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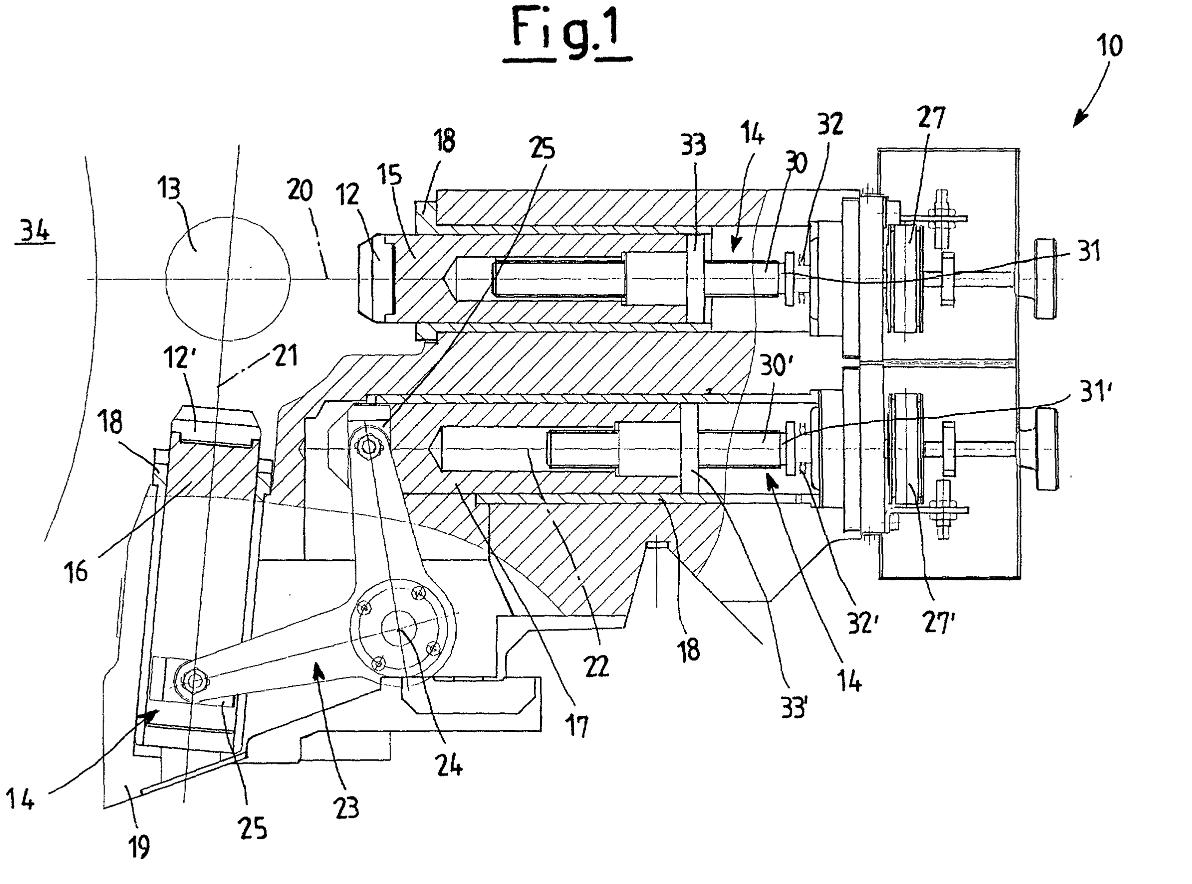
(54) **Moving device of the skids of a steady rest for grinding**

(57) A moving device of the skids of a steady rest for the grinding of articles having a cylindrical geometry comprises a bearing structure (19) which houses a motion transfer group. Said motion transfer group comprises at least one compressed air motor (26, 26') which drives movement cylinders (14) having at least two skids (12, 12') at the ends.

Fig.1

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## Description

[0001] The present invention relates to a moving device of skids of a steady rest for grinding.

[0002] The steady rest object of this patent was created for the grinding of Z-mill cylinders. These cylinders are very slender, with a "length/diameter" ratio of over 20; they are therefore particularly flexible and consequently difficult to process especially when grinding operations are required.

[0003] Even if expressly conceived for Z-Mill cylinders, this steady rest solution can be naturally applied to all "slender" components, which means having a length/diameter ratio > 20, whose form can be created by a rotation around the axis and on which a tangential grinding operation is necessary in points excluding the ends, for example, on the intermediate ball bearing tracks of transmission shafts.

[0004] In common practice, the grinding of cylinders is effected with cylinders between the centres and supporting steady rests. The grindstone creates a thrust pressure which, in a first approximation, lies in a plane orthogonal to the axis. In reality, this pressure is not the only factor which determines the shape and therefore the linearity of the article. In general, the entity and direction of the deformation of a free rod, during rectification, depends on various parameters among which the shear rate and quantity of material removed locally, the rotation velocity and pressure of the grindstone, the type of material being processed, the pressure exerted by the "centres" and the weight itself of the cylinder undergoing processing.

[0005] For particularly slender cylinders a pressure of a few grams is sufficient for creating deformations incompatible with the grinding operation. This considerable sensitivity makes the system unpredictable in its evolution as it is subject to phenomena of a local or fortuitous nature. In practice, this instability and uncertainty with respect to the shape are solved by the use of local rigidizing systems - the steady rests, in fact - which are arranged along the whole length of the cylinder subjected to processing and, by means of skids with a low coefficient of friction, create a constraint to its deformation.

[0006] In common practice, these "steady rests", called "finger shaped", are positioned by an operator who regulates the skids manually and with extreme delicacy due to the very slight pressures required. The upper skid is necessary for discharging horizontal stress, orthogonal to the axis, and the lower one for contrasting the tangential stress at the surface of the cylinder undergoing processing, and also its weight. The constraints imposed consequently act on the surface of the rod, in order to take into account the variations in diameter due to the material removed during the processing; this regulating operation should therefore be repeated several times during the grinding of each cylinder.

[0007] The market tendency of cylinder grinders is oriented towards an increase in performances in terms of processing rate, safety, repeatability, reliability and a reduction in the operating costs. The best way for achieving all of these objectives is through an ever-increasing automation. In this respect, important results have been obtained with CND for the control of machine axes.

[0008] All the control systems of the grindstone are based on the fact that the article being processed is assimilable to a rigid body. In the case of "slender" cylinders it is evident that a procedure which is manual and, what is more, particularly critical, such as the regulation of steady rests, is not compatible with the tendency based on the automation of the grinding operation.

[0009] To overcome this situation, various manufacturers of grinder equipment have commercialized several steady rests which can be moved by "calibrated stress", capable of keeping the pressure exerted during grinding, constant, regardless, therefore, of the consequent reduction in diameter and of guaranteeing the rigidity of the workpiece, making it "grindable" without the manual intervention of the operator. These steady rests can be interfaced with the machine electronics. The pressure exerted on the workpiece is controlled by a negative feedback system based on electric advance motions, such as for example step-by-step motors, and pressure sensors assembled on each skid.

[0010] On a practical level, due to the complexity of the stress acting on the article under processing, this type of instrument is extremely complex from a mechanical point of view and also with respect to the control electronics, its calibration is complicated and unsuitable for the kind of operators normally assigned to this type of processing.

[0011] In addition to the type of "automatic steady rest" described above, negative feedback systems based on hydraulic power, have also been commercialized. These systems have proved, on the one hand, to be not particularly sensitive when great positioning delicacy is required and, on the other hand, too yielding as the thrust fluid medium maintains an elasticity which does not easily adapt to the possible pressure drops which may occasionally occur during processing. Finally, the high rates required by the control system increase problems relating to set-up and operating costs.

[0012] The use of automatic steady rests and complete automation systems of grinders in applications to slender cylinders has caused problems of such an entity as to discourage their use. To have the capacity of grinding cylinders in the required tolerances with a good repeatability, the machines are highly complex, are easily damaged and require specialized and regular maintenance, as well as complicated operations for their initial calibration.

[0013] Furthermore, numerous systems have proved to be incapable of promptly reacting to load transients, typical of the state of stress of grinding operations.

[0014] An objective of the present invention is to produce a moving device of the skids of a steady rest for grinding with automatic functioning.

**[0015]** A further objective of the present invention is to solve the technical drawbacks described above.

**[0016]** Yet another objective of the present invention is to produce a moving device of the skids of a steady rest for grinding which is particularly simple and functional, with limited costs.

**[0017]** These objectives according to the present invention are achieved by means of a moving device of the skids of a steady rest for grinding as described in claim 1.

**[0018]** Further characteristics are illustrated in the subsequent dependant claims.

**[0019]** The characteristics and advantages of a moving device of the skids of a steady rest for grinding according to the present invention are specified in more detail in the following illustrative but nonlimiting description, referring to the enclosed schematic drawings in which:

- figure 1 is a partially sectional raised view of a moving device of the skids of a steady rest for grinding in rest position;
- figure 2 is a plan view of the device of figure 1;
- figure 3 is a partially sectional raised view of a moving device of the skids of a steady rest for grinding in operating position;
- figure 4 is a plan view of the device of figure 3.

**[0020]** With reference to the figures, these illustrate a moving device of the skids of a steady rest for grinding, indicated as a whole with 10, wherein the skids 12 and 12' are driven on a workpiece undergoing processing 13 by means of a motion transfer group. This group comprises movement cylinders 14 containing pistons 15, 16 and 17 which run in housings lined with bushings 18 and situated in an bearing structure 19, which has an anchoring function to the grinder.

**[0021]** Two pistons 15 and 16, on which the skids 12 and 12' are assembled for contact with the workpiece 13 undergoing processing on the grinder, are arranged so as to act on said workpiece 13 according to a horizontal axis 20 and a substantially vertical axis 21, respectively. In addition, an auxiliary piston 17, which forms part of the kinematic chain of the piston 16, acts along an axis 22, parallel to the horizontal axis 20. Said auxiliary piston 17 is connected to the piston 16 by means of a quadrant 23, which transfers the movement from the direction of the axis 22 to the sliding direction of the piston 16, the substantially vertical axis 21. Said quadrant 23 is hinged to the bearing structure 19 at a fixed point 24, which forms the rotation centre. The quadrant 23 is constrained at its ends to the auxiliary piston 17 and piston 16, respectively, by means of sliding blocks 25 which allow the relative rotation and translation movement in an orthogonal direction to the axis 22 and 21 of said auxiliary piston 17 and piston 16, respectively.

**[0022]** The motion transfer group for creating the movement of the skids 12 and 12', as described above, uses two distinct kinematic chains.

**[0023]** Each of these kinematic chains consists of an air compressed motor 26 or 26' demultiplied by means of two cog pulleys 27 and 28 or 27' and 28' with a relative transmission belt 29 or 29', which transfer the movement to a ball or trapezium threaded maneuvering screw 30 or 30' with a short pitch, assembled on a transmission shaft 31 or 31' with interposed axial thrust bearings 32 or 32'. In the movement cylinders 14, the maneuvering screws 30 or 30' operate with the piston 15 or auxiliary piston 17 by means of an inlet flange 33 or 33' of said pistons having an internal thread.

**[0024]** The activation of the maneuvering screw 30 along the axis 20 therefore causes the skid 12 to advance in the same direction 20. The activation of the maneuvering screw 30' along the axis 22, parallel to the axis 20, on the other hand, causes the skid 12' to advance in the direction of the axis 21, substantially orthogonal to said activation axis 22.

**[0025]** The moving device of the skids of a steady rest for grinding 10 is designed for supporting the workpiece undergoing processing 13 during grinding to avoid undesired bending and vibrations. Specifically designed for "Z-mill" cylinders, it can be applied to any workpiece under processing 13 with a similar geometry.

**[0026]** The functioning is autonomous, i.e. the positioning of the skids 12 and 12' on the workpiece under processing takes place automatically before starting the grinding. The air motors 26 and 26' supply a pair, which can be regulated by means of the feed compressed air pressure which moves the skids 12 and 12' on the cylindrical workpiece undergoing processing 13 and keeps them in contact by exerting a constant pressure. The pair supplied is generally very low to reproduce human sensitivity in positioning the steady rest against the workpiece under processing 13 and thus guarantee the quality of the grinding.

**[0027]** The deterioration of the workpiece under processing 13 and of the skids 12 an 12' is progressively recovered by the rotation of the maneuvering screws 30 and 30' to which the pair of motors is constantly applied.

**[0028]** Due to the absence of control systems of the negative feedback or electronic type in general, there is not limit to the number of steady rests which can be used, which is defined only by the geometry of the cylindrical workpiece under processing (normally 3 or 5).

**[0029]** From 3 to 5 steady rests therefore function contemporaneously for each article under processing 13 to be ground; the functioning of each of these is effected by means of the following phases:

- starting from a completely backward rest position (figures 1 and 2) the motors 26 and 26' are fed by air under pressure with pre-established flow and pressure
- the motors, cause the maneuvering screws 30 and 30' to rotate, by means of the kinematic chain de-

fined above, and these move the pistons 15 and 16 towards the workpiece under processing 13 until contact is established between the skids 12 and 12' and the workpiece 13

- in the work position, the skids 12 and 12' act as a rigid support for the workpiece 13 rotating during the grinding phase (figures 3 and 4)
- the air motors 26 and 26', fed during the grinding operation of the workpiece 13, maintain contact between the skids 12 and 12' and said workpiece, thus recovering the clearances which would be created as a result of the reduction in the diameter caused by the grinding operation
- at the end of the grinding cycle, the air motors 26 and 26' are fed by a stream which inverts the rotation movement, and the kinematic chain brings the pistons 15 and 17 back to a position caused by an electric end stop
- the steady rests are again in the starting rest position (figures 1 and 2).

**[0030]** The moving device of the skids of a steady rest for grinding 10 is capable of forming rigid supports for the workpiece under processing 13, with a position of the skids 12 and 12' which cannot be modified even if pushed with great force by a grindstone 34 from the opposite end, as, in practice, the backward movement is prevented.

**[0031]** The use of maneuvering screws 30 and 30' with a short pitch also provides the necessary rigidity for contrasting the load transients present during the grinding process.

**[0032]** The moving device of the skids 12 and 12' of a steady rest for grinding, object of the present invention, has the advantage of reducing the number of components which make up the steady rest and obtaining it standardization due to the use of elements which are commonly available.

**[0033]** This leads to an easy set up and maintenance during the operating phase, as the only connection to the feeding lines is that of the compressed air.

**[0034]** The moving device of the skids of a steady rest for grinding, object of the present invention, reaches the desired delicacy in the force applied during apposition of the constraint, so as to reproduce the sensitivity of a manual approach towards the workpiece under processing.

**[0035]** An excellent rigidity is also guaranteed in the grinding phase, due to the automatic advancing of the skids 12 and 12' exclusively towards reducing the diameter of the cylindrical workpiece under processing 13.

## Claims

1. A moving device of the skids of a steady rest for the grinding of articles having a cylindrical geometry and comprising a bearing structure (19) which houses a motion transfer group, **characterized in that** said motion transfer group comprises at least one compressed air motor (26, 26') which drives movement cylinders (14) having at least two skids (12, 12') at the ends.

2. The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** each of said movement cylinders (14), having at least two skids (12, 12') at the ends, is fed by a compressed air motor (26, 26').

3. The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** said at least one compressed air motor (26, 26') is of the low intensity type.

4. The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** said at least one compressed air motor (26, 26') is demultiplied by at least two cog pulleys (27 and 28, 27' and 28').

5. The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** the motion transfer group consists of at least two maneuvering screws (30, 30') which operate with at least two pistons (15, 17).

6. The moving device of the skids of a steady rest for grinding according to claim 5, **characterized in that** said at least two maneuvering screws (30, 30') have a short pitch.

7. The moving device of the skids of a steady rest for grinding according to claim 5, **characterized in that** said at least two maneuvering screws (30, 30') are ball or trapezium threaded screws.

8. The moving device of the skids of a steady rest for grinding according to claim 5, **characterized in that** at least one of said at least two pistons (15, 17) is constrained to a quadrant (23) which transfers the movement of at least one skid (12, 12').

9. The moving device of the skids of a steady rest for grinding according to claim 8, **characterized in that** said quadrant (23) is hinged to the bearing structure (19) at a fixed point (24) and constrained at its ends so as to respectively allow its rotation with two pistons (16, 17) by means of sliding blocks (25) in an orthogonal direction to the axes (22, 21) of said pistons (16 and 17).

10. The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** said movement cylinders (14) have housings lined with bushings (18) for the sliding of pistons (15, 16,

17).

**11.** The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** said articles with a cylindrical geometry are preferably rods, cylinders, shafts.

**12.** The moving device of the skids of a steady rest for grinding according to claim 1, **characterized in that** said articles with a cylindrical geometry are generally "slender" elements, i.e. having one or more sections with an "overall length of the workpiece/local diameter" ratio greater than 20.

Fig.1

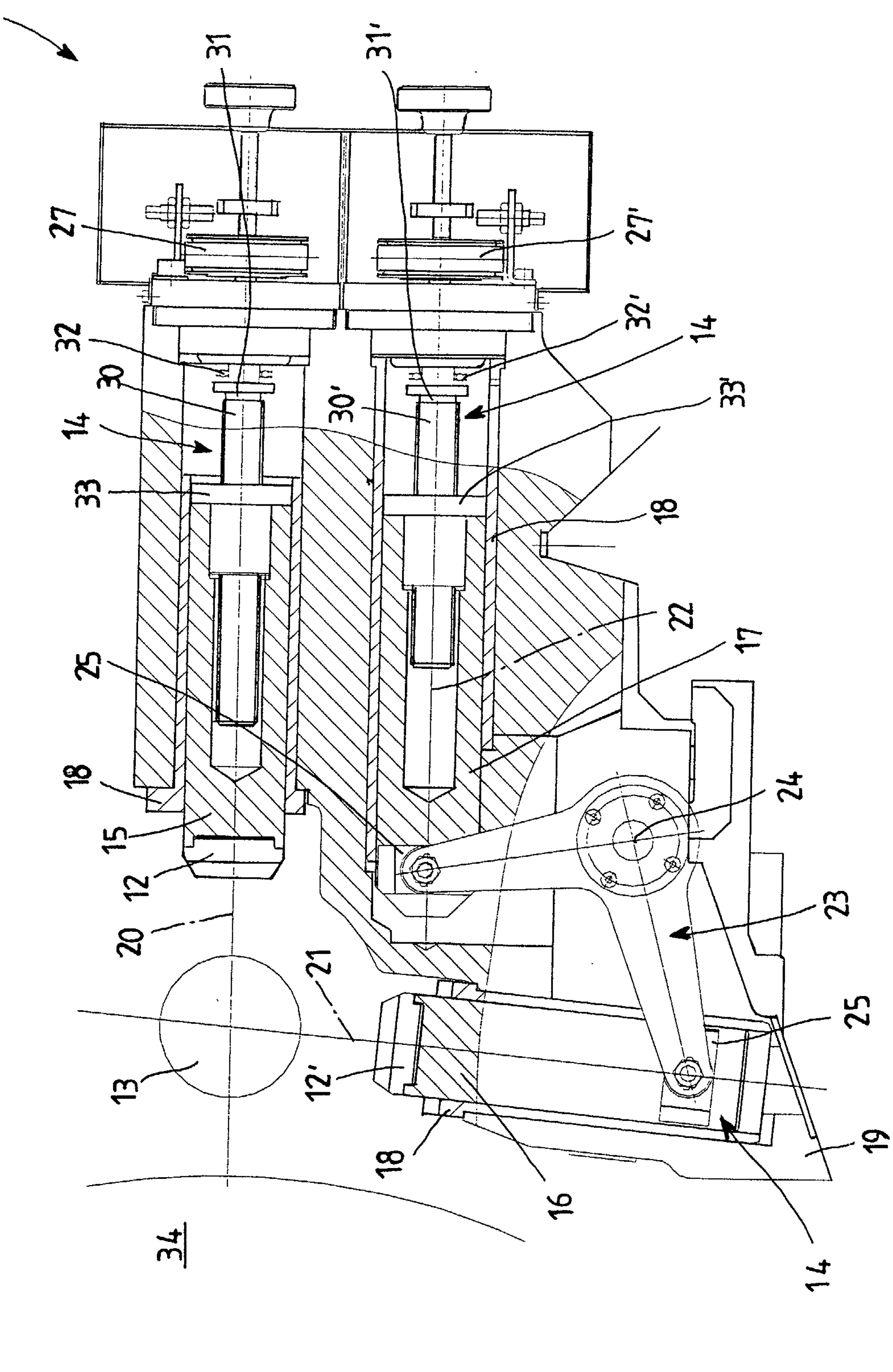
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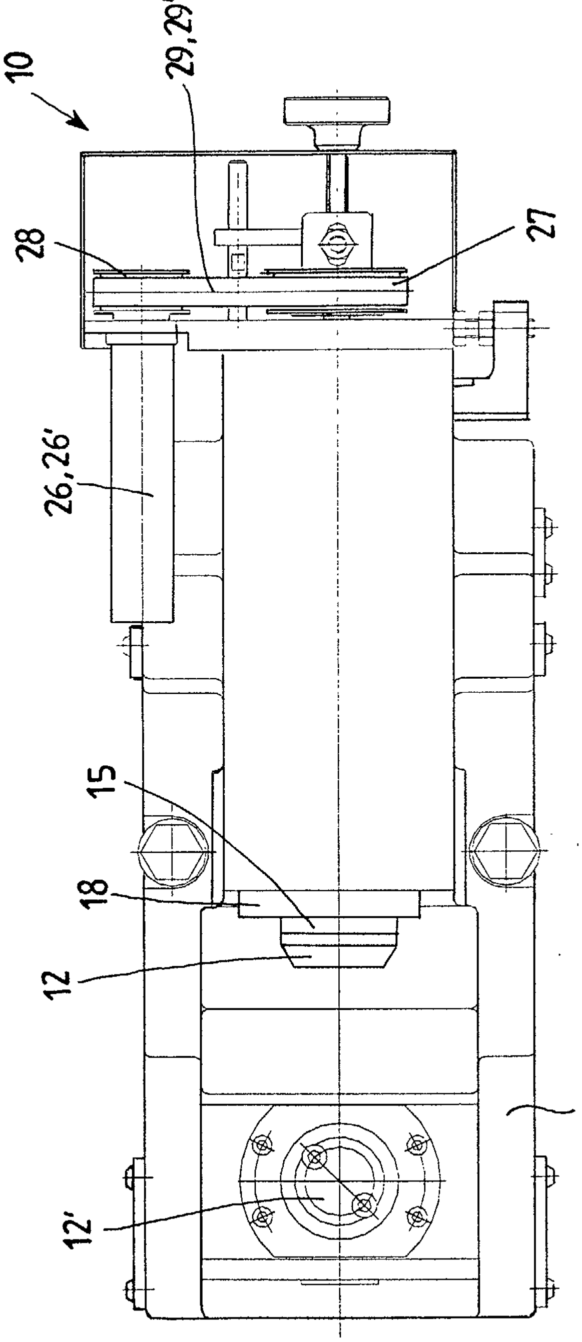
Fig.2



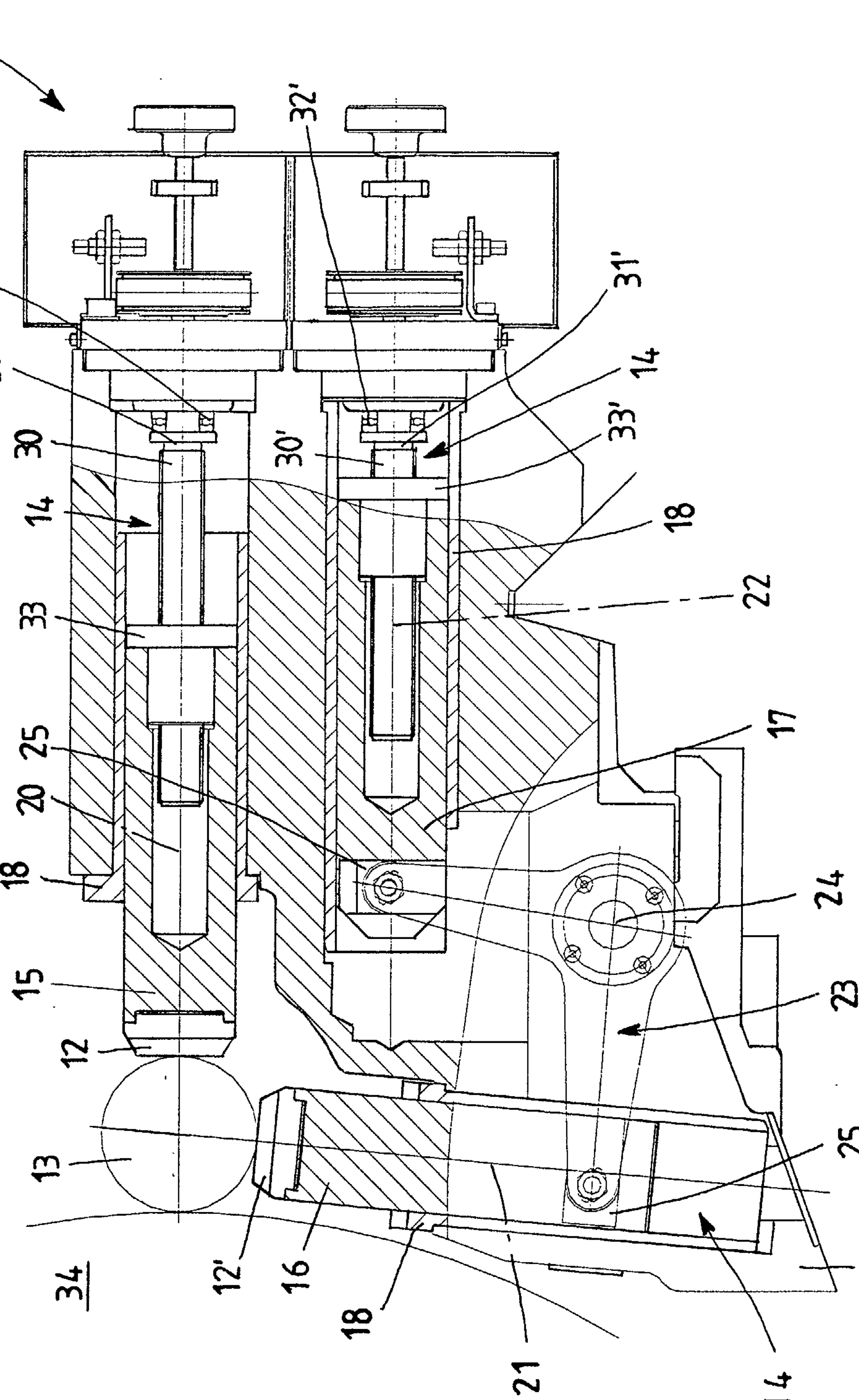

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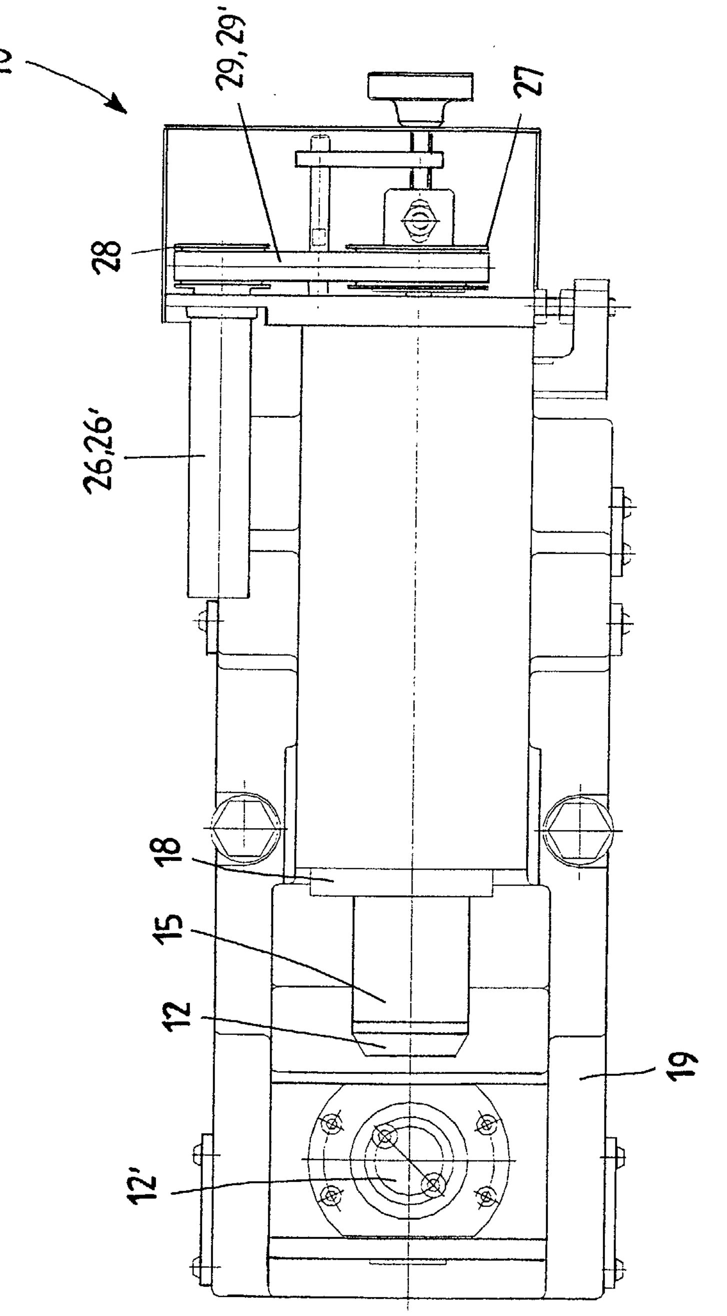
Fig.3

Fig.4



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Application Number
EP 01 20 4928

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The present search report has been drawn up for all claims

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