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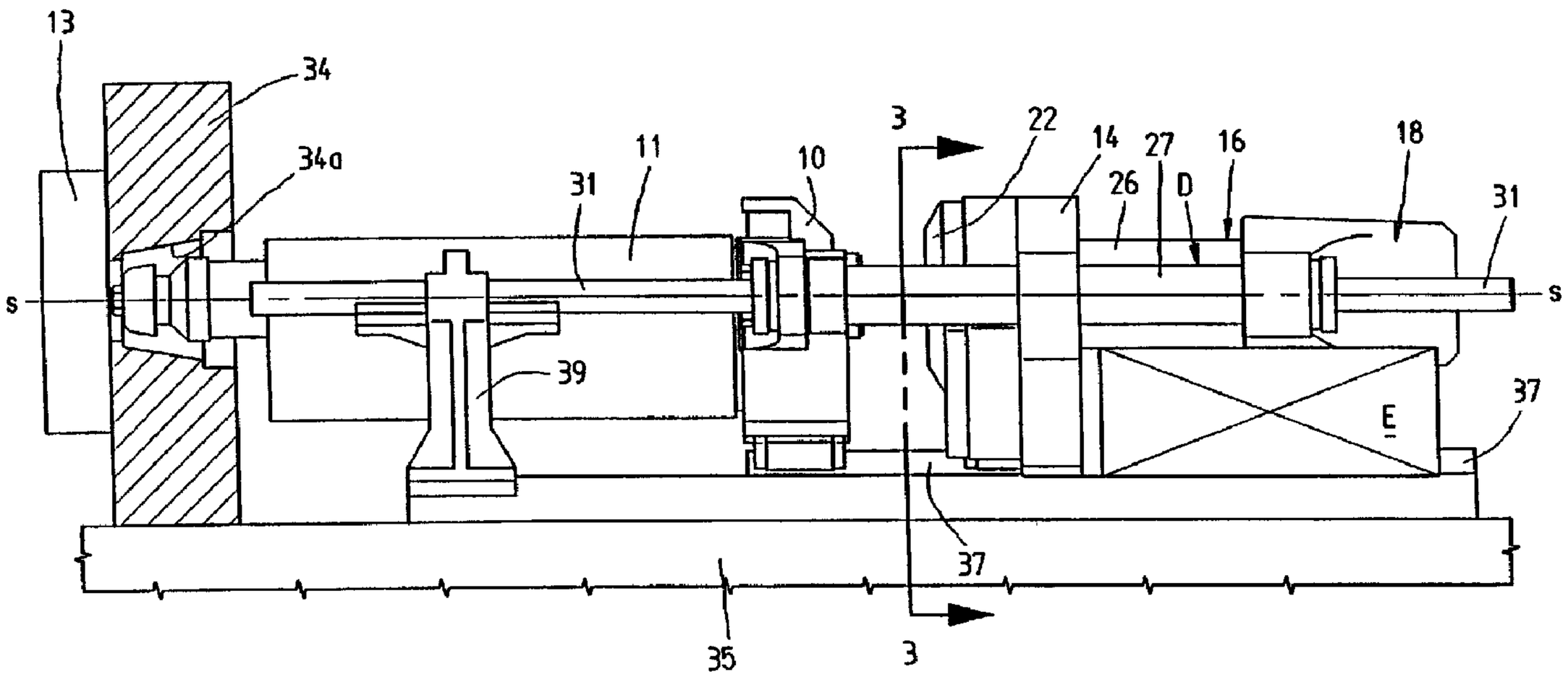
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(54) Titre : UNITE D'INJECTION POUR MACHINE A MOULER PAR INJECTION
(54) Title: INJECTION MOULDING UNIT FOR AN INJECTION MOULDING MACHINE




(57) Abrégé/Abstract:
An injection-moulding unit for an injection-moulding machine has an injection motor (E) to activate an electromechanical injection unit (16) for axial movement of the feed screw (12). An electromechanical rotary motor is provided to be able to turn the feed screw independently of the axial movement. The rotary motor (R) and the injection motor (E) work via a first drive element (19) and a drive element (20) coaxial to the first drive element (19) to make the feed screw move. To transmit the axial movement to the feed screw (12) by a means of linear movement (16a) of the injection unit (16), there is an axial bearing element (21) directly between the first drive element (19) and the other drive element. The axial bearing element is a force-transmission element, but at the same time has the job of acting as a means of separation to allow the drive elements 19, 20 to rotate independently of one another and, if necessary, at the same time. This is a simple way of permitting compact coupling of the drive elements for dosing and injection on an injection-moulding unit.

Abstract

An injection-moulding unit for an injection-moulding machine has an injection motor (E) to activate an electromechanical injection unit (16) for axial movement of the feed screw (12). An electromechanical rotary motor is provided to be able to turn the feed screw independently of the axial movement. The rotary motor (R) and the injection motor (E) work via a first drive element (19) and a drive element (20) coaxial to the first drive element (19) to make the feed screw move. To transmit the axial movement to the feed screw (12) by a means of linear movement (16a) of the injection unit (16), there is an axial bearing element (21) directly between the first drive element (19) and the other drive element. The axial bearing element is a force-transmission element, but at the same time has the job of acting as a means of separation to allow the drive elements 19, 20 to rotate independently of one another and, if necessary, at the same time. This is a simple way of permitting compact coupling of the drive elements for dosing and injection on an injection-moulding unit.

# Description

## Injection-moulding Unit for an Injection-moulding Machine

### FIELD OF INVENTION

The invention concerns an injection-moulding unit for an injection-moulding machine to process compounds that can be plasticized such as plastics, ceramic compounds or other powdered compounds.

### STATE OF THE ART

This type of injection-moulding unit is known from EP 0 752 303 A1, which uses an electromechanical injection-moulding unit to inject the plasticizable compound into the cavity of a mould clamped into a mould-closing unit and an electromechanical rotary motor to rotate a feeding means. The injection unit is supported at a support, which is connected to a carrier block via cross beams. These cross beams are used to guide an injection bridge. The feeding means and the ball roll spindle of the injection-moulding unit are coaxial to one another. The rotary motor and the injection motor are both arranged on the injection bridge and move with it. They transmit their drive torque to drive elements arranged coaxial to one another and coaxial to the injection axis. Both feed screws and ball roll spindles are rotary-mounted on the injection bridge in bearings. That way, no radial forces are transmitted from the injection bridge to the cross beams, which is essential there to detect the reaction forces, however, this involves considerable bearing expense in respect of the bearing for rotary mounting the feed screw and the spindle. Since the bearings are not in a housing, it is difficult to protect them from getting dirty. Since the force needed to move the injection bridge axially is transmitted via a tapering of the spindle, bearing and spindle sheath back to the feed screw, many different components must be assembled at some expense, so this unit cannot be made in a

modular design. The mounting is done so that the bearings that absorb the relatively high forces during the axial movement of the worm, are inside, while the bearings that absorb the comparatively lower dosing forces are outside. This arrangement of the bearings basically parallel to one another is a disadvantage.

It is also known from DE 43 44 335 A1 how to arrange electromechanical drives to make the screw rotate and make the screw move axially with their axes flush with the axis of the screw. To make this possible, at least one of the motors must be a hollow shaft motor, so that despite its compact design, it is expensive.

## SUMMARY OF THE INVENTION

Starting from this state of the art, the problem of this invention is to create a simple, compact coupling of the drive elements for dosing and injecting on an injection-moulding unit.

In accordance with one aspect, there is provided an injection-moulding unit for an injection-moulding machine to process plastics and other plasticizable compounds with a carrier block to hold a plasticizing cylinder, a feeding means arranged in the plasticizing cylinder along an injection axis to inject the plasticizable compound into a mould, an injection bridge that moves axially along the injection axis, on which the feeding means is rotatably mounted with at least one bearing element, an electromechanical injection unit to move the injection bridge axially, wherein a means of linear movement of the injection unit is rotatably mounted on the injection bridge via at least one bearing element, a support to non-rotatably support a sleeve cooperating with the means of linear movement, an injection motor, which turns the means of linear movement by means of a first drive element coaxial to it, an electromechanical rotary motor, which rotates the feeding means by means of another drive element coaxial to the feeding means and also to the first drive element, force-transmission elements comprising at least one axial bearing element, for transmitting the axial movement of the means of linear movement to the feeding means, characterised by the fact that the axial bearing element is arranged directly between the first drive element and the other drive element as a force-transmission element.

Compared to the known embodiments, the rotating mountings are now no longer mounted separately by themselves, instead the axial bearing enabling the transmission of axial forces is now arranged directly between the two drive elements. This saves one bearing element, on one hand; and on the other hand, the local proximity gained thereby creates the structural conditions for the drive element to be arranged in a housing (claim 4), which effectively protects them from outside influences. However, it also creates the conditions so that a largely modular design with many structurally equal parts is possible. Arranging the axial bearing element directly between the first drive element and the other one makes a space-saving design possible, on one hand, and, on the other hand, where high axial forces occur during the axial movement of the screw, larger bearings can be provided, while smaller bearings can be used for the dosing forces. This is more compatible with the forces that actually occur than is usual in the state of the art.

Although the same parts are also insofar arranged largely symmetrically to the injection axis to make the load on the injection-moulding unit symmetrical, a gear reduction is effectively obtained by assigning a planet gear to the

means of linear movement. To protect this drive from outside influences, it can be surrounded by a pipe so that it looks like a piston/cylinder unit on the outside.

SHORT DESCRIPTION OF FIGURES

The invention will be explained in greater detail below using the figures.

Fig. 1 shows a side view of an injection-moulding unit supported on a machine base and set next to a mould in side view,

Fig. 2 shows an enlarged section along Line 2-2 in Fig. 3,

Fig. 3 shows an enlarged section along line 3-3 in Fig. 1,

Fig. 4 shows an angled section along line 4-4 in Fig. 3,

Fig. 5 shows the view in Fig. 2 in another embodiment.

The invention will now be explained in greater detail with examples, referring to the attached drawings. The examples of embodiment are only examples and do not limit the inventive concept to a contain physical arrangement.

The injection-moulding unit shown schematically in Fig. 1 is an integral part of an injection-moulding machine and is thus arranged on the base 35 of that injection-moulding machine. It penetrates in an opening 34a in a stationary mould carrier 34, on which part of the mould 13 is visible on the left side. The injection-moulding unit itself is used on an injection-moulding machine to process plasticizable compounds, basically to inject those compounds, such as plastics, ceramic compounds or other powdered compounds into the mould cavity in the mould 13.

In Figure 1, the injection-moulding machine has a carrier block 10 to hold a plasticizing cylinder 11. The feeding means shown in Fig. 2 is arranged in the plasticizing cylinder 11 along the injection axis s-s. This feeding means 12 is used to inject the plasticizable compounds into the mould 13. An injection bridge 14 is arranged via cross beams 31 on

cylinders 27 axially movable in the direction of the injection axis s-s. In Fig. 2, the feeding means 12 is rotatably mounted on this injection bridge 14 via at least one bearing element 15. The injection bridge 14 is moved axially by an electromechanical injection unit 16. Fig. 2 shows how the injection unit 16 works; its means of linear movement 16a is rotatably mounted on the injection bridge via at least one bearing element 17.

On the right end of the injection-moulding unit, there is a supporting element 18 to rotatably fixed support element 16b which cooperates with the means of linear movement 16a. An injection motor E rotates the means of linear movement 16a by means of a first drive element 19 coaxial to it. Fig. 2 shows at the top right an electromechanical rotary motor R, which is intended to start the rotational movement of the feeding means 12. This takes place by means of another drive element 20, which is coaxial to the centre axis of the feeding means 12 and also coaxial to the first drive element 19. Hence, the feeding means 12, the first drive element 19 and the other drive element 20, and the means of linear movement 16a of the injection unit lie on one axis, injection axis s-s.

While the bearing elements 1 S and 17 are basically intended to permit the radial movement of the drive element that occurs during dosing, directly between the two drive elements 19, 20, there is an axial bearing element 21 as a force-transmission element to transmit forces during the axial movement of the means of linear movement 16a. When the means of linear movement 1 6a is moved, then the force flux from the means of linear movement goes to the drive element 19 connected to the means of linear movement and from it via axial bearing element 21 to the other drive element 20 and from there to the feeding means 12. This axial bearing element 21 must thus transmit the relatively high axial forces. At the same time, it makes it possible for the two drive elements 19, 20 to turn independently of one another. This is necessary during the plasticization of material, since when the feeding means 12 is rotating, an axial force-controlled movement of the feeding means 12 must be completed at the same time. In this case, both drive elements 19, 20 can then be moved at the same time, but independently of one another. This is possible due to the fact that the axial bearing element 21 is also designed as a separation means to uncouple the turning movements of the drive elements 19, 20.

Fig. 2 shows that the different bearing elements 15, 17 and the axial bearing element 21 are arranged almost in series one after another. Nevertheless, by direct intermediate connection of

the axial bearing element 21 between the two drive elements 19, 20, a compact design is possible, so that the first drive element 19 and the other drive element 20 can be arranged together in a housing formed in the injection bridge 14. This housing is closed by housing cover 22 in the direction of the carrier block, which is best shown in Fig. 4. The drive elements 19, 20 are identical in terms of their diameters and are toothed wheels in the example of embodiment. The drive elements 19, 20 can be driven by the drive toothed wheels 24, 25 of the injection motor E or the rotary motor R via intermediate toothed wheels 23. The injection motor and the rotary motor are attached to the injection bridge 14 and are moved with the injection bridge 14. In Fig. 4, this design not only enables to protect both gears in a common housing, it also largely creates the conditions for using structurally identical parts. Thus Fig. 4 shows that the two intermediate toothed wheels 23 are structurally identical and the housing in the injection bridge, which is symmetrical to the injection axis s-s, holds these two intermediate toothed wheels 23 at the same site symmetrically. The two intermediate toothed wheels 23 are turned only 180° to one another and are also in turn mounted symmetrically to injection axis s-s.

Likewise, the injection motor E and the rotary motor R are largely structurally identical and are both arranged symmetrically to a plane e-e going through the injection axis. As shown in Fig. 3, they are under the cross beams 31 and basically inside a vertical projection of a surface that extends between the two cross beams 31. However, it is understood that, here again, other arrangements are possible around the injection axis.

The means of linear movement 1 6a of the injection unit 16 has a spindle head 16c. This spindle head is inserted into a threaded sleeve that forms element 16b, which cooperates with the means of linear movement 1 6a. The threaded sleeve is non-rotatably supported on support 18, as shown in Fig. 2. Between the spindle head 16c and the threaded sleeve several planet gears 16d cooperating with it are arranged, so that another reduction is possible here. In this way, both motors, the injection motor E on one hand and the rotary motor R on the other, can be operated at the same rpm limits, wherein there is a gear reduction due to the gears formed by the toothed wheels, which can be further reduced by the planet gears for high forces.

Basically there can be an interplay between the spindle and the spindle nut for the electromechanical drive of the injection unit. However, in the example of embodiment, a form of embodiment is chosen in which a rod 16e has a spindle head 16c, which moves during

rotation along with the planet gears inside the threaded sleeve 16b. To protect the rod, planet gears and spindle head from outside influences, the rod 16e is surrounded coaxially by a pipe 26 supported on an injection bridge 14 so it cannot rotate. At each position of the injection unit, shown by the maximum injection stroke b (Fig. 2), this pipe penetrates into a pot-like moulded formation 18a of support 18.

The injection-moulding unit itself must also be set against the mould. This is done by a hydraulic piston/cylinder unit D, whose cylinders 27 can move axially to the stationary cross beams 31 designed as piston rods. The cylinders 27 form a frame with the carrier block 10 and the support 18. The frame is movably supported on the cross beams, which are in turn supported, inter alia, by carriers 39 on the machine base. Likewise, the carrier block 10 is supported on a guide rail 37, which is also used, according to Fig. 3, practically as an additional guide for the injection bridge next to the cross beams 31. For this, the injection bridge 14 has a guide wagon 38, which overlaps the centre guide rail 37.

The carrier block 10 is set in the frame comprising the cylinder, carrier block and support in the area near the front cylinder cover 32 and the support 18 in the area near the rear cylinder cover 33. The injection bridge 14 is axially movably guided between the carrier block 10 and the supporting element 18 on cylinders 27 of the piston/cylinder unit D and is secured against rotation. In the example of embodiment, the piston/cylinder unit is driven hydraulically. Here again, it is understood that there can be other ways of driving it, like electromechanical drives, for example, and it should only be ensured that the outside of this drive unit has a guide function. This piston/cylinder unit D can also be said to be  a guide cylinder unit.

Fig. 5 shows another form of embodiment. The reference numerals are kept to make it easier to understand, although comparison with Fig. 2 shows that at least the means of linear movement 1 6a and here especially the rod 1 6e and the pipe 26 are dimensioned differently. In addition, there is another axial bearing element 40 between the pipe 26 and element 1 6b. Finally, an axial bearing was made of what was once a radial bearing 17.

These changes have the object to reduce the load on the injection unit 16. As in the first example of embodiment especially, the first drive element 19 is driven by the injection motor. This results in a rotation of the rod 16e and an accompanying movement of the spindle head 1 6c and the planet gears 16d, which move relative to the threaded sleeve 16b as a result of the

rotation. Now here, pipe 26 inserts into the threaded sleeve, i.e. element 16b, which cooperates with the means of linear movement 16a. The threaded sleeve and the pipe 26 are indirectly connected to one another via an axial bearing element 40. Consequently, the forces that occur when the injection motor E is engaged are not transmitted as they were via rod 16e to drive element 19. Instead, the forces are transmitted from the threaded sleeve (element 16b) via the planet gears 16d to the spindle head. The spindle head has a band 16f that works on the axial bearing element 40 and transmits the forces to the pipe 26. The pipe 26 then transmits the forces via the bearing element 17 to the first drive element 19, from which the forces are then transmitted, as in the example of the first embodiment, via the axial bearing element 21 and the other drive element 20 to the feed screw 12.

For this, pipe 26 is now dimensioned stronger, while rod l 6e can be dimensioned smaller, which shows a comparison between Fig. 2 and Fig. 5. This has the advantage that rod 1 6e of the means of linear movement 1 6a must no longer be dimensioned for transmission of forces but only for transmission of rotation. This reduces the masses being moved and thus the moment of inertia. Since these moments of inertia put more load on the injection motor when turning on than the motors (injection motor E, rotary motor R), that move with it during any movement of the injection bridge it is easy to put up with the design of the pipe 26 as a force-transmission pipe.

Both forms of embodiment thus have a symmetrical arrangement of the structural elements to the injection axis s-s in common. But above all it is possible to apply the injection force directly to the feeding means 12 centrally and coaxially.

The injection-moulding unit works in the following way in these forms of embodiment: before the actual injection process, the injection-moulding unit is set against the mould 13 by the piston/cylinder unit D. Therein, a hydraulic medium is inserted into the cylinder space 29 through one of the bore holes 36. Since the piston rod and the annular piston 30 are stationary, the whole unit moves in the direction of the mould 13. In the next stop, dosing, the feeding screw 12 is turned by the rotary motor R via the other drive element 20. Hence, plasticized material comes into the space in front of the feeding means wherein the feeding means 12 gradually sets back. The two drive elements 19 and 20 are uncoupled by the axial bearing element. A tapered bearing, spherical roller bearing or similar one can also be used instead of this axial bearing element.

As soon as a corresponding amount of plasticized material was dosed in front of the feed screw, the first drive element 19 is activated via the injection motor E. When this drive element 19 rotates, the means of linear movement 16a moves at the same time. Therewith the spindle head 16c at the end of rod 16e rotates between the planet gears 16d, which causes a relative movement of spindle head 16c and planet gears 16d opposite the threaded sleeve, non-rotatably mounted on the support, the element 16b cooperating with the means of linear movement 16a. When the plasticized material is injected, the dosing process starts over again.

Finally, to take the injection-moulding unit off the mould again, one of the bore holes 36 in the cylinder space 28 to the right of the annular piston 30 is actuated on now, which makes the injection-moulding unit pull back.

It is obvious that this description can be subject to a wide variety of modifications, changes and adjustments, which fall into the area of equivalents to the pending claims.

Patent Claims

1. An injection-moulding unit for an injection-moulding machine to process plastics and other plasticizable compounds with

- a carrier block to hold a plasticizing cylinder,
- a feeding means arranged in the plasticizing cylinder along an injection axis to inject the plasticizable compound into a mould,
- an injection bridge that moves axially along the injection axis, on which the feeding means is rotatably mounted with at least one bearing element,
- an electromechanical injection unit to move the injection bridge axially, wherein a means of linear movement of the injection unit is rotatably mounted on the injection bridge via at least one bearing element,
- a support to non-rotatably support a sleeve element cooperating with the means of linear movement,
- an injection motor, which turns the means of linear movement by means of a first drive element coaxial to it,
- an electromechanical rotary motor, which rotates the feeding means by means of another drive element coaxial to the feeding means and also to the first drive element,
- force-transmission elements comprising at least one axial bearing element, for transmitting the axial movement of the means of linear movement to the feeding means,

characterised by the fact that the axial bearing element is arranged directly between the first drive element and the other drive element as a force-transmission element.

2. The injection-moulding unit of Claim 1, characterised by the fact that the axial bearing element is designed as a separating means for uncoupling the rotational movements of the drive elements.

3. The injection-moulding unit of Claim 1 or Claim 2, characterised by the fact that the injection motor and the rotary motor are largely structurally identical, and by the fact that these two motors are arranged symmetrically to a plane that goes through the injection axis.

4. The injection-moulding unit of any one of Claims 1 to 3, characterised by the fact that the first drive element and the other drive element are both arranged in a housing in the injection bridge.

5. The injection-moulding unit of any one of Claims 1 to 4, characterised by the fact that the drive elements, almost identical in terms of their diameter.

6. The injection-moulding unit of Claim 5, characterised by the fact that the toothed wheels are driven via intermediate toothed wheels by the drive wheels of the injection motor or rotary motor, respectively.

7. The injection-moulding unit of Claim 6, characterised by the fact that the two intermediate toothed wheels are structurally identical and are mounted in a housing in the injection bridge, which housing is symmetrical to the injection axis, turned roughly 180° to one another symmetrically to the injection axis.

8. The injection-moulding unit of Claim 1, characterised by the fact that the means of linear movement of the injection unit comprises a spindle head, which penetrates into the sleeve element, the sleeve element being threaded.

9. The injection-moulding unit of Claim 8, characterised by the fact that between the spindle head and the threaded sleeve element several planet gears are arranged cooperating with them.

10. The injection-moulding unit of Claim 8 or Claim 9, characterised by the fact that a rod of the means of linear movement bears the spindle head and is surrounded by a pipe non-rotatably supported on the injection bridge, which pipe penetrates into the support at each position of the injection unit.

11. The injection-moulding unit of Claim 9, characterised by the fact that the means of linear movement are surrounded coaxially by a pipe non-rotatably supported on the injection

bridge, which pipe penetrates into the threaded sleeve element, wherein the occurring axial forces are transmitted from the threaded sleeve element via the planet gears and the spindle head to an axial bearing element and from it to the pipe.

12. The injection-moulding unit of any one of the Claims 1 to 11, characterised by the fact that a hydraulic piston/cylinder unit is provided to set the injection-moulding unit against the mould whose cylinders can move axially on the stationary piston rods designed as cross beams and form a frame with the carrier block and the support.

13. The injection-moulding unit of Claim 12, characterised by the fact that the carrier block is mounted in the area near the front cylinder cover and the support in the area near the rear cylinder cover and by the fact that the injection bridge is supported between the carrier block and the support on the cylinders of the piston/cylinder unit to be axially movable and rotatable.

14. The injection-moulding unit of any one of the Claims 1 to 13, characterised by the fact that the injection motor and the rotary motor are connected to the injection bridge so they can move together and essentially lie in the vertical projection of a plane extending between two cross beams.

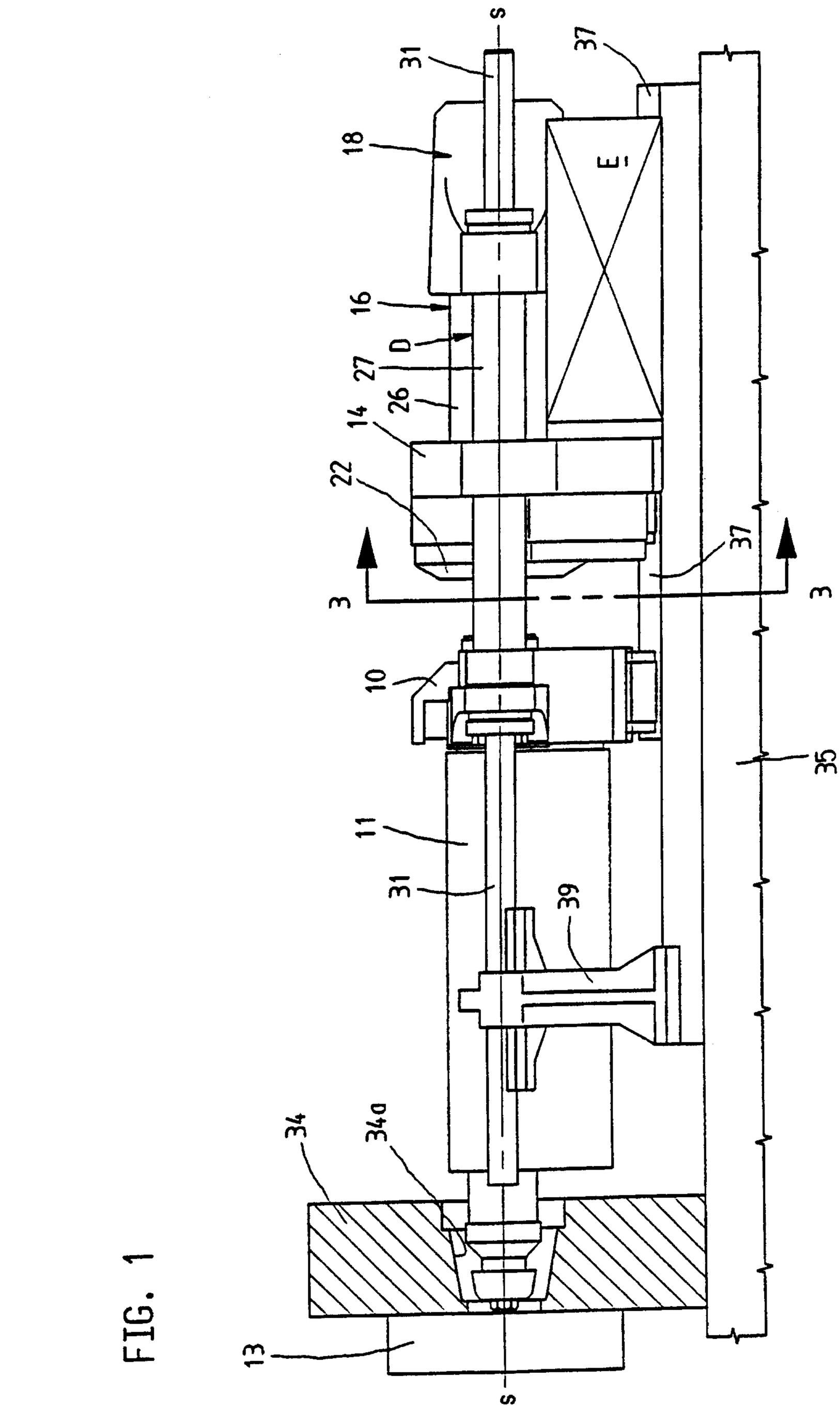



FIG. 1

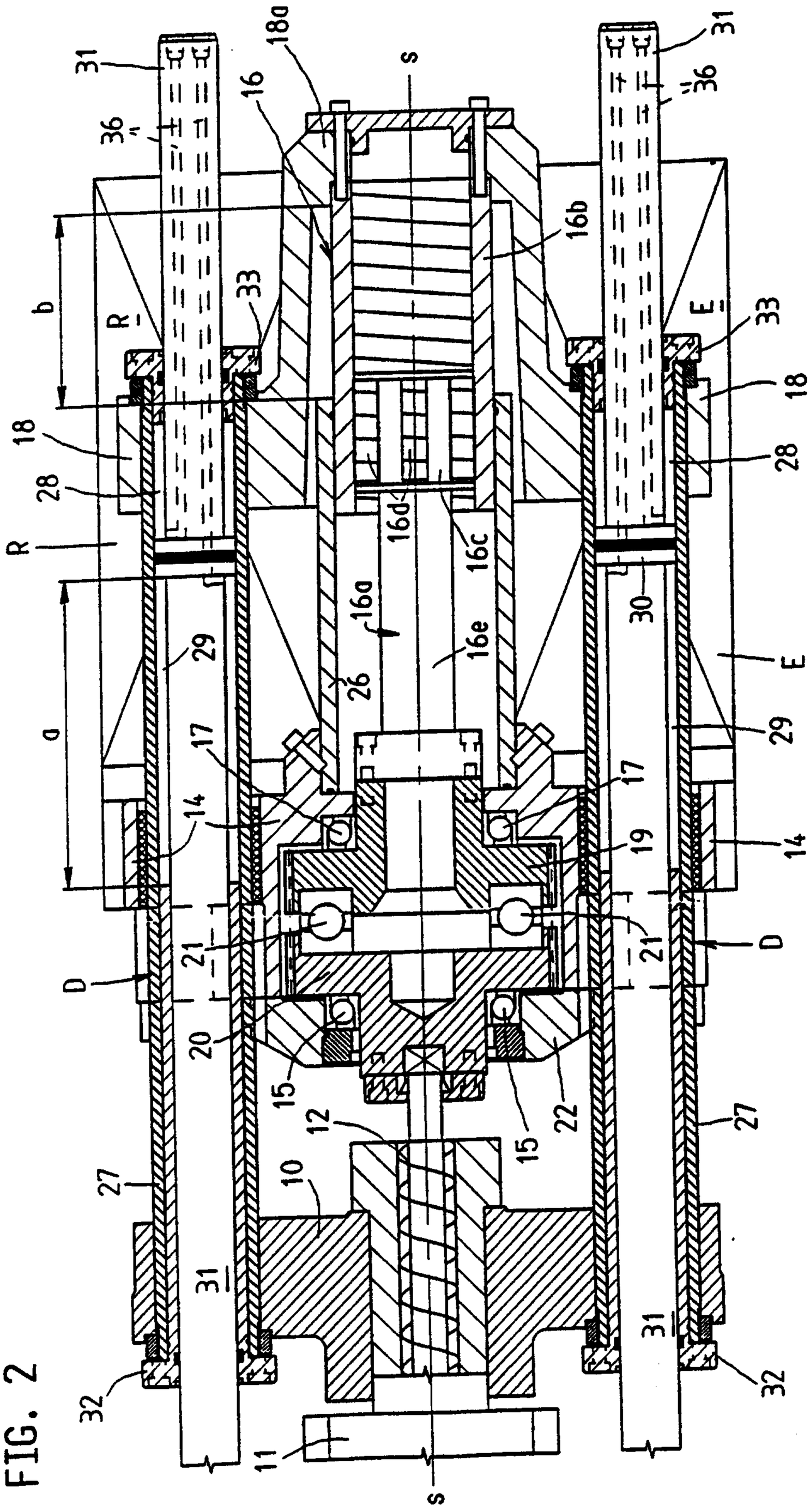

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FIG. 2

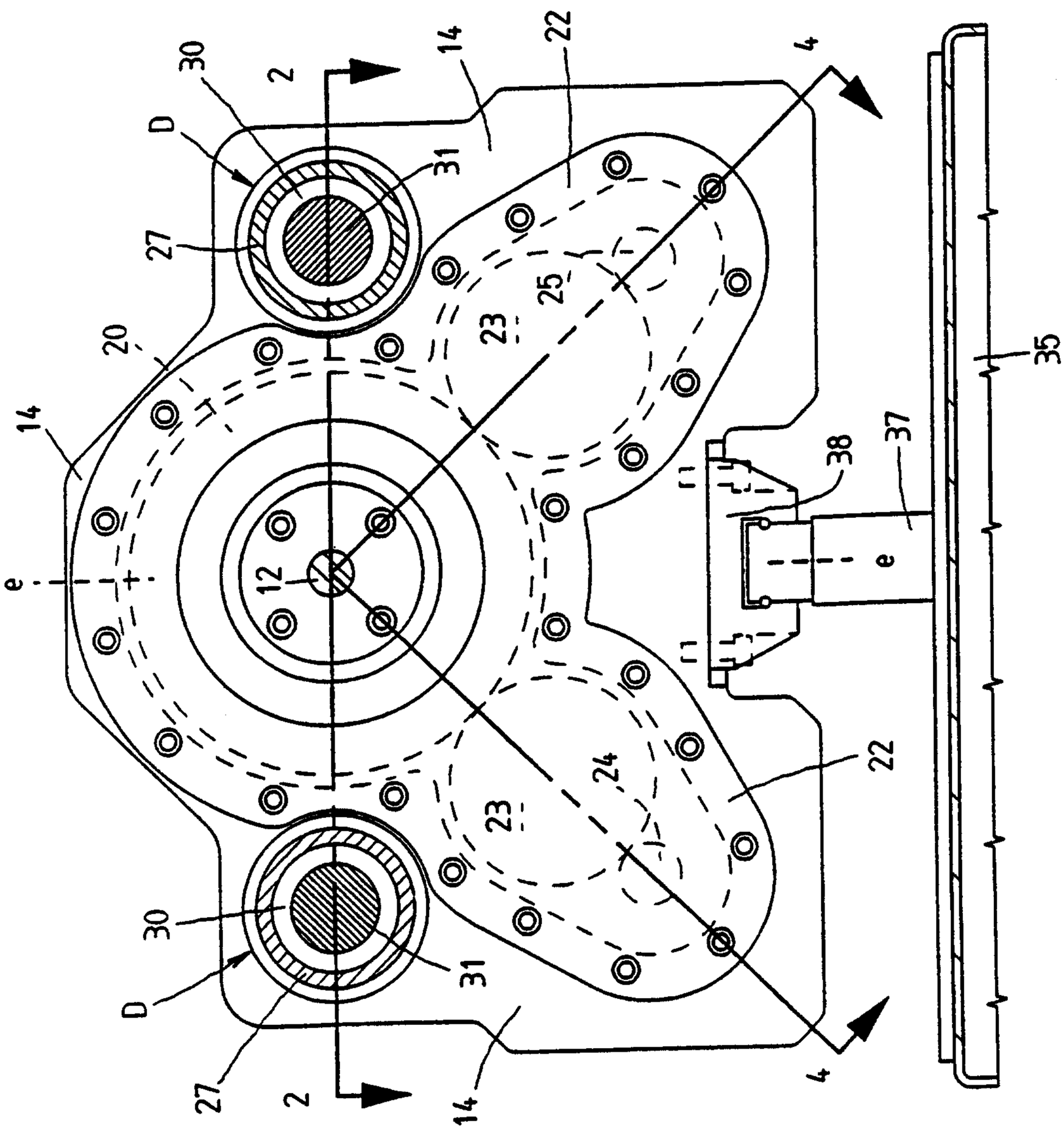



FIG. 3

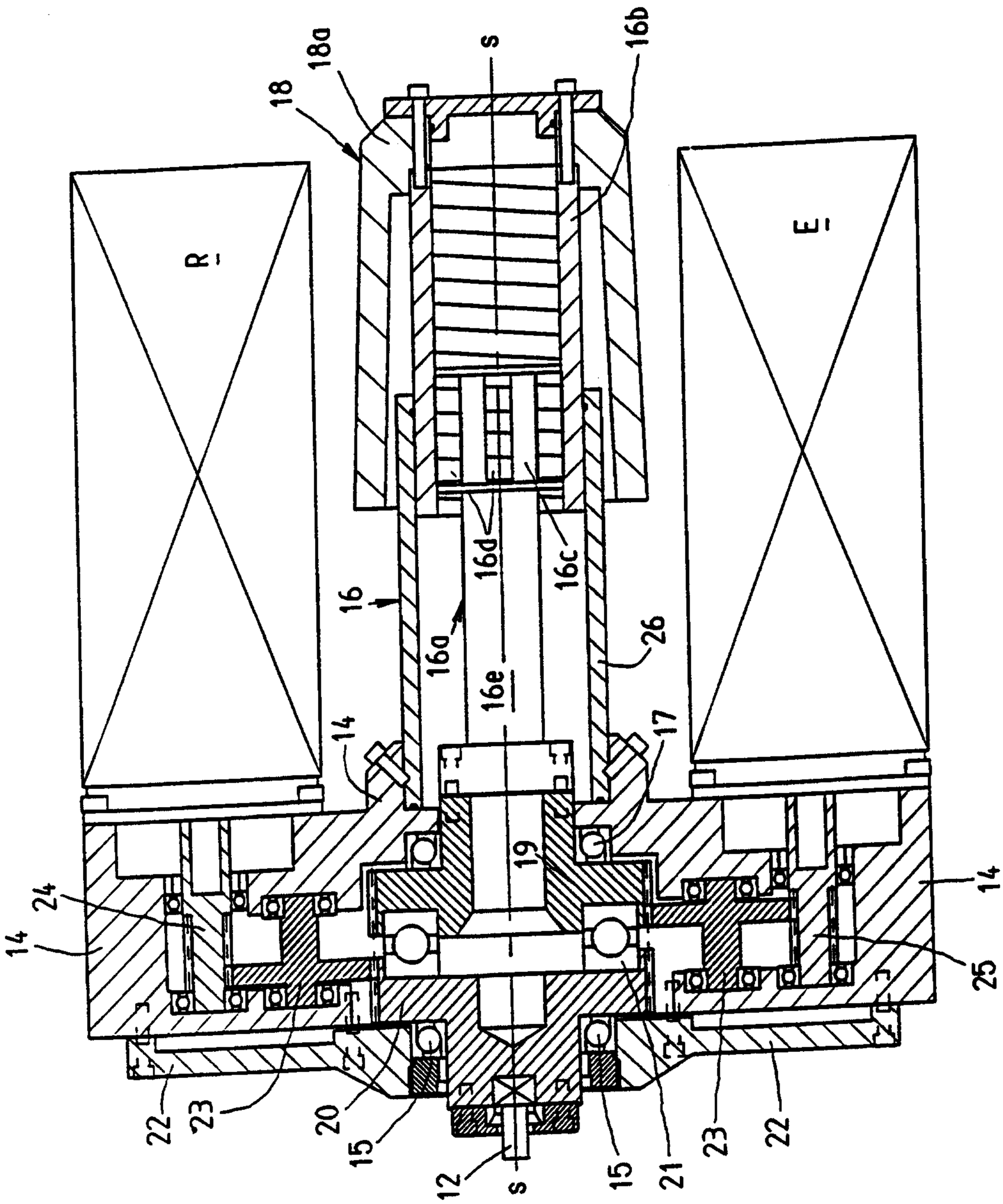

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FIG. 4

*rB

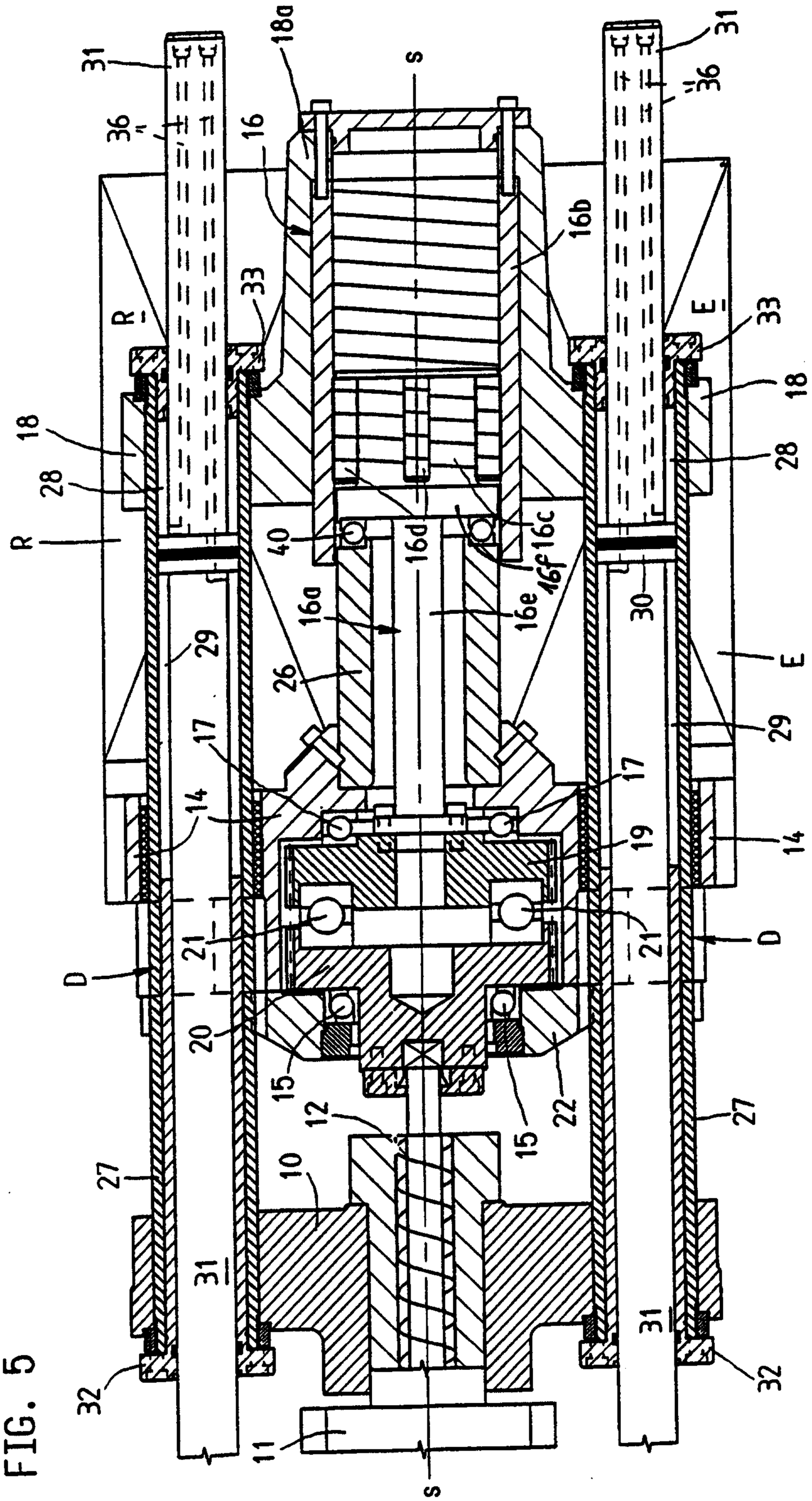
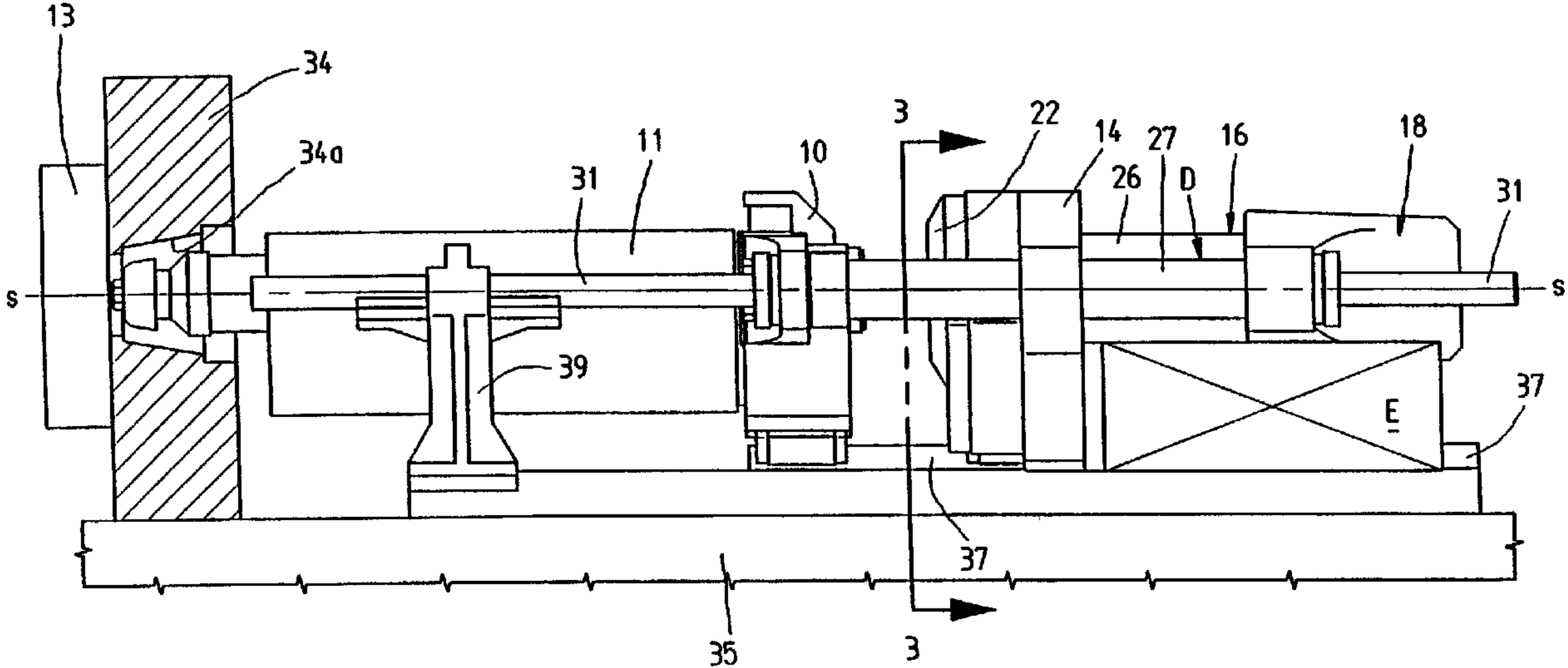

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FIG. 5


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