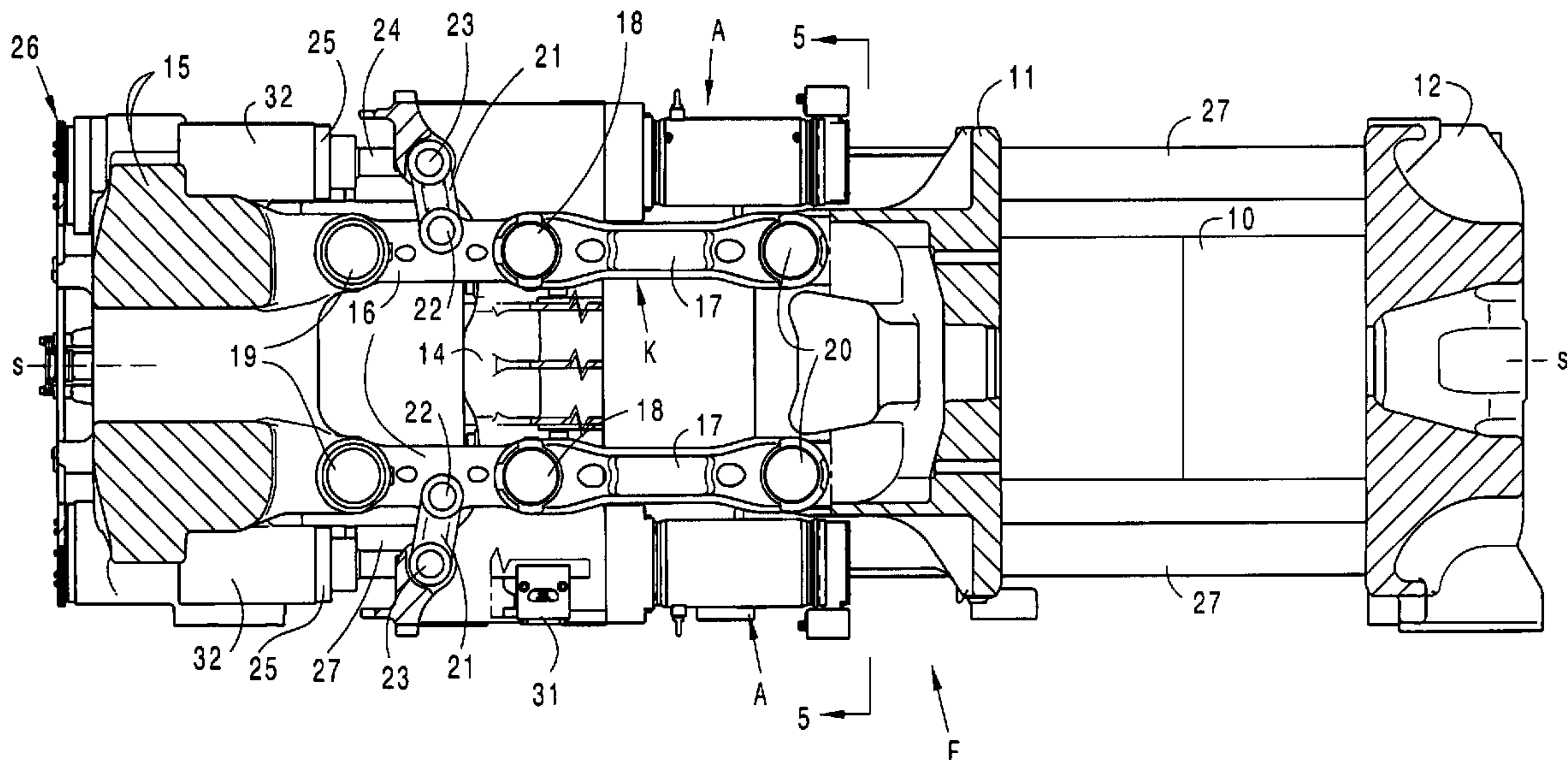




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(54) **Titre : MACHINE DE MOULAGE PAR INJECTION COMPORTANT AU MOINS DEUX MECANISMES DE GENOUILLERES**
(54) **Title: INJECTION MOULDING MACHINE WITH AT LEAST TWO TOGGLE MECHANISMS**



(57) **Abrégé/Abstract:**

An injection-moulding machine for processing plastics has, on a mould-closing unit (F), at least one injection mould (10) which can be accommodated between a stationary mould carrier (12) and a movable mould carrier (11). The mould carriers are moved by means of at least one pair of toggle levers with two toggle lever mechanisms (K), which are driven in a closing direction (s-s) independently of one another each by a drive unit (A), wherein the toggle lever mechanisms (K) are mounted on a bearing plate (14). Since the bearing plate (14) is mounted on the injection-moulding machine such that it can move along guides (28), and the drive units (A) are mounted on the movable bearing plate (14) on which the actuating elements for the at least two toggle lever mechanisms (K) are mounted, it is possible to influence the parallelism of the mould carriers both in the static and in the dynamic state.

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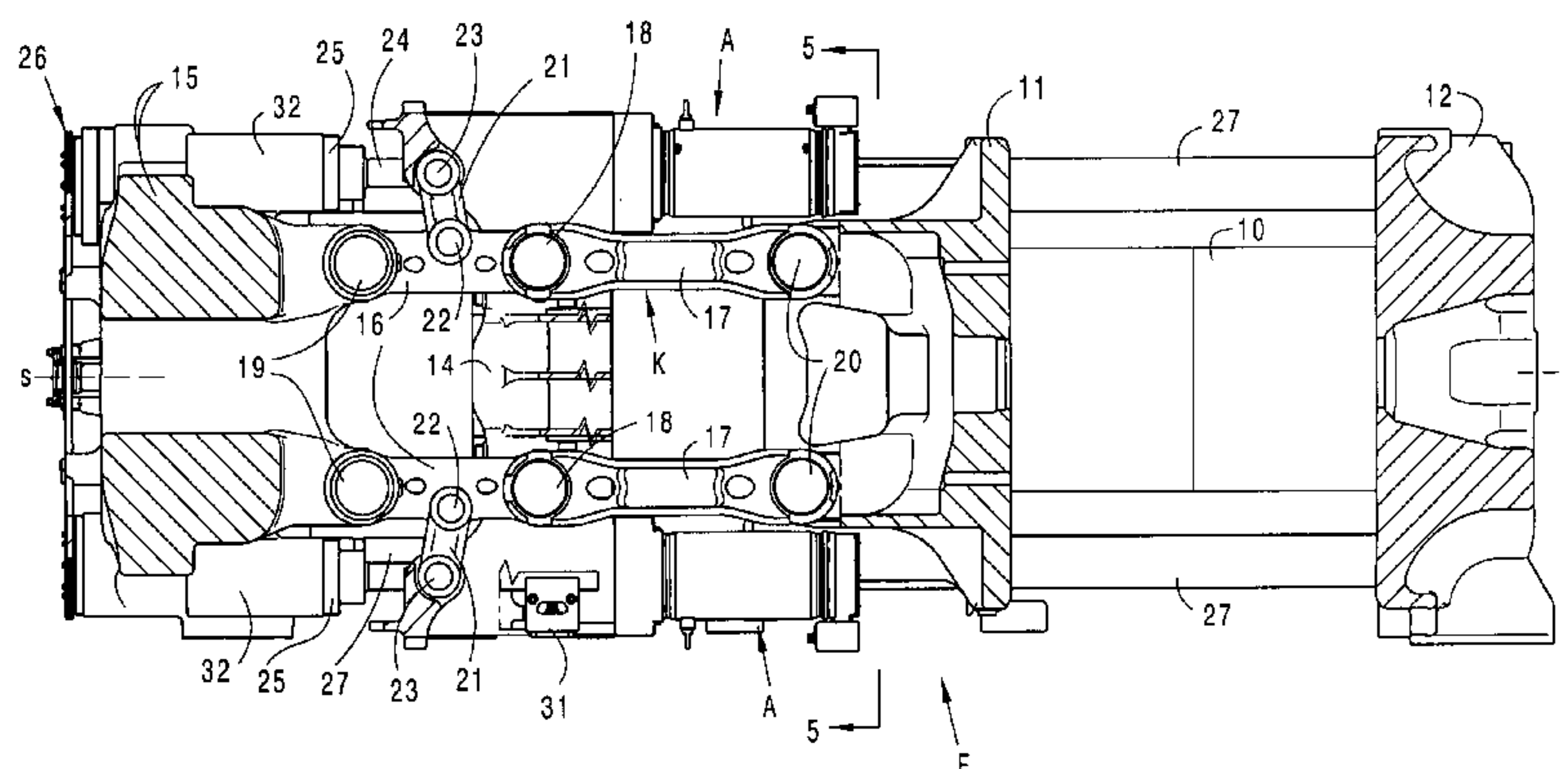
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(54) Title: INJECTION-MOULDING MACHINE HAVING AT LEAST TWO TOGGLE LEVER MECHANISMS

(54) Bezeichnung : SPRITZGIESSMASCHINE MIT WENIGSTENS ZWEI KNIEHEBELMECHANISMEN

FIG.2



(57) **Abstract:** An injection-moulding machine for processing plastics has, on a mould-closing unit (F), at least one injection mould (10) which can be accommodated between a stationary mould carrier (12) and a movable mould carrier (11). The mould carriers are moved by means of at least one pair of toggle levers with two toggle lever mechanisms (K), which are driven in a closing direction (s-s) independently of one another each by a drive unit (A), wherein the toggle lever mechanisms (K) are mounted on a bearing plate (14). Since the bearing plate (14) is mounted on the injection-moulding machine such that it can move along guides (28), and the drive units (A) are mounted on the movable bearing plate (14) on which the actuating elements for the at least two toggle lever mechanisms (K) are mounted, it is possible to influence the parallelism of the mould carriers both in the static and in the dynamic state.

(57) Zusammenfassung:

[Fortsetzung auf der nächsten Seite]

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Eine Spritzgießmaschine zur Verarbeitung von Kunststoffen weist an einer Formschließeinheit (F) wenigstens eine zwischen stationärem Formträger (12) und beweglichem Formträger (11) aufnehmbare Spritzgießform (10) auf. Die Bewegung der Formträger erfolgt mittels wenigstens einer Kniehebelpaarung mit zwei Kniehebelmechanismen (K), die unabhängig voneinander von je einer Antriebseinheit (A) in einer Schließrichtung (s- s) angetrieben werden, wobei die Kniehebelmechanismen (K) an einer Lagerplatte (14) gelagert sind. Dadurch, dass die Lagerplatte (14) an der Spritzgießmaschine entlang von Führungen (28) beweglich gelagert ist und dass die Antriebseinheiten (A) an der beweglichen Lagerplatte (14) gelagert sind, an der die Betätigungselemente für die wenigstens zwei Kniehebelmechanismen (K) gelagert sind, ist die Parallelität der Formträger sowohl im statischen als auch im dynamischen Zustand beeinflussbar.

Injection moulding machine with at least two toggle mechanisms

Reference to related application

The present application claims priority from German patent application 10 2010 048 560.8, filed on 18 October 2010.

5 Field of the invention

The invention relates to an injection moulding machine for processing plastics and other plastifiable materials, having at least two toggle mechanisms.

Background of the invention

WO 01/38069 A1 discloses an injection moulding machine, with a mould closing unit on
10 which two toggle mechanisms are driven by means of two separate linear drives. An actuation frame is provided according to the embodiment of figure 1, in which frame the linear drives are received and which frame is movable relative to an end plate and to the stationary mould carrier. A beam is provided in the lower region, which is at the same time acting as inductor comb for the linear drive and connects stationary mould carrier and end plate
15 with each other. In the upper region such guidance is not provided.

EP 0 383 935 A1 discloses an injection moulding machine with a mould closing unit, on which two toggle mechanisms for adjusting mould parallelism are driven in servo-

controlled manner by means of two drive units in the form of servo motors. The servo motors drive spindles, which are connected to a nut which is mounted such that it actuates the toggle mechanism. The drive motors and a mould height adjusting mechanism are attached to the rear support plate, such that the masses moved are reduced.

- 5 A mould closing unit with two toggle mechanisms is known from DE 10 2006 054 072 A1, wherein the toggle mechanisms are driven by a central hydraulic cylinder at a movable actuation plate. A control of the contact force is not possible therewith. The same applies to the generally analogous construction according to US 2002/068109 A1, where a spindle drive is used instead of the hydraulic cylinder (see also JP 62 087813 U).
- 10 DE 201 20 612 U1 discloses a mould closing unit with a toggle mechanism, wherein an adjusting mechanism for adjusting the distance between the counter plate and an intermediate plate is provided at the intermediate plate.

FR 1 364 693 A shows a mould closing unit with a toggle mechanism, wherein an hydraulic cylinder driving the toggles is received in the centre of a mould height adjustment device, which is mounted on a support plate by means of a screw thread.

15

DE 199 23 849 C2 discloses a mould closing unit for an injection moulding machine, on which a double toggle mechanism is driven by means of a thrust crank. The thrust crank and its drive unit are mounted on a rear supporting element.

DE 10 2006 061 969 B4 discloses an injection moulding machine with two toggle mechanisms configured as a Y-shaped toggle. In this respect, the drive motors are arranged transversely of the drive axis.

20

Object of the invention

Taking this prior art as basis, the object of the invention is to develop further an injection moulding machine of the above-mentioned type in such a way as to make it possible to influence the parallelism of the mould carriers in both the static and the dynamic state.

- 5 This object is achieved by an injection moulding machine having the features of the proposed concept.

The toggle mechanisms are driven in a known manner by separate drive units or mechanisms, but these drive units are now mounted on a bearing plate likewise moved during toggle movement, on which bearing plate the actuating elements for the toggle mechanisms are mounted. As a result of toggle movement, said plate moves at the start of the movement at roughly the same rate as the mobile mould carrier, whilst towards the end of the mould movement said bearing plate continues to move in the millimetre range, while the mould carriers are already in the mould-closing state. The position of the bearing plate may thereby be used as a reference dimension for mould movement, since the transmission ratio on mould closing is most precise there. While in the prior art adjustment by way of the drive motors takes place above all during the mould closing movement, the configuration selected herein allows the resulting greater precision still to be influenced even on mould closing in the event of corresponding adjustment. To increase precision still further, the bearing plate is guided on force transmission elements such as beams arranged between the stationary mould carrier and the supporting element and on the machine foot eventually.

By mounting the drive motors themselves on the bearing plate, the masses to be moved are increased, but this is taken consciously into account, since an extremely rigid plate is

formed overall, which may simultaneously be used as a multifunctional part. In addition, this bearing plate may be fully preassembled with its drive units as an independent module and then installed in the machine. For the manufacturer this means on the one hand better prefabrication, it being possible to carry out functional tests on the module even before
5 "marriage" with the rest of the machine. It is additionally possible to dispatch the entire module separately to other countries. Alternatively, a nut or spindle may be mounted on the bearing plate as part of the drive mechanism, such that a grid frame-like bearing plate may be formed, to which the prefabricated drive unit may then be added during production or during subsequent operational maintenance. In both cases, however, the guidance of
10 said bearing plate ensures increased precision.

As a multifunctional element, the bearing plate on the one hand accommodates the drive unit, which comprises the motor, such as for example a servo motor, and also bearings, nuts and spindles, has the bearing points for toggle mounting and also comprises seatings for guiding the plate. In addition to the function of driving the toggles, which are mounted
15 on this bearing plate, guidance of the bearing plate relative to the rest of the machine may lastingly influence the accuracy of the interplay between opening and closing of the injection mould. Cooling devices for bearing, nut and spindle may likewise be provided on said plate. Since this cooling may for example be integrated into the bearing plate, geometric accuracy is obtained for the entire system, which increases the service life of the injection
20 moulding machine as well as precision during the production of injection mouldings.

Brief description of the drawings

The invention is explained in greater detail below with reference to exemplary embodiments illustrated in the Figures, in which:

Fig. 1 is a three-dimensional side view of a mould closing unit arranged on a machine
5 foot,

Fig. 2 shows a vertical section through the mould closing unit of Fig. 1 at the level of the centre axis with the toggle mechanisms in extended position and a closed injection mould,

Fig. 3 shows an illustration according to Fig. 2 with an open injection mould,

Fig. 4 shows a vertical section through the bearing plate with the drive units mounted
10 thereon,

Fig. 5 shows a section along line 5-5 of Fig. 2,

Fig. 6 shows an illustration according to Fig. 4 of a further exemplary embodiment with drive units mounted on the supporting element,

Fig. 7 shows a three-dimensional illustration of the bearing plate according to Fig. 6,

15 Fig. 8 shows a partially sectional illustration of a drive unit.

Description of preferred embodiments

The invention will now be explained in greater detail by way of example with reference to the appended drawings. However, the exemplary embodiments are merely examples, and are not intended to restrict the inventive concept to a specific arrangement. Before the in-

vention is described in detail, it should be pointed out that it is not limited to the particular components of the device and the particular method steps, since these components and methods may vary. The terms used herein are merely intended to describe particular embodiments and are not used in a limiting manner. In addition, where the present text uses
5 the singular or indefinite article, this also covers a plurality of said elements, providing that the overall context does not unambiguously indicate otherwise.

The Figures show two exemplary embodiments of an injection moulding machine for processing plastics and other plastifiable compositions such as pulverulent, metallic or ceramic compositions, said machine having, as is conventional in an injection moulding machine, a mould closing unit F on a machine foot 13 and an injection moulding unit not
10 shown in the drawings. Between the mould carriers, namely a stationary mould carrier 12 and a movable mould carrier 11, at least one injection mould 10 consisting of a plurality of parts may be accommodated. At least one toggle pair with two toggle mechanisms K, which may be individually driven by separate drive units A, are provided for movement of
15 the mould carriers in the closing direction s-s towards one another up to closing of the injection mould 10 and away from one another to open the injection mould 10. The toggle mechanisms K are mounted on a bearing plate 14, 14'. As is in particular clear from Figures 2 to 4 and 6, the drive units are mounted on a bearing plate 14, 14', which is moved in the closing direction during the closing and opening movements. The bearing plate includes bearing points 23, clearly visible in Fig. 4, on which the actuating elements for the
20 at least two toggle mechanisms K are mounted. In principle, a similar configuration may be provided in the case of more than two toggle mechanisms.

According to Fig. 2, the toggle mechanism K is mounted in articulated manner at one end on a mould carrier, in the exemplary embodiment on the movable mould carrier 11, and at the other end on a supporting element 15, the bearing plate 14 being arranged between the mould carrier and the supporting element. In principle, a configuration is also conceivable
5 in which the at least two toggle mechanisms are mounted on the stationary mould carrier, as shown for example in DE 10 2006 061 969 B4. In contrast therewith, however, the bearing plate is here located between mould carrier and supporting element.

In conjunction with Fig. 2, Fig. 4 shows how the drive units A are mounted. At one end, a bearing 30 is provided for mounting the drive unit A on the bearing plate 14. The drive
10 unit, which in the exemplary embodiment is a servo-electric motor with associated spindle mechanism and comprises lead or roller spindles of any desired design, is provided in the bearing region with cooling by cooling ducts 29 or in Fig. 6 with a cooling jacket 33. As an alternative to the servo-electric drive unit, however, hydraulic drive units may also be used, provided that the drive mechanism is mounted in the same way. The short structure of the
15 closing unit ensured by the arrangement of the toggle mechanisms is also clear.

In the first exemplary embodiment of Figs. 1 to 5, the drive unit is mounted at one end on the bearing plate 14, while the associated drive mechanism, i.e. the spindle mechanism in the exemplary embodiment, is mounted at the other end on the supporting element 15, on which the toggle mechanism K is also mounted in the exemplary embodiment. This ar-
20 rangement is reversed in the exemplary embodiment of Figs. 6 to 8, i.e. in Fig. 6 the drive motor is mounted on the supporting element 15', while the nut 25 is mounted on the bearing plate 14'. Common to both exemplary embodiments is guidance of the bearing plate 14, 14' in the closing direction s-s, in the one case using the machine foot 13 and in the other

using the force transmission elements 27, wherein a combination of the two guides or a guide at another location in the injection moulding machine in the closing direction s-s is also possible.

Fig. 2 shows the spindle 24 on the one hand and the mount for the nut 25 on the other. Since, as a result of rotation of the spindle 24, the latter moves with the bearing plate 14 to the left in the Figures during the opening movement, i.e. on changeover from the representation according to Fig. 2 to the representation according to Fig. 3, a receiving housing 32, into which the spindle 24 may enter, is provided in the region of the nut 25. The spindle 24 is driven by the drive unit A mounted on the bearing plate, while the nut 25 is mounted non-rotatably on the supporting element 15. This concept may in principle also be reversed, i.e. rotation of the nut and a non-rotatable mounting of the spindle. To this end, known hollow-shaft motors may be used, for example.

The toggle mechanism K is a five-point toggle in both exemplary embodiments. In this respect, an articulated lever 21 is mounted in articulated manner on one of the two toggles 16 of the respective toggle mechanism K and is coupled at the other end to the bearing point 23 on the bearing plate 14, 14'. This bearing point 23 moves in the closing direction s-s during closing and opening movement, as is clear from a comparison of Figures 2 and 3. The movement pivots the articulated lever 21, however, leading to changeover of the toggle from the position according to Fig. 3 into the extended position according to Fig. 2. In the extended position, the two toggles 16, 17 are extended substantially in the closing direction s-s and the toggle joint 18 is roughly in a line with the coupling points 19 on the supporting element 15 and the coupling point 20 on the movable mould carrier 11, said line being parallel to the closing direction s-s. In the position according to Fig. 3, the toggles

16, 17 of the toggle mechanisms arranged preferably vertically one above the other have moved outwards from their extended, inner position on the opening movement of the injection mould 10. This movement sequence contributes to the short structure of the mould closing unit overall.

5 A mould height adjusting mechanism 26 is provided on the supporting element 15, 15' in order to adjust the extended position which is of significance to the toggle mechanisms. The mould height is here understood to be the height of the injection mould 10 when the mould is clamped between the movable mould carrier 11 and the stationary mould carrier 12, i.e. the distance between the mould carriers when the mould is clamped. Depending on
10 this distance, the supporting element 15 needs to be moved in the closing direction s-s by the mould height adjusting mechanism 26, in order to achieve efficient, energy-saving mould clamping with maximum force. The supporting element 15, 15' is itself connected to the stationary mould carrier 12 via force transmission elements. In the exemplary embodiment, the force transmission elements take the form of columns or beams 27, but in principle
15 force transmission elements may also be used which transmit the forces around the mould clamping space, such that the space between the mould carriers is virtually freely accessible. Stirrup-like elements are known in the prior art for this purpose.

The bearing plate 14 is mounted on the machine foot 13 on guides 28, wherein by guiding the plate the accuracy of interplay between opening and closing is influenced. According to
20 Fig. 5, bearings 31 are provided for this purpose, which mount the bearing plate 14 on the guides 28. The bearings 31 may also be configured such that the beams 27 provide guidance. As illustrated in Fig. 4, the bearing plate may be fully preassembled with its drives as an independent module and then installed in the machine. This allows the functionality of

said module to be tested prior to connection with the rest of the injection moulding machine.

The bearing plate is preferably of one-piece construction and in this respect is a multifunctional part. It serves not only to accommodate the drive unit A with the associated bearings or the spindle 24, it also comprises bearing points 23 for mounting the toggles and has receptacles for the guides 28 of the bearing plate 14 on the machine foot 13. Cooling devices, such as cooling ducts 29 in the plate, or a cooling jacket 33 in the second exemplary embodiment, are preferably also provided for the bearings of the spindle 24 or for direct cooling of the nut 25, so increasing the geometric accuracy and service life of the injection moulding machine. The cooling devices are provided in particular at the points at which the drive units A, A' are connected to the bearing plate 14, 14'. By cooling or temperature control, the same temperature is ensured at the two drive units, such that the temperature-dependent longitudinal expansion is likewise equal, which thus further increases the precision of the entire system.

The position of the bearing plate 14, 14' serves as a reference criterion for mould movement, since the transmission ratio, above all on mould closing, is most accurate there. It allows the parallelism of the mould carriers and thus of the parts of the injection mould to be influenced even in the static state. In both the static and dynamic states, i.e. during the mould closing movement, the servo motors may be adjusted, for example by corresponding position encoders, to achieve the desired parallelism. In this case, the distances covered by the bearing plate 14, 14' at the start of the mould closing movement are roughly identical to the movement of the movable mould carrier 11, but close to the point of mould closing the

bearing plate 14 continues to move, while the movable mould carrier effects scarcely any further movement.

In the exemplary embodiment of Figs. 6 to 8 on the one hand the arrangement of motor and nut 25 is reversed relative to the first exemplary embodiment. In addition, the drive unit A' according to Fig. 8 forms a drive module removable from the bearing plate, said drive module substantially comprising motor, bearing, nut 25 and spindle 24 as well as the cooling jacket as a structural unit. This is advantageous if, for example during servicing, the drive unit needs to be replaced, since the new unit can then be inserted as a complete, pre-tested unit.

According to Fig. 7, the bearing plate 14' of the second exemplary embodiment is of grid frame-like construction, the toggle mechanisms K being arranged within the force transmission elements, which take the form of beams and act as a guide for the bearing plate 14' by way of the bearings 31'. The arrangement of the toggle mechanisms relatively far inwards relative to the centre axis, which is thus possible, contributes on the one hand to the fact that the forces arising may be readily dissipated and removed with less deflection of the bearing plate 14'. On the other hand, this simultaneously assists in an open structure of the bearing plate 14' as a frame structure, which at the same time simplifies access to the components of the mould closing unit.

It goes without saying that the present description may be subjected to the most varied modifications, changes and adaptations which are of the nature of equivalents to the present invention.

List of reference signs

10	Injection mould
11	Movable mould carrier
12	Stationary mould carrier
13	Machine foot
14, 14'	Bearing plate
15, 15'	Supporting element
16, 17	Toggle
18	Toggle joint
19, 20	Coupling point
21	Articulated lever
22	Coupling point of 21
23	Bearing point
24	Spindle
25	Nut
26	Mould height adjusting mechanism
27	Beam
28	Guide
29	Cooling ducts
30, 30'	Bearing for drive unit A
31, 31'	Bearing for bearing plate 14
32	Receiving housing
33	Cooling jacket
A, A'	Drive unit
F	Mould closing unit
K	Toggle mechanism
s-s	Closing direction

Claims

1. An injection moulding machine for processing plastics and other plastifiable materials with a mould closing unit arranged on a machine foot, the injection moulding machine comprising:

at least one injection mould accommodated between a stationary mould carrier and

a movable mould carrier,

at least two toggle mechanisms, each driven mutually independently by a corresponding drive unit, each toggle mechanism including a pair of toggles,

a plurality of force transmission elements for absorbing forces arising, which force transmission elements connect the stationary mould carrier with a supporting element,

the toggle mechanisms being mounted on a movable bearing plate, the movable bearing plate being mounted on the injection moulding machine so as to be movable on the force transmission elements,

the drive units being mounted on the movable bearing plate, on which actuating elements for the toggle mechanisms are mounted,

wherein the force transmission elements are arranged on mutually opposite sides symmetrically to a centre axis and serve as a guide for the movable bearing plate,

and

wherein all drive units are mounted on the movable bearing plate distant to the force transmission elements.
2. The injection moulding machine according to claim 1, wherein the toggle mechanisms are mounted in an articulated manner at one end on one among the stationary mould carrier and the movable mould carrier, and at another end on the supporting

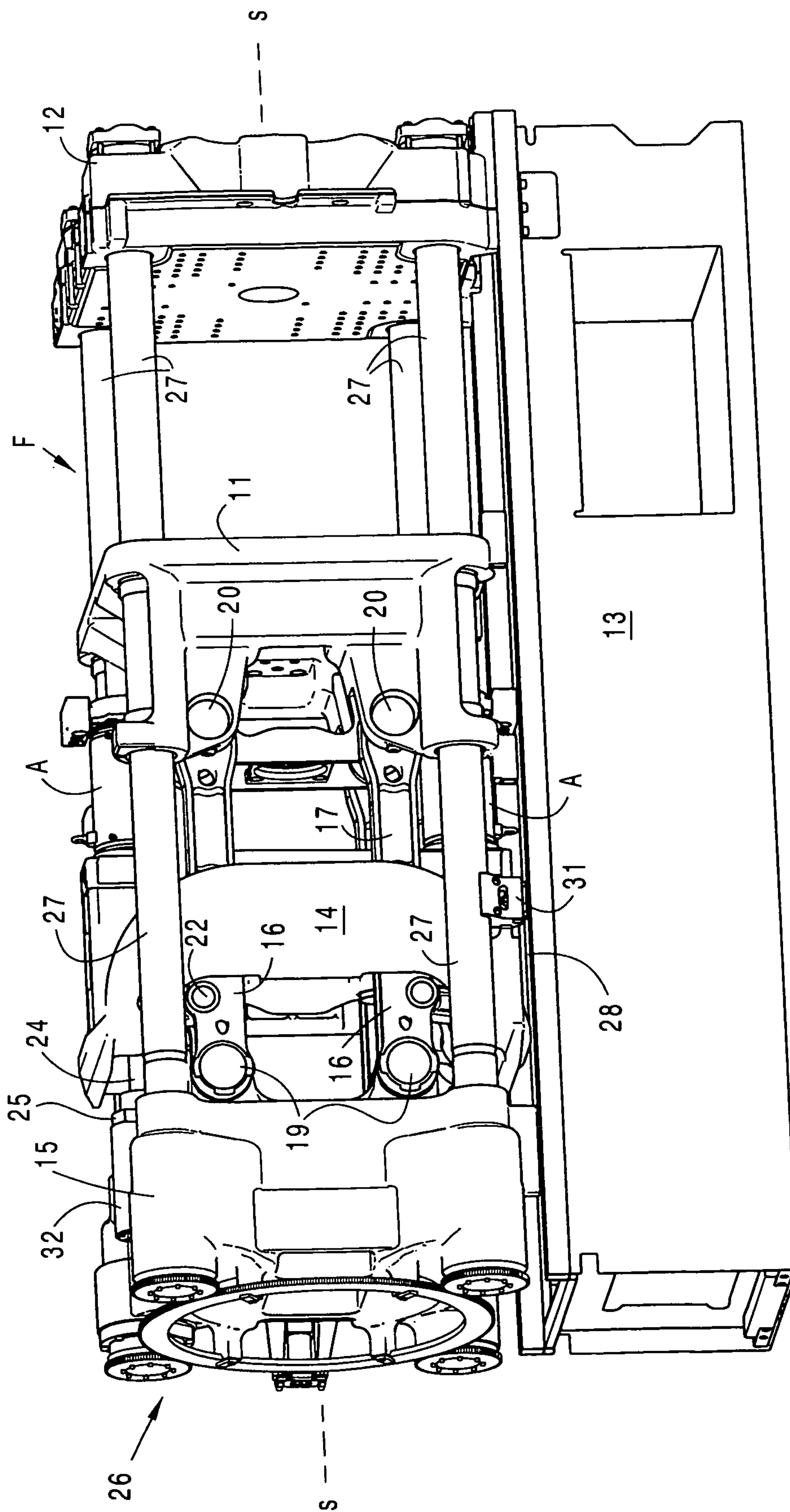
element, the movable bearing plate being arranged between the corresponding mould carrier and the supporting element.

3. The injection moulding machine according to claim 2, wherein the mould carrier to which the toggle mechanisms are mounted is the movable mould carrier.
4. The injection moulding machine according to any one of claims 1 to 3, wherein each drive unit operates a corresponding drive mechanism that has one end mounted on the supporting element.
5. The injection moulding machine according to any one of claims 1 to 3, wherein each drive unit is a servo-electric motor, which drives a spindle mechanism having a spindle and a nut, and wherein only one among the spindle and the nut is driven by the drive unit while the other among the spindle and the nut is mounted non-rotatably on the supporting element.
6. The injection moulding machine according to any one of claims 1 to 5, wherein an articulated lever is mounted in an articulated manner at one end on one of the two toggles of a respective one of the toggle mechanisms, and is mounted in an articulated manner at another end on a corresponding bearing point of the movable bearing plate.
7. The injection moulding machine according to any one of claims 1 to 6, wherein during an opening movement of the injection mould the toggles of the toggle mechanisms are arranged vertically one above the other and move outwards from an extended, inner position.

8. The injection moulding machine according to any one of claims 1 to 7, wherein the movable bearing plate is of grid frame-like construction, the toggle mechanisms being arranged within the force transmission elements configured as beams.
9. The injection moulding machine according to any one of claims 1 to 8, wherein cooling devices for temperature control of the drive units are provided at points where the drive units are connected to the movable bearing plate.
10. The injection moulding machine according to any one of claims 1 to 9, wherein the movable bearing plate is movable along guides on the machine foot.

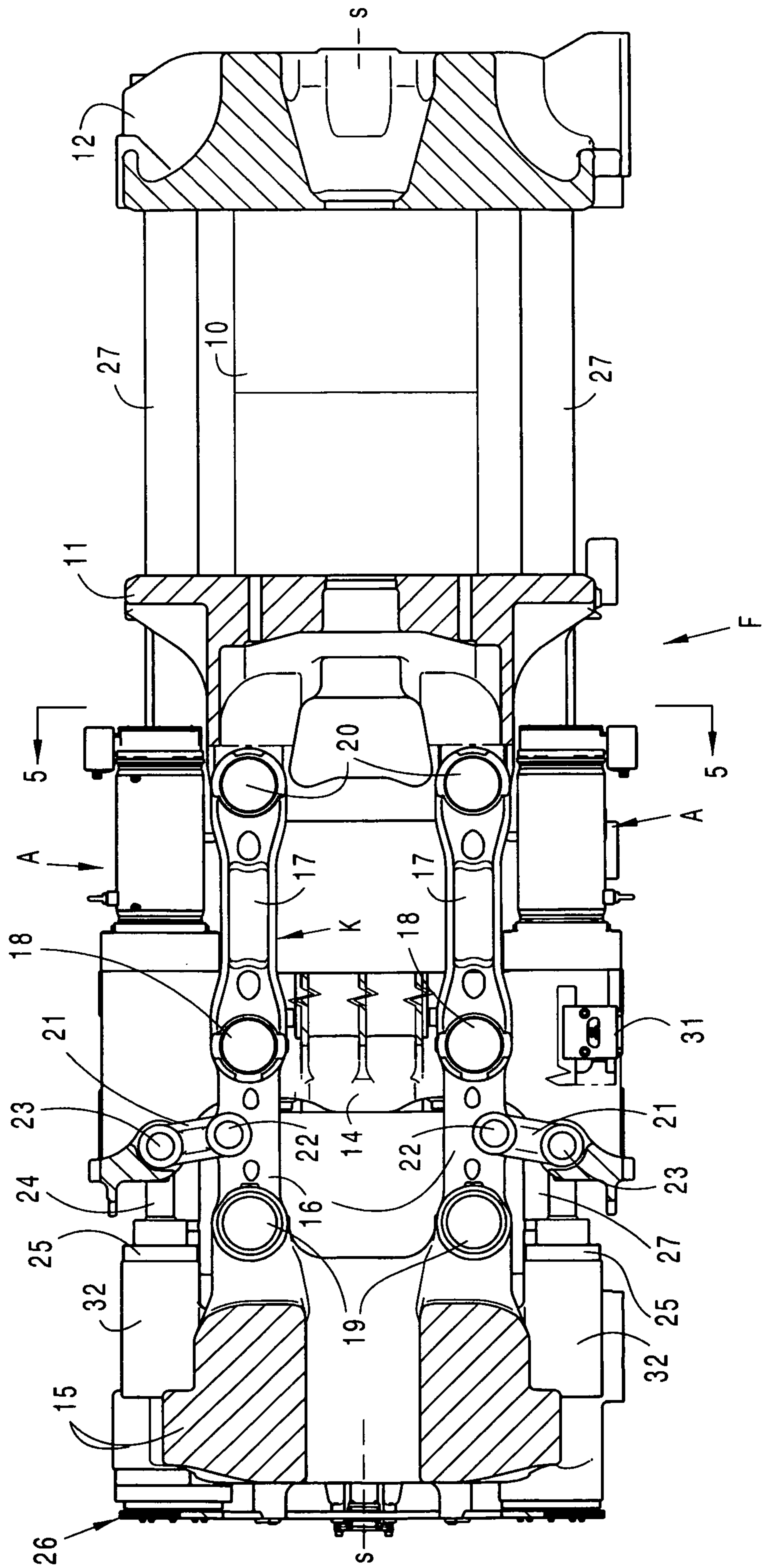
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FIG. 1



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FIG. 2



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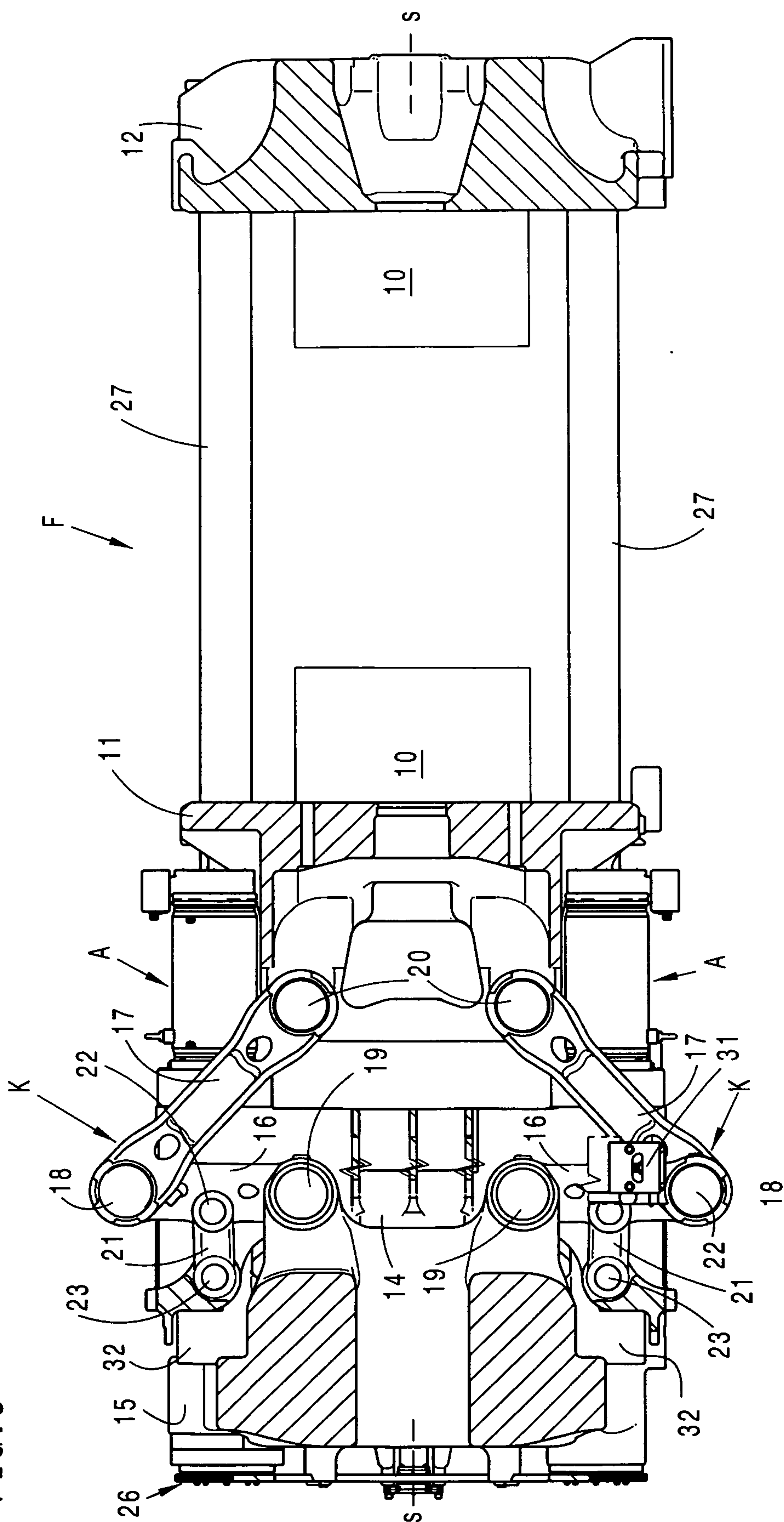


FIG. 3

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FIG. 4

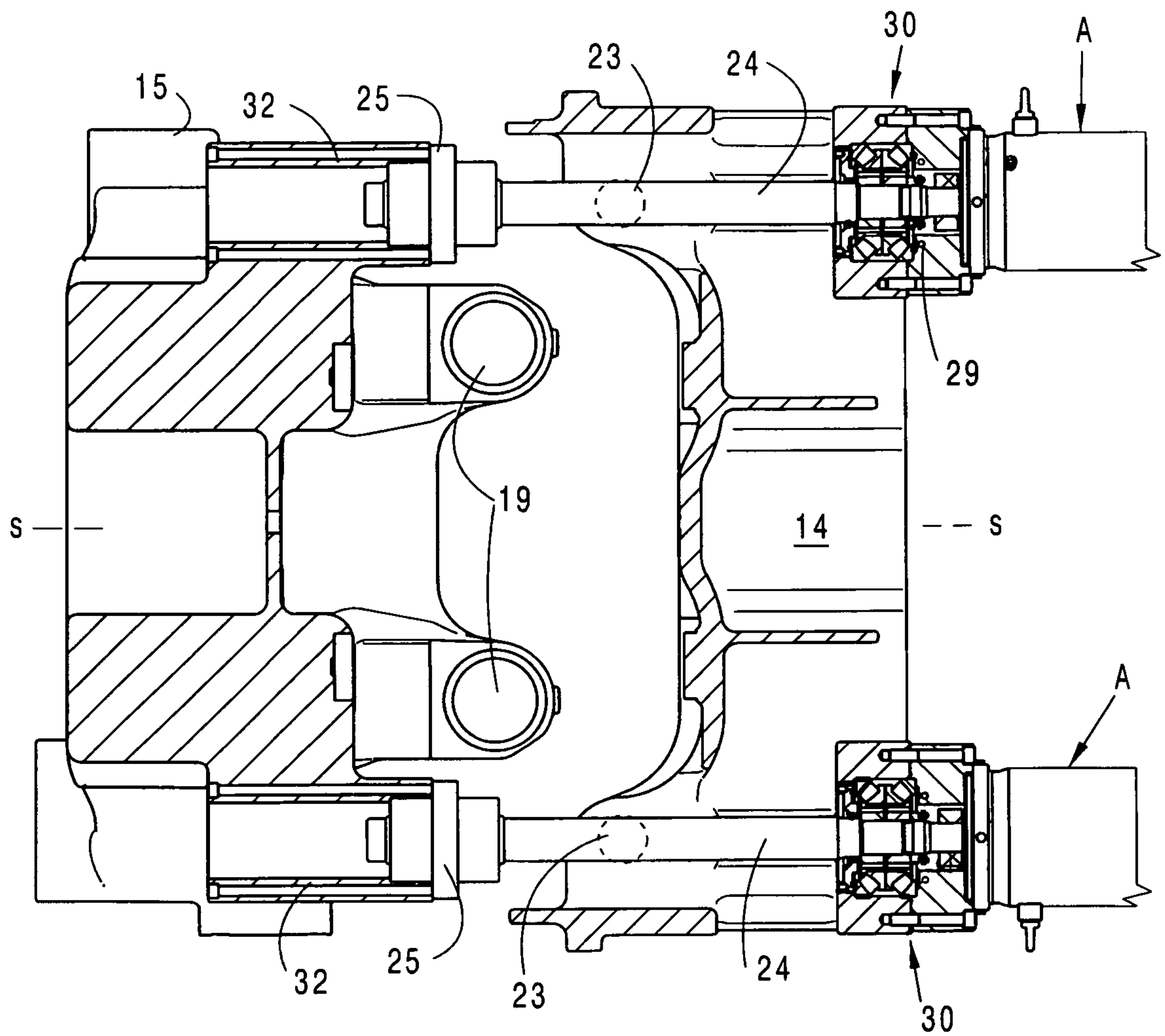
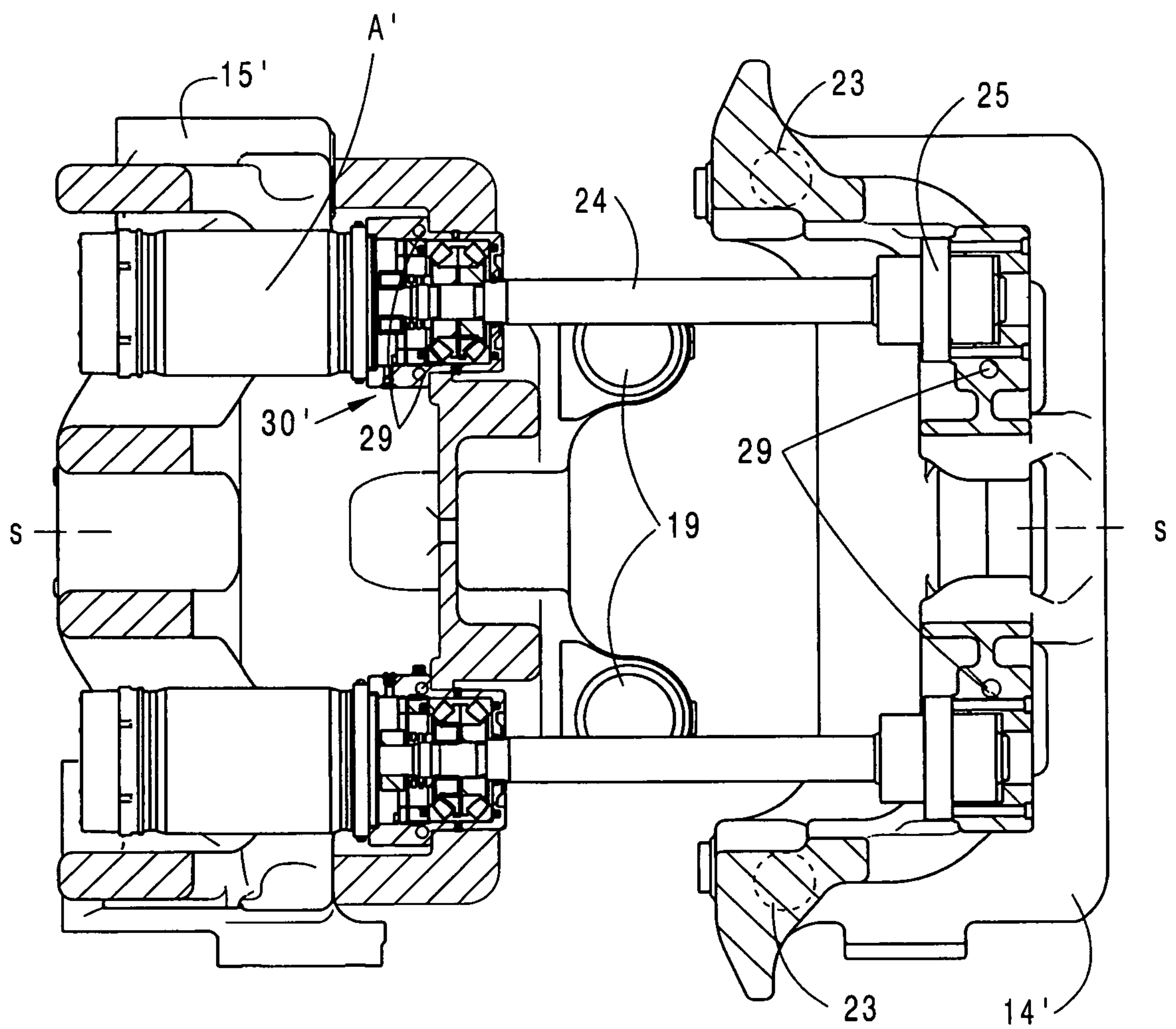
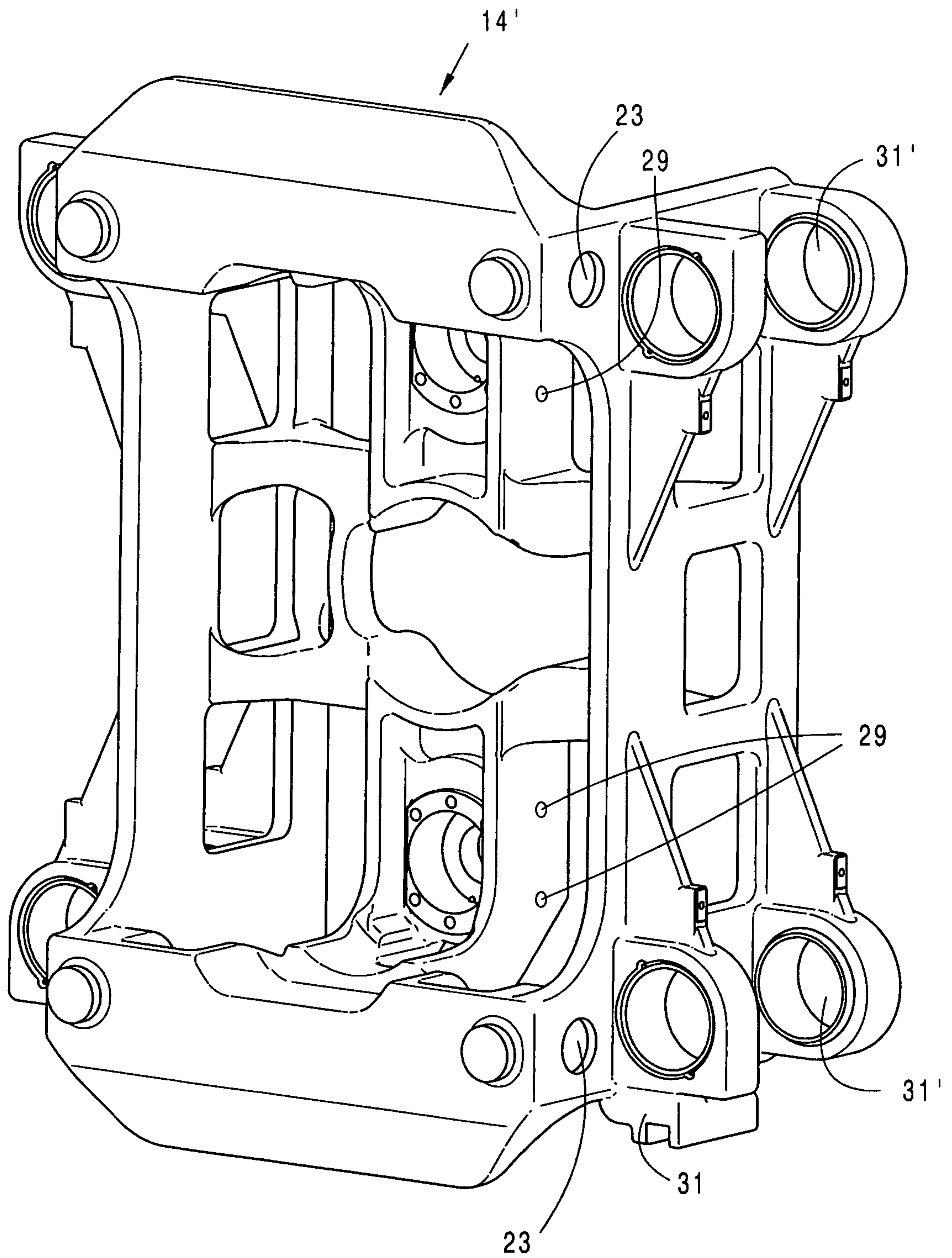


FIG. 6



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FIG. 7



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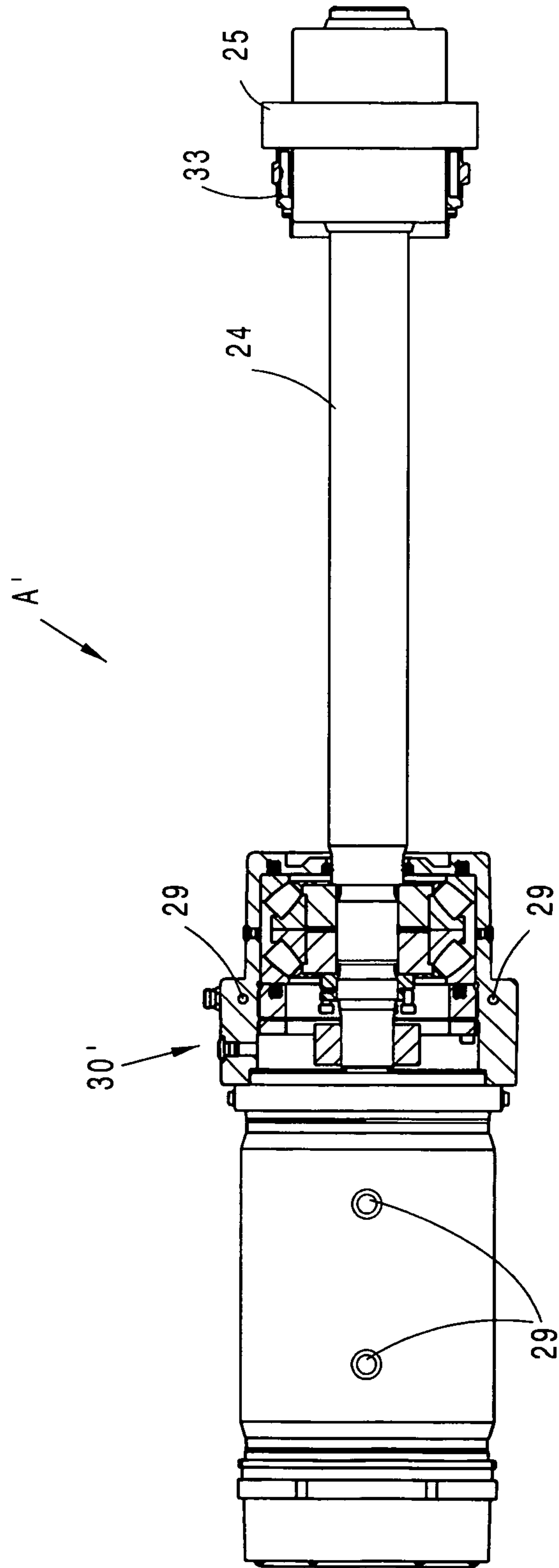


FIG. 8

