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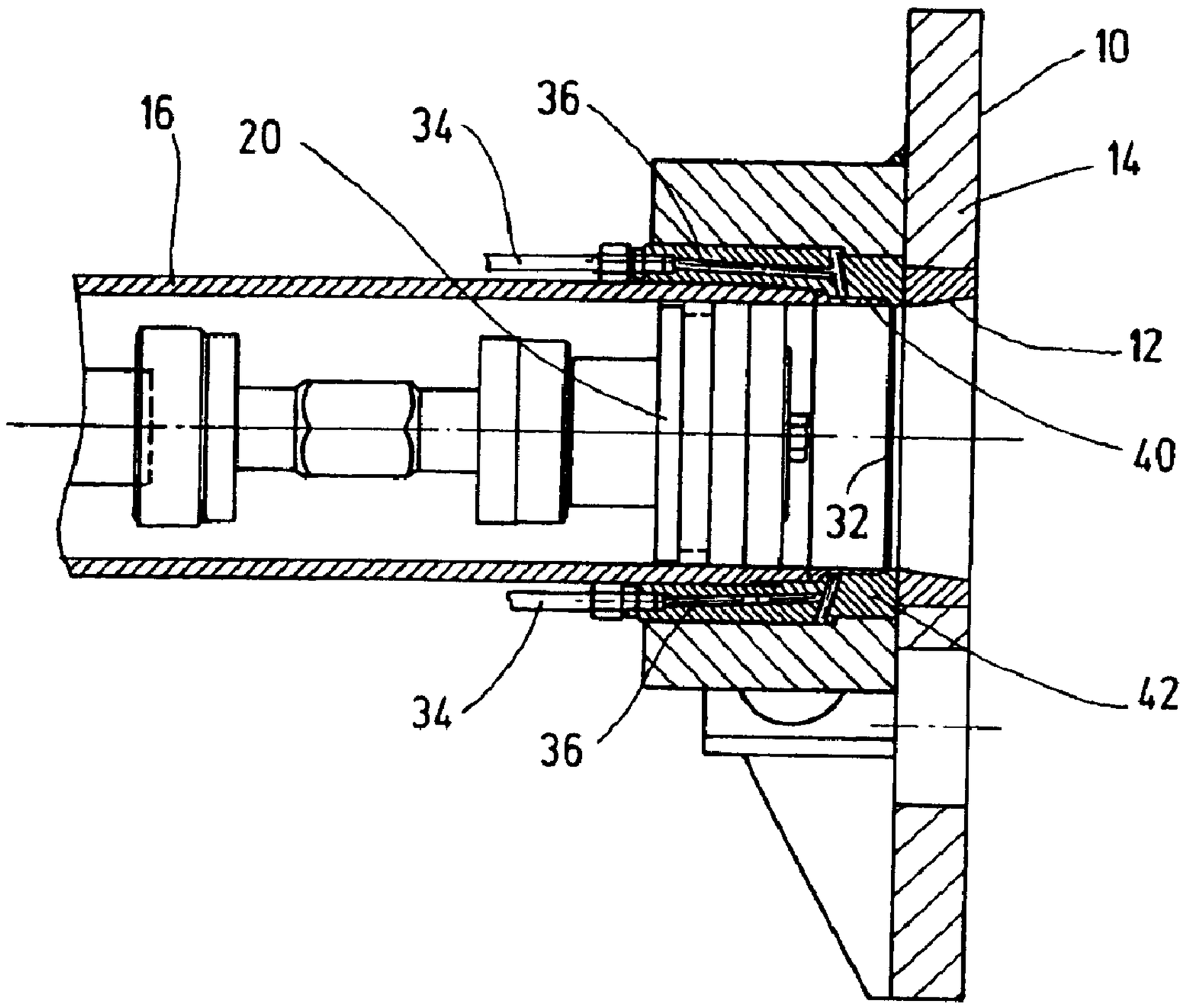
(54) Title: PISTON PUMP FOR THICK MATTER



(57) Abrégé/Abstract:
The invention relates to a piston pump for thick matter, in particular for high-solids sewage sludge, coal sludge and concrete. The piston pump has at least one delivery cylinder (16) which contains a motor-driven or hydraulically driven delivery piston (20) and

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(57) Abrégé(suite)/Abstract(continued):
which has an orifice (12) which communicates alternately with the interior of a material feed container (10) and with a pressure delivery line (30) in a slide-controlled manner in accordance with the movement of the delivery piston (20). In order to significantly increase the degree of filling of the at least one delivery cylinder (16), an annular nozzle (32) opening into the delivery cylinder (16) in the region of the orifice (12) is provided, and this annular nozzle (32) is connected to an external pressure line (34) to which a lubricant can be admitted.

ABSTRACT

The invention relates to a piston pump for thick matter, in particular for high-solids sewage sludge, coal sludge and concrete. The piston pump has at least one delivery cylinder (16) which contains a motor-driven or hydraulically driven delivery piston (20) and which has an orifice (12) which communicates alternately with the interior of a material feed container (10) and with a pressure delivery line (30) in a slide-controlled manner in accordance with the movement of the delivery piston (20). In order to significantly increase the degree of filling of the at least one delivery cylinder (16), an annular nozzle (32) opening into the delivery cylinder (16) in the region of the orifice (12) is provided, and this annular nozzle (32) is connected to an external pressure line (34) to which a lubricant can be admitted.

Piston pump for thick substances

Specification

The invention relates to a piston pump for thick substances, having at least one feed cylinder containing a motor-driven or hydraulically driven feed piston, which cylinder has an orifice opening that alternately communicates with the interior of a material application container and with a pressure feed line, as determined by the movement of the feed piston, controlled by a slide.

Piston pumps of this type are used to convey mixtures of solids and liquids that have a high proportion of solids, such as, for example, sewage treatment sludge, coal slurry, biomass, or concrete. Such thick substances have a high internal friction, so that the degree of filling of the feed cylinders frequently leaves something to be desired during the suction process. On the other hand, it is known, in the case of piston pumps of this type (EP-B-633863), to introduce a lubricant between the strand of thick substance and the wall of the pressure feed line, in order to reduce the wall friction, at the entrance of the pressure feed line. This is usually done continuously, and in a metered amount

proportional to the feed stream, with the result that a border layer forms between the inner wall of the pipe and the thick-substance strand, by means of which the feed pressure can be reduced. Since the lubricant layer gradually disappears along the feed distance, additional lubricant has to be injected into the pressure feed line at certain intervals. In order to increase the degree of filling of the feed cylinder, a pre-pressing device is usually provided in the region of the material application container, with which device the filling pressure can be raised by at least 1 bar. In many cases, however, this is not sufficient.

Proceeding from this, the invention is based on the task of improving the known piston pump for thick substances, to the effect that the degree of filling in the feed cylinder can be significantly increased, even at high proportions of solids in the thick-substance material.

To accomplish this task, the combination of characteristics indicated in claim 1 is proposed. Advantageous embodiments and further developments of the invention are evident from the dependent claims.

The solution according to the invention is primarily based on the idea that a ring nozzle that opens into the feed cylinder is disposed in the region of the orifice opening, which nozzle is connected with an external pressure line, whereby the pressure line can have a lubricant applied to it by way of a high-pressure pump. It is advantageous if the pressure line is connected with a ring channel that opens into the ring nozzle, by way of a bore disposed in the orifice region of the feed cylinder.

A preferred design embodiment of the invention provides that the feed cylinder carries an outer ring that has at least one bore connected with the pressure line on the outside, having a ring channel that leads to the ring nozzle, whereby the ring channel is delimited on the inside by an outer surface of the feed cylinder, or of an inner ring that follows it axially, and on the outside by an inner surface of the outer ring. It is practical if the aforementioned inner ring engages into a recess of the outer ring that is open towards the inside, and delimits the ring channel and the ring nozzle together with this ring. In this connection, it is advantageous if the inner ring is braced between two ring surfaces of the feed cylinder and of the outer ring body that face one another, with a rear, radially projecting collar.

In order to guarantee uniform distribution of the thick substances over the circumference, it is practical if the ring channel has at least one ring-shaped widening in cross-section. It is advantageous if two ring-shaped widenings in cross-section are provided, disposed at a distance from one another.

According to a preferred embodiment of the invention, a control device that responds to the position and/or the stroke direction of the feed piston in the feed cylinder, and a control valve that responds to an output signal of the control device and is disposed in the pressure line, which opens during the suction stroke of the feed piston and closes before its pressure stroke, are provided. In this connection, it is practical if the control valve is configured as a directional valve that can be controlled by way of the feed piston, preferably magnetically.

A preferred embodiment of the invention provides that two feed cylinders, which each have a ring nozzle in their orifice region, are provided, whose ring nozzles can have lubricant applied to them, by way of the control valve, during every suction stroke of the feed piston, which is controlled with opposite cycles.

The invention furthermore relates to a method for operation of a piston pump for thick substances, in which thick-substance

material is alternately drawn into a feed cylinder that is open on one side, during a suction stroke, and pressed out of the feed cylinder into a pressure feed line during a subsequent pressure stroke. In order to significantly increase the degree of filling of the feed cylinder, it is proposed, according to the invention, that a lubricant is injected into the feed cylinder during every suction stroke. In this connection, it is advantageous if the lubricant is injected into the separation region between thick-substance material and feed cylinder inner surface, specifically over its entire circumference. In order to prevent unintentional emptying of the incoming lines for the lubricant, it is practical if the lubricant injection is interrupted during the pressure stroke. The lubricant is injected at a higher pressure than that of the thick substance disposed in the feed cylinder. It is practical if the injection pressure is more than 50, preferably about 100 bar, while it is practical if the pre-pressing pressure in the thick-substance material during the suction stroke is approximately 2 bar.

A preferred embodiment of the invention provides that in the case of a two-cylinder piston pump, the pistons in a first and a second feed cylinder are controlled in opposite cycles, performing a suction stroke and a pressure stroke, whereby a lubricant is injected into the feed cylinders during every

suction stroke, and the lubricant injection is interrupted during the pressure stroke, in each instance.

Using the measures according to the invention, a significant improvement in the degree of filling in the feed cylinder is achieved, particularly in the case of thick substances having a high proportion of solids. Furthermore, the lubricant layer that forms in the feed cylinder is entrained into the pressure feed line, so that in a first line section that follows the thick-substance pump, an additional lubricant injection is no longer necessary. Only in the case of long pressure feed lines having a length of more than 50 to 100 m can additional lubricant be injected into the pressure feed line, at a distance from the thick-substance pump. While the lubricant is injected into the feed cylinder only during the suction stroke, lubricant injection into the pressure feed line should take place continuously.

In the following, the invention will be explained in greater detail using an exemplary embodiment shown schematically in the drawing. This shows:

Fig. 1 a top view of a two-cylinder piston pump for thick substances, for connection to a feed line;

Fig. 2a and b a top view and a sectional representation of the two-cylinder piston pump according to Fig. 1, in an enlarged representation, without the material application container;

Fig. 3 an enlarged detail of the sectional representation according to Fig. 2b;

Fig. 4 a section through the orifice region of one of the feed cylinders, in a representation that is enlarged as compared with Fig. 3.

The two-cylinder thick-substance pump shown schematically in Fig. 1 is intended to convey thick substances that are rich in solids, such as partially dewatered sewage treatment sludge, coal dust sludge, or concrete, for example.

The piston pump consists essentially of a material application container 10; two feed cylinders 16 connected to the material application container 10 by way of their face-side orifice openings 12, by way of wall openings 14; two feed pistons 20 that can be driven in the feed cylinders 16 in opposite cycles, by way of hydraulic drive cylinders 18; and a water box 22 disposed between the drive cylinders 18 and the feed cylinders 16. A pipe

slide 21 is disposed within the material application container 10; it can be alternately connected to the orifice opening 12 of the feed cylinder, whose piston is performing a pressure stroke, with its entry opening 26, and releases the orifice opening 12 of the other feed cylinder, whose piston is performing a suction stroke, and its exit opening 28 is connected with a pressure feed line, not shown, by way of a pressure connector 30 disposed on the material application container 10. In the case of the exemplary embodiment shown in Fig. 1, the pipe slide 24 has a pivot pipe curved in S shape, which can pivot within the material application container 10. Accordingly, thick-substance material gets from the interior of the material application container 10, if necessary with the exertion of a pre-pressing pressure, into the related feed cylinder 16, by way of the open orifice opening 12, during every suction stroke, while the thick-substance material situated in the other feed cylinder 16 is pressed into the subsequent pressure feed pipe, by means of the feed piston 20, performing a pressure stroke, by way of the pivot pipe of the pipe slide 24 and the pressure connector 30.

A particular feature of the invention consists in the fact that a ring nozzle 32 is disposed in the region of the orifice opening 12, which nozzle can have a lubricant at a pressure of approximately 50 to 100 bar applied to it, by way of pressure

pipes 34, bores 36, and a ring channel 38. To form the ring channel 38 and the ring nozzle 30, an inner pipe 40 axially follows the feed cylinder 16 in the region of the orifice opening 12, which pipe is covered by an outer pipe 42 screwed onto the feed cylinder 16. For this purpose, the inner ring 40 has a radially projecting collar 44, which is braced between a ring surface 46 of the outer pipe 42 and the face-side ring surface 48 of the feed cylinder 16, in such a manner that the ring nozzle 32 and the ring channel 38 between inner pipe and outer pipe remain open. The bores 36 for the lubricant supply are disposed in the outer pipe 42. The inner pipe 40 has two ring grooves on its inner surface that delimits the ring channel 38, which form a cross-section widening 50 and ensure uniform distribution of the lubricant that exits from the ring nozzle 32, over the circumference.

For the lubricant supply to the individual feed cylinders 16, an external control device, not shown, is controlled in such a manner that lubricant is injected into the feed cylinder only during the suction stroke. There, the lubricant gets into the separation region between thick-substance material and feed cylinder inner surface, so that the degree of filling is improved because of the reduced slide friction. Experiments have shown that using the measures according to the invention, it is

possible to achieve an improvement in the degree of filling of at least 25%, in the case of sewage treatment sludges that are rich in solids. During the subsequent pressure stroke, the lubricant gets into the pressure line, together with the thick-substance material, and also reduces the slide friction there, and thus reduces the feed pressure required for the material transport. During the pressure stroke, the lubricant injection is interrupted, in each instance. In this way, the risk of emptying the lubricant line because of the thick-substance material that is flowing past it is avoided.

In summary, the following should be stated: The invention relates to a piston pump for thick substances, particularly for sewage treatment sludge, coal slurries, and concrete, which are rich in solids. The piston pump has at least one feed cylinder 16 containing a motor-driven or hydraulically driven feed piston 20, which cylinder has an orifice opening 12 that alternately communicates with the interior of a material application container 10 and with a pressure feed line 30, as determined by the movement of the feed piston 20, controlled by a slide. In order to significantly increase the degree of filling of the at least one feed cylinder 16, a ring nozzle 32 that opens into the feed cylinder 16 is provided in the region of the orifice opening

12, which nozzle is connected with an external pressure line 34 to which lubricant can be applied.

Amended claims 1-12

1. Piston pump for thick substances, having at least one feed cylinder (16) containing a motor-driven or hydraulically driven feed piston (20), which cylinder has an orifice opening (12) that alternately communicates with the interior of a material application container (10) and with a pressure feed line (pressure connector 30), as determined by the movement of the feed piston (20), controlled by a slide, **characterized in that** a ring nozzle (32) that opens into the feed cylinder (16) is disposed in the region of the orifice opening (12), which nozzle is connected with at least one external pressure line (34), that the pressure line (34) can have a lubricant applied to it by way of a high-pressure pump, and is connected with a ring channel (38) that opens into the ring nozzle (32), and that the feed cylinder (16) carries an outer ring body (42), which has at least one bore (36) connected with the pressure line (34) on the outside, having a ring channel (38) that leads to the ring nozzle (32).

2. Piston pump according to claim 1, **characterized in that** the ring channel (38) is delimited on the inside by an outer surface of the feed cylinder, or of an inner pipe (40) that

follows it axially, and on the outside by an inner surface of the outer ring body (42).

3. Piston pump according to one of claims 1 or 2, **characterized in that** an inner pipe (40) follows the feed cylinder (16), on the face side, which pipe engages into a recess of the outer ring body (42) that is open towards the inside, and delimits the ring channel (38) and the ring nozzle (32) together with this ring body.

4. Piston pump according to one of claims 1 to 3, **characterized in that** the ring channel (38) has at least one ring-shaped cross-section widening (50).

5. Piston pump according to claim 4, **characterized in that** the ring channel (38) has two ring-shaped cross-section widenings (50), spaced at a distance from one another.

6. Piston pump according to one of claims 1 to 5, **characterized by** a control device that responds to the position and/or the stroke direction of the feed piston (20) in the feed cylinder (16), and a control valve that responds to an output signal of the control device and is disposed in the pressure line (34).

7. Piston pump according to claim 6, **characterized in that** the control valve disposed in the pressure line (34) opens during the suction stroke of the feed piston (20) and closes before its pressure stroke.

8. Piston pump according to claim 6 or 7, **characterized in that** the control valve is configured as a directional valve that can be controlled by way of the feed piston (20), preferably magnetically.

9. Piston pump according to one of claims 1 to 8, **characterized in that** two feed cylinders (16), which each have a ring nozzle (32) in their orifice region (12), are provided, whose ring nozzles (32) can have lubricant applied to them, by way of the control valve, during every suction stroke of the feed piston (20), which can be controlled in opposite cycles.

10. Piston pump according to one of claims 1 to 9, **characterized in that** the inner pipe (40) is braced between two ring surfaces (46, 48) of the feed cylinder (16) and of the outer ring body (42) that face one another, with a rear, radially projecting collar (44).

11. Method for operation of a piston pump for thick substances, in which thick-substance material is alternately drawn into a feed cylinder (16) that is open on one side, during a suction stroke, and pressed out of the feed cylinder into a pressure feed line during a subsequent pressure stroke, **characterized in that** lubricant is injected into the feed cylinder (16) during every suction stroke, whereby the lubricant is injected over the entire circumference of the feed cylinder inner surface into the separation region between thick-substance material and feed cylinder inner surface.

12. Method according to claim 11, **characterized in that** the lubricant injection is interrupted during the pressure stroke.

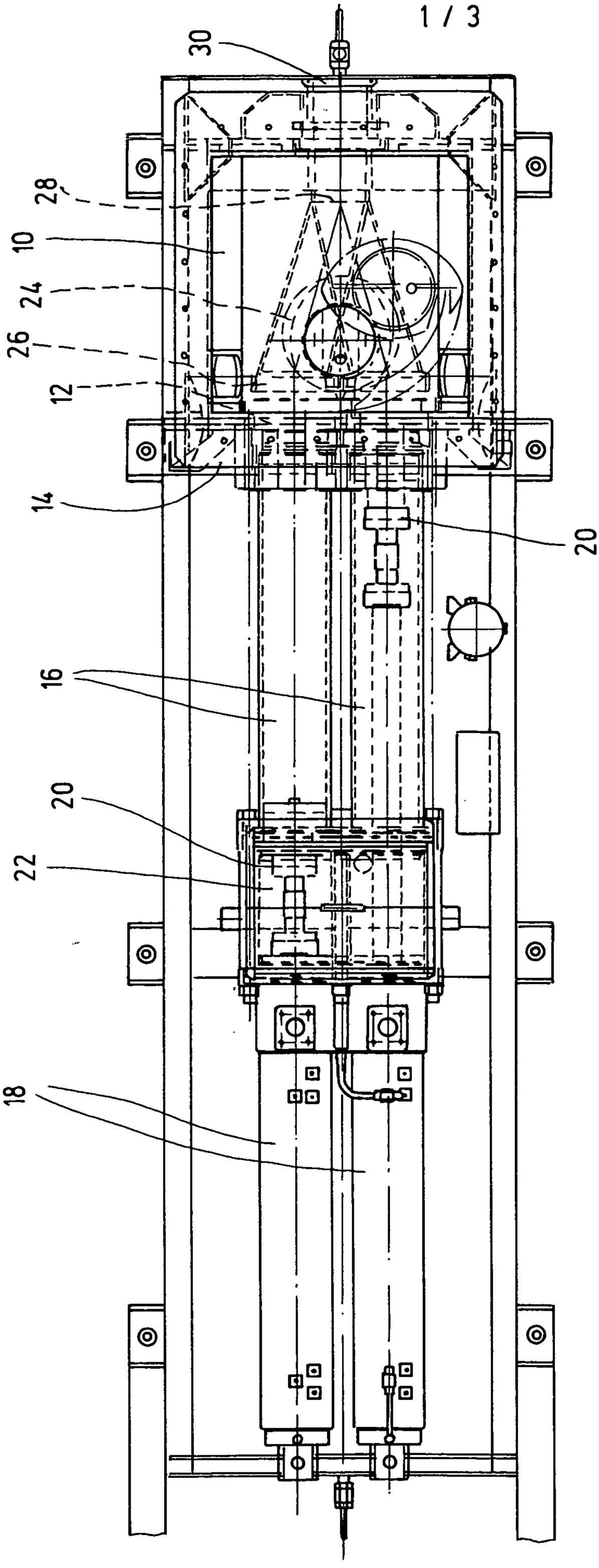

Fig.1

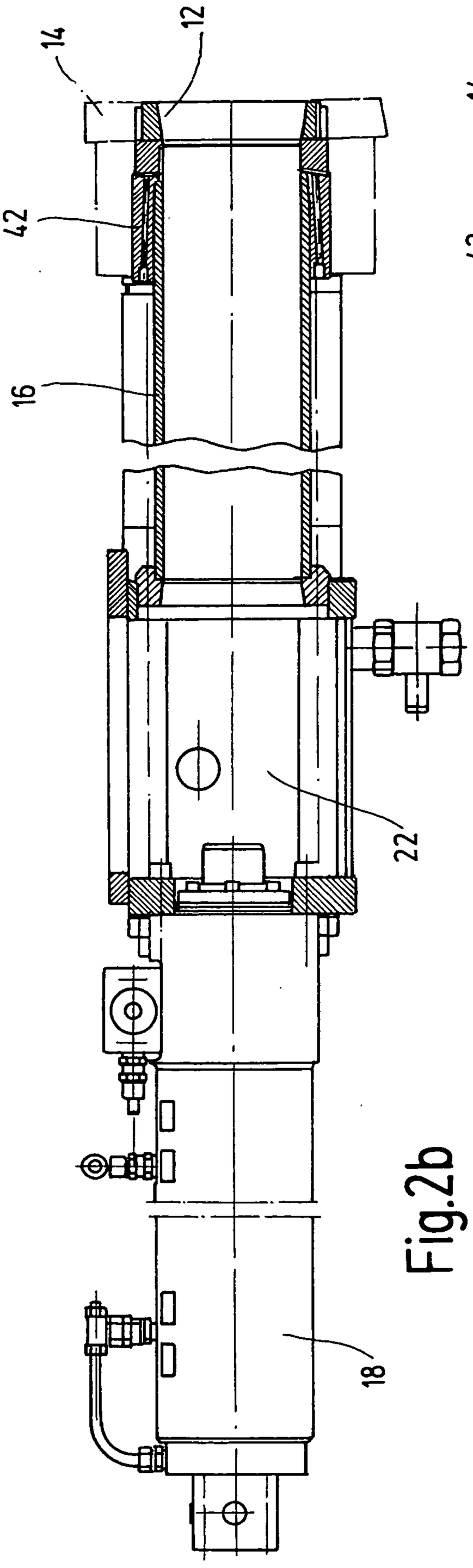

Fig.2b

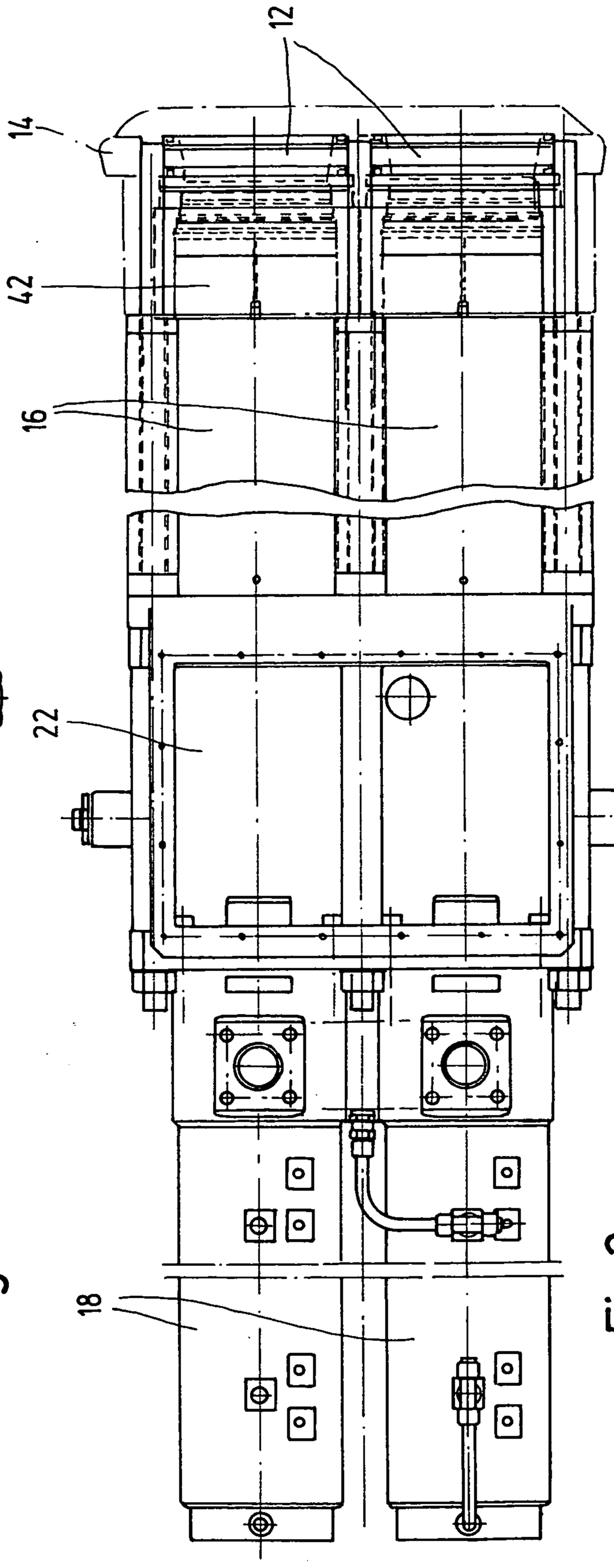

Fig.2a

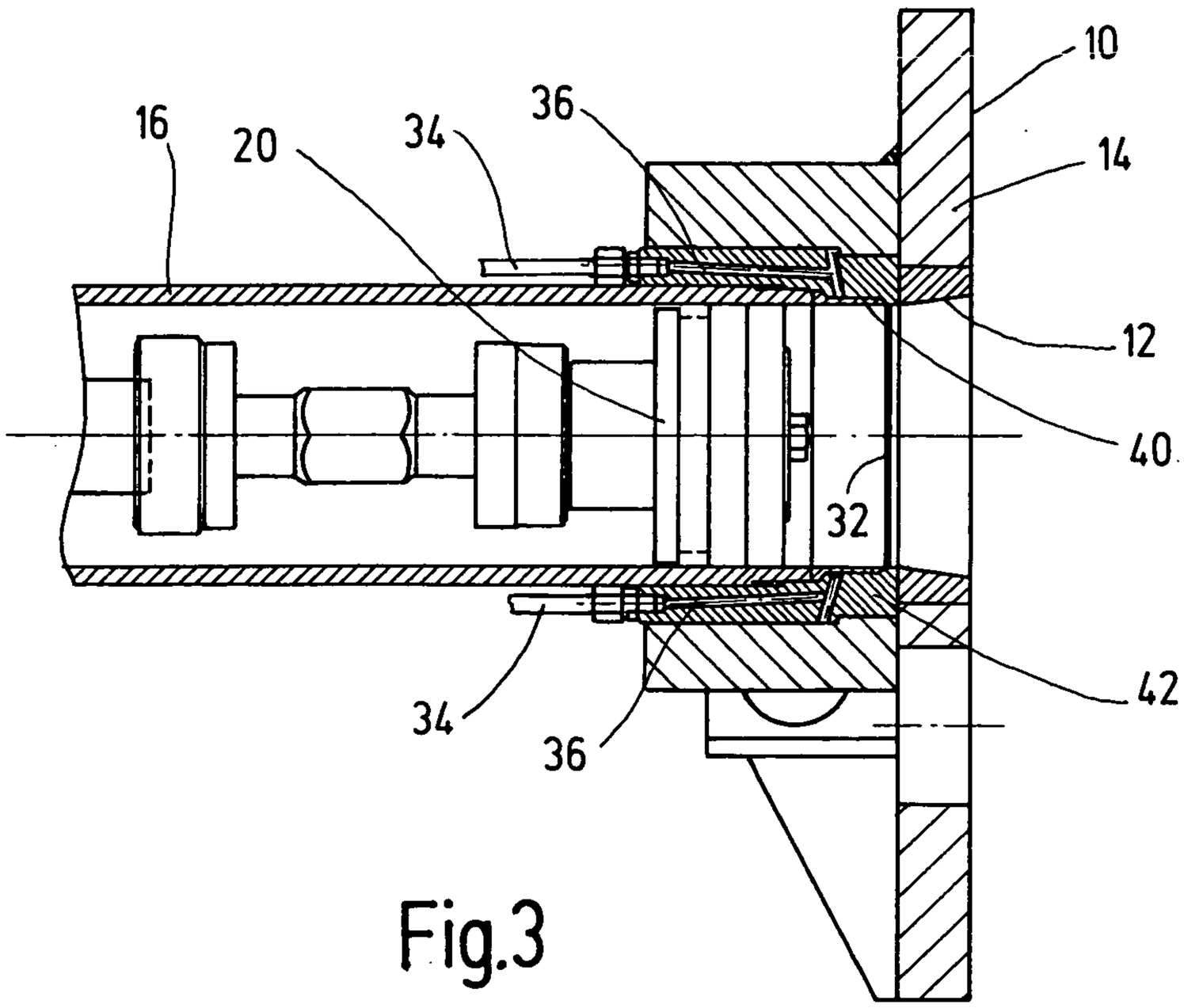
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Fig.3

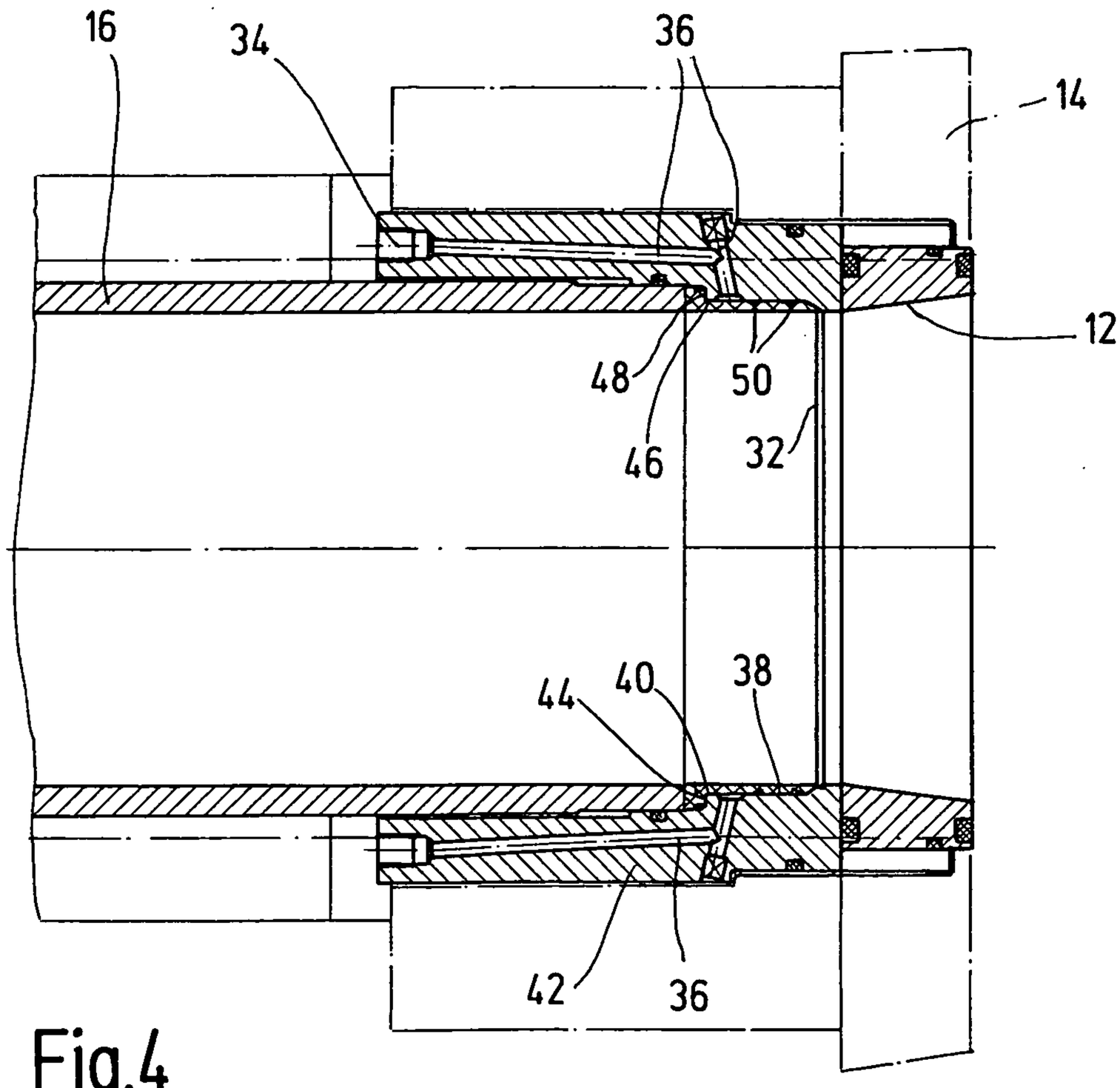
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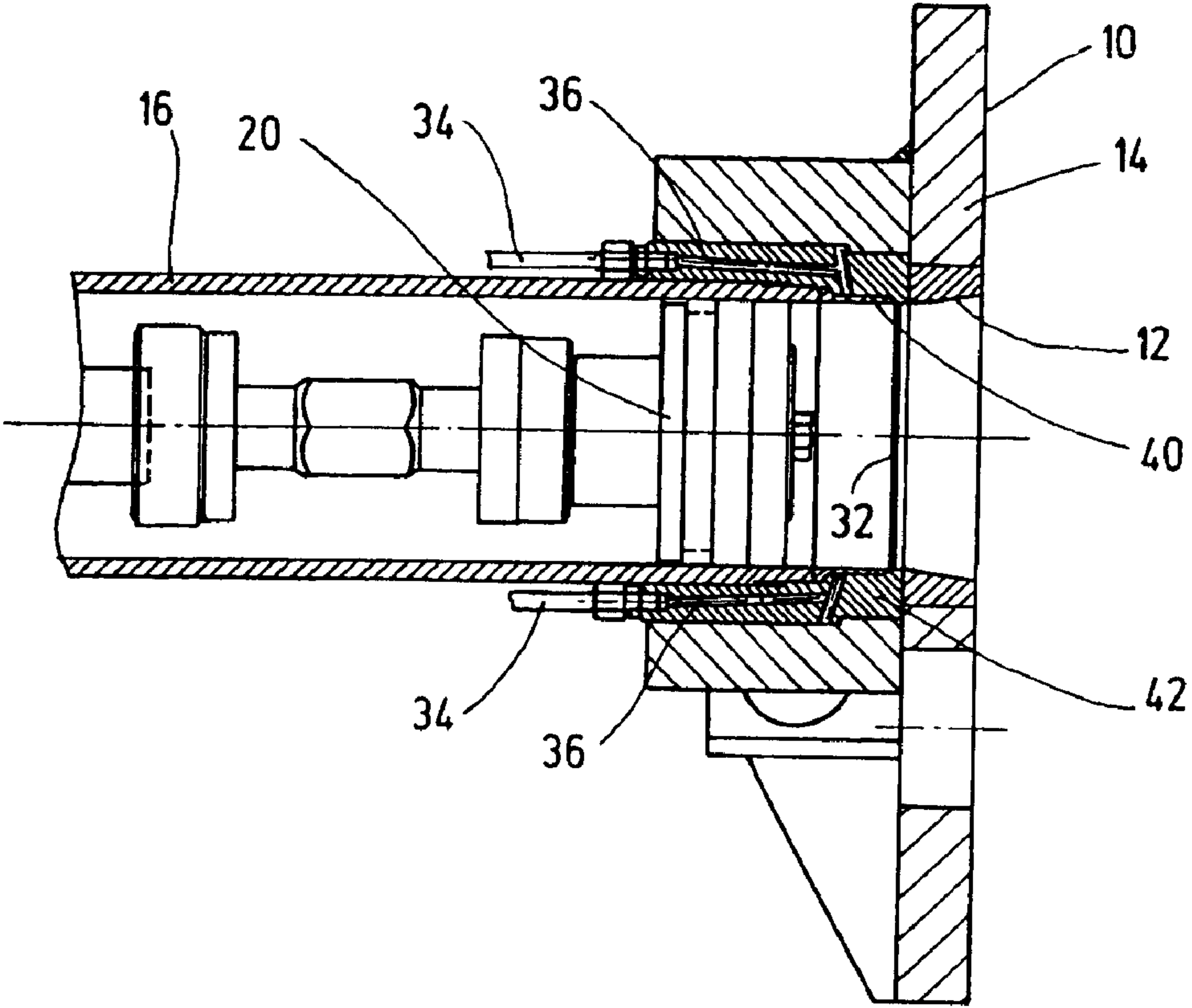
Fig.4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