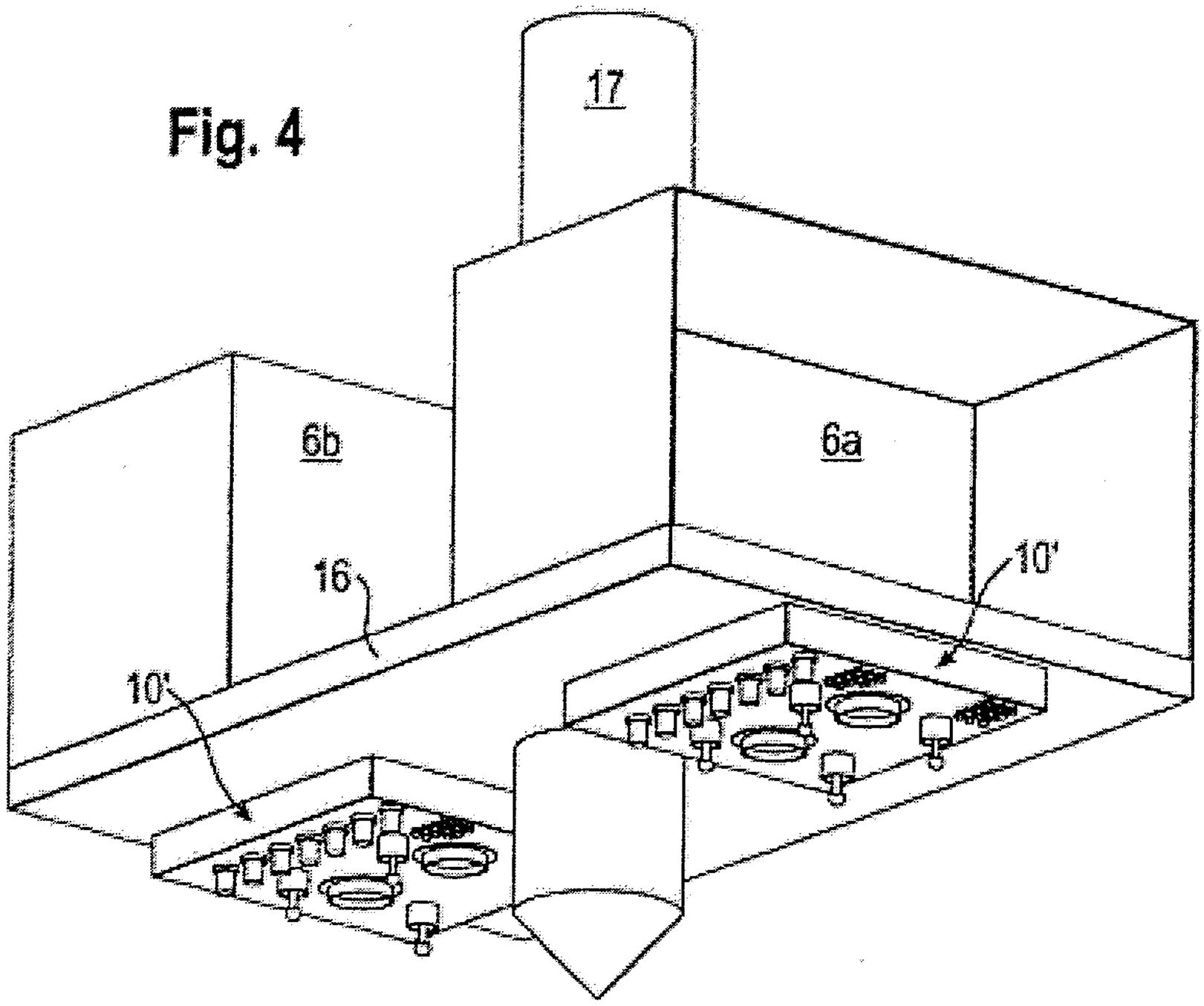
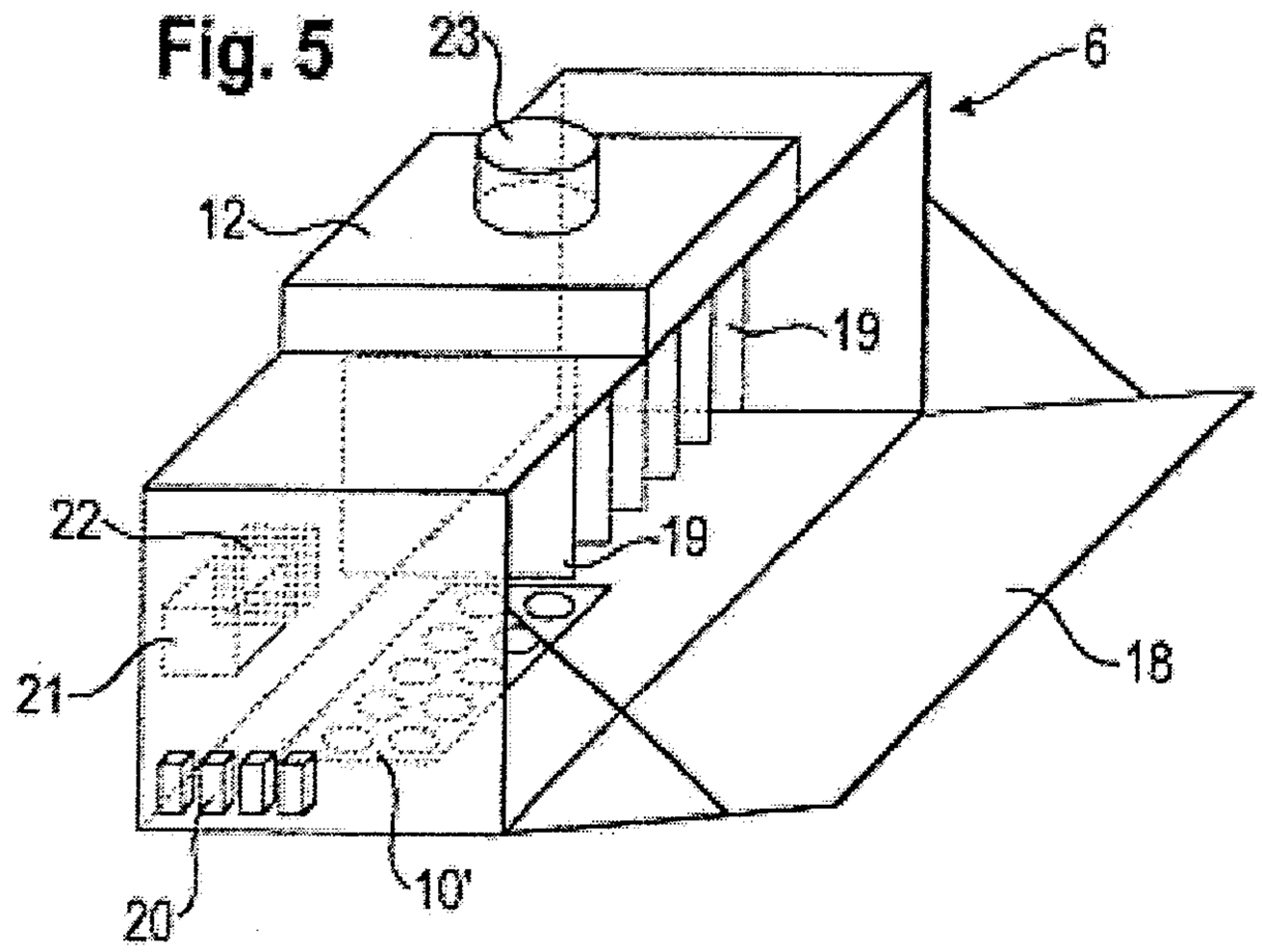


Fig. 5



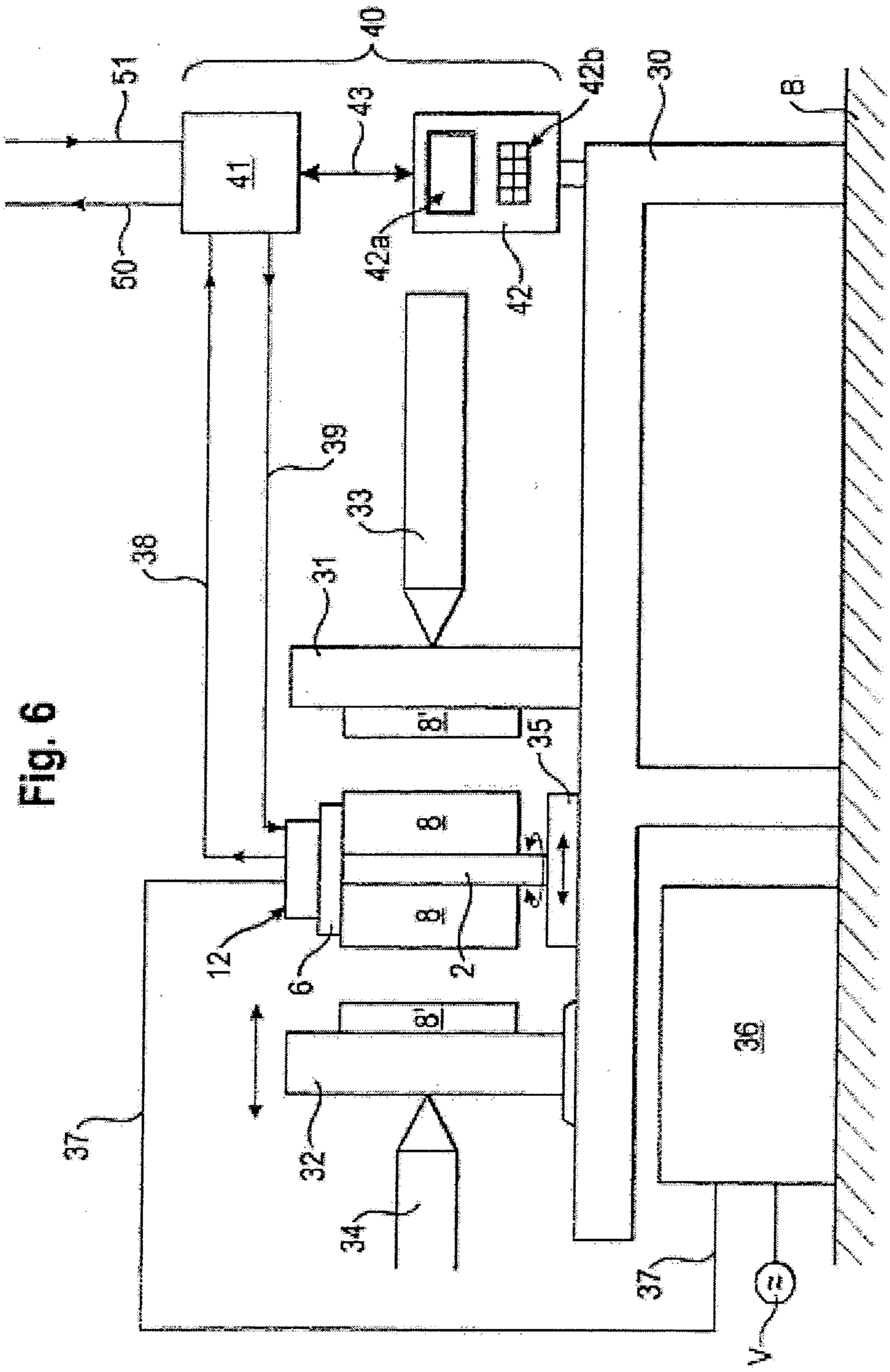
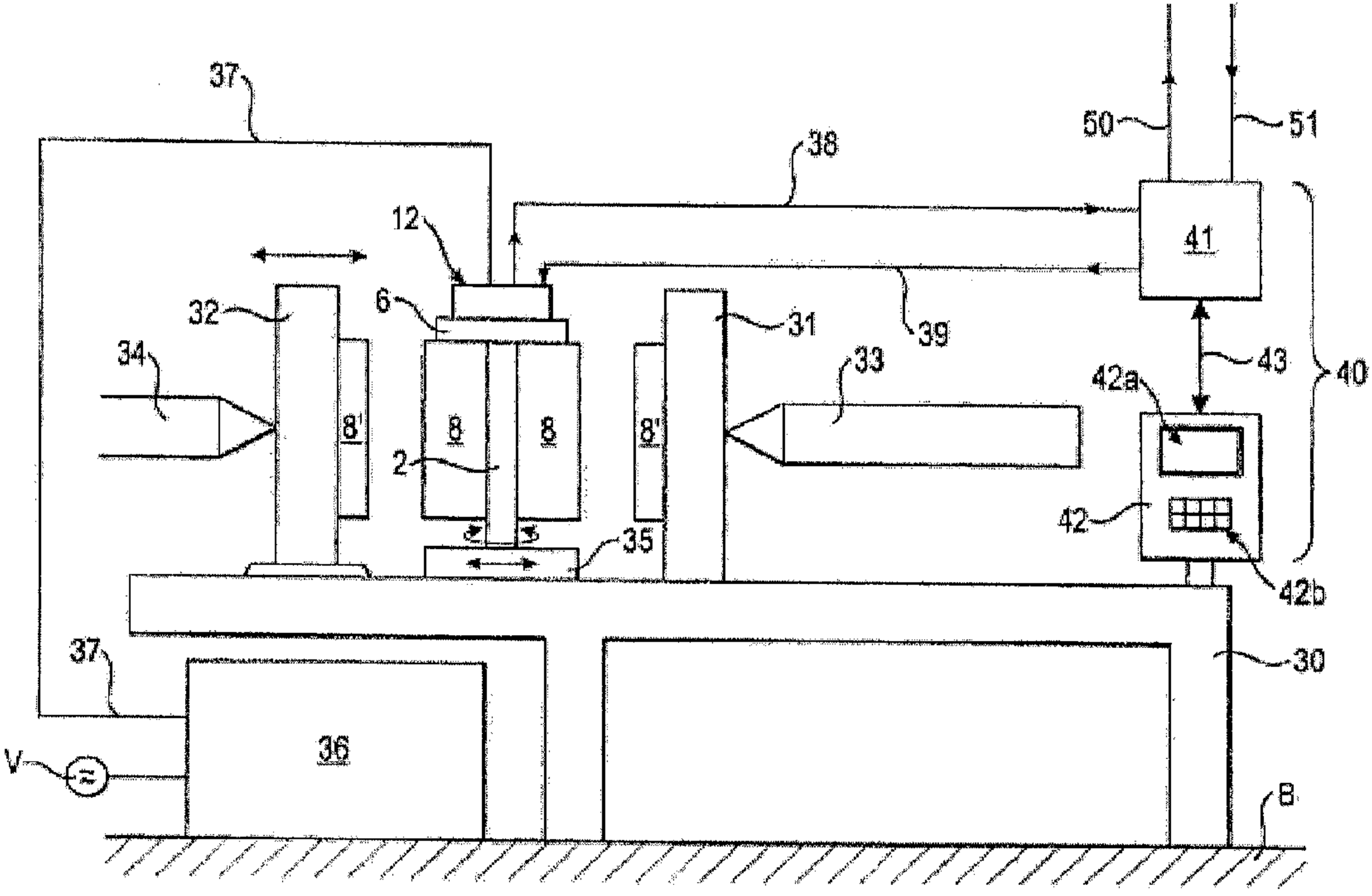


Fig. 6


37
38
50
51
12
41
32
6
31
39
34
33
43
40
42a
8'
8
8
8'
2
42
35
42b
37
30
36
V
B