GRINDING APPARATUS FOR TREATING FIBROUS MATERIAL

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Fig. 1

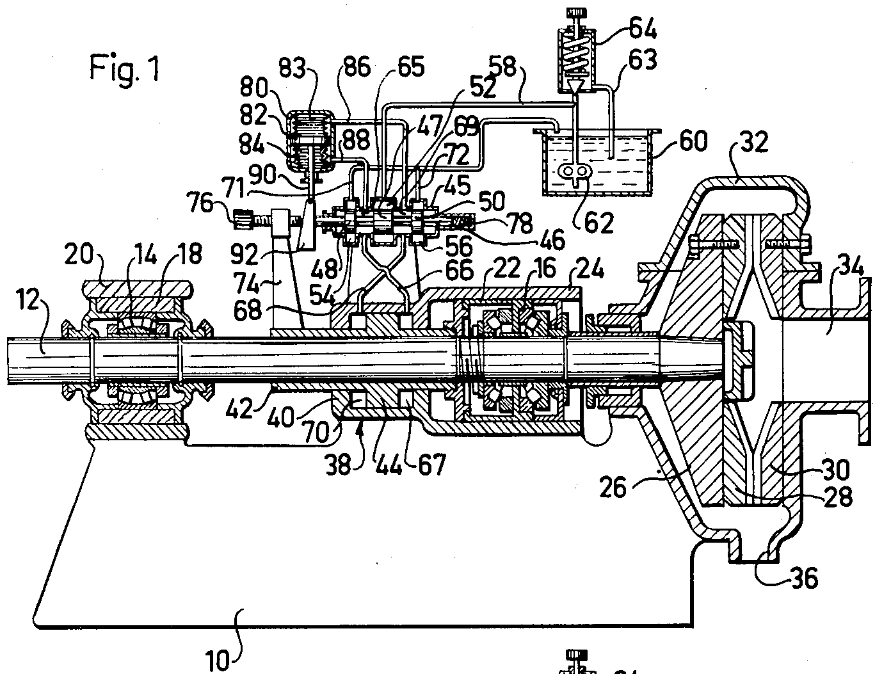
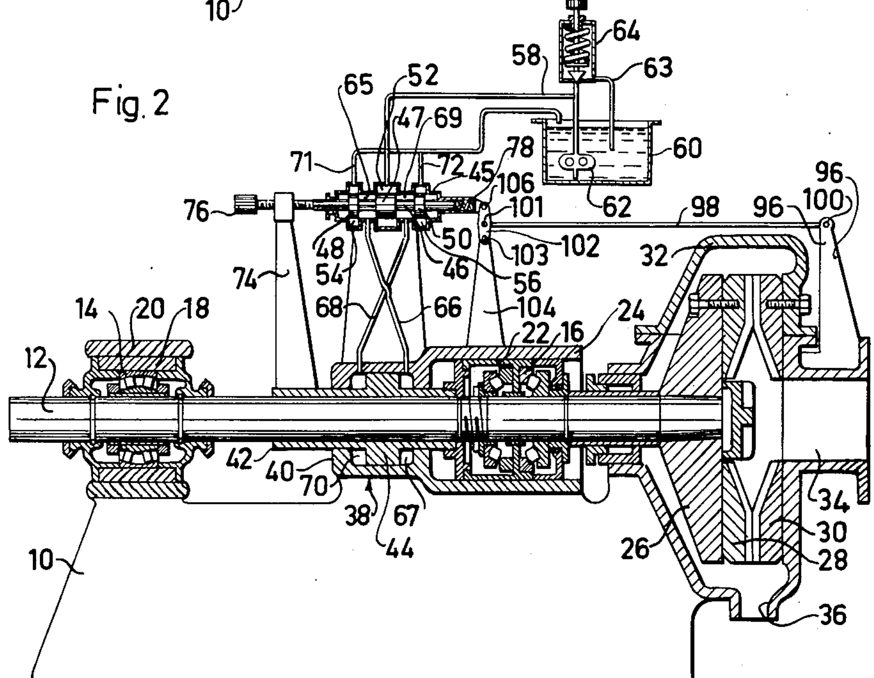
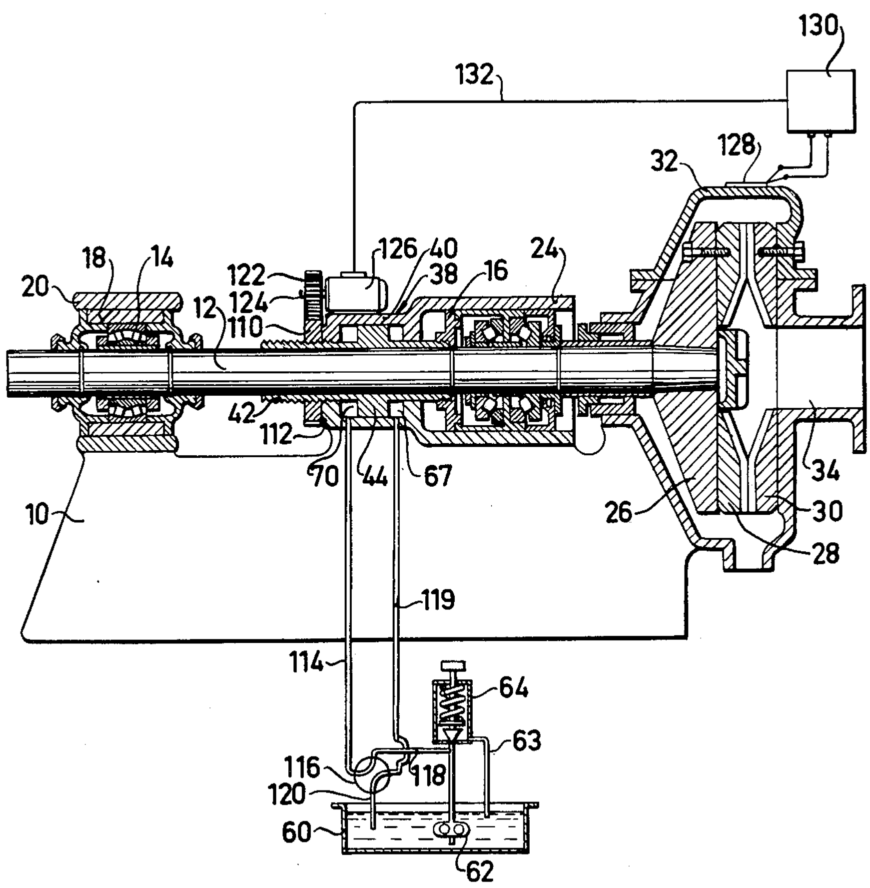


Fig. 2



INVENTOR.
ARNE JOHAN ARTHUR ASPLUND
et al
BY
ERIC Y. MUNSON

Fig. 3



INVENTOR.
ARNE JOHAN ARTHUR ASPLUND,
et al
BY ERIC Y. MUNSON

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GRINDING APPARATUS FOR TREATING FIBROUS MATERIAL

Arne Johan Arthur Asplund, Bromma, Rolf Bertil Reinhall and Lars Pentén, Lidingo, and Sven Herbert Johansson, Bromma, Sweden, assignors to Defibrator Aktiebolag, Stockholm, Sweden, a body of Sweden

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This invention relates to grinding apparatus for treatment of fibrous material.

More particularly this invention relates to grinding apparatus such as defibrators and refiners for treatment of fibrous material comprising a rotatable and a rotationally stationary grinding member, both of which have disc form, for example. The rotatable grinding member is supported by a shaft and axially displaceable by means of a fluid-actuated servomotor for adjusting the interspace between the grinding members and producing a grinding pressure therebetween.

In disc refiners the spacing or gap between the grinding discs is not constant but varies with the pressure exerted on said discs by the material to be ground when it passes therebetween. On an increase of the quantity of the material fed into the gap between the discs said gap must be adjusted anew if it is desired to maintain the grinding interspace unchanged. This is the consequence of elongations or stretches in those parts of the apparatus which are subjected to tensile forces, and of compressions in those parts which are subjected to pressure. In general apparatus of the kind in consideration are operated with so small grinding gaps that the elongations and compressions, respectively, occurring in the various parts of the apparatus are considerably larger, such as ten times larger, than the grinding gap. If the supply of pulp ceases for some reason the grinding discs may come into metallic contact with each other.

It has already been proposed to avoid this drawback by inserting into the supply conduit for the material to be ground or the pulp a pressure-responsive relay which when the pressure in the conduit decreases or ceases actuates the grinding discs so as to prevent them from abutting against one another. The relay can also affect the driving motor for the rotatable disc so as to put said motor out of operation when the pressure in the pulp supplying conduit falls below a predetermined value. This system can be employed only when the pulp is pumped between the grinding discs but not when the pulp is introduced between the grinding discs by means of a screw conveyor or in a disc refiner operating under steam pressure. A further disadvantage with the system in consideration is that the apparatus must be started manually or the spacing between the grinding discs be adjusted when the pressure on the pulp supply conduit decreases.

It has further been proposed to cause the pressure in the pulp supply conduit to govern the spacing between the grinding discs through intermediation of a hydraulic servomotor, for example. This pressure is, however, not in proportion with the stretches or compressions produced in the apparatus parts, for which reason it is not possible to keep the spacing between the grinding discs constant in the proposed way.

One main object of the present invention is to provide an improvement of the grinding apparatus with regard to

the drawbacks indicated hereinbefore. A further object of the invention is to bring about the desired improvement of the grinding apparatus by providing means adapted to cause a displacement of the rotatable grinding member relative the stationary grinding member in response to the pressure produced between the grinding members, and thereby to keep the gap between the grinding members at a predetermined value.

Further objects and advantages of the invention will become apparent from the following description considered in connection with the accompanying drawings, which form part of this specification and of which:

FIG. 1 is a vertical longitudinal section through a disc refiner constructed according to the invention. FIGS. 2 and 3 are similar sectional views of two alternative embodiments of the invention. In the various figures equivalent parts have been denoted with the same reference numerals.

Referring to the drawings, reference numeral **10** denotes a base of a grinding apparatus, a shaft **12** being supported in said base by two bearings **14** and **16**, respectively. The bearing **14** is located in an interior bearing casing **18** and together with this latter member is axially displaceable within an outer bearing casing **20**. In the same manner the bearing **16**, which is a combined axial and radial thrust bearing, is axially displaceable together with an inner bearing casing **22** within an outer bearing casing **24**. The shaft **12** carries a rotor **25**, onto which a grinding disc **28** is rigidly secured and thus is rotated together with the shaft. A stationary grinding disc **30** is fastened by means of bolts to a casing **32**, divided at a horizontal level above the shaft. The material to be ground is fed into the apparatus through a central channel **34** formed in the casing **32** and conveyed in an outward direction between the grinding discs **28** and **30**, where it is disintegrated. Disposed in the base part of the casing **32** is a discharge opening **36** for removal of the ground fibrous material.

A hydraulic servomotor, generally denominated **38**, is provided around the shaft **12**. Said servomotor comprises a casing **40** which may be made integral with the bearing casing **24**, and a piston **42**, which is concentric with and, with play, surrounds the shaft **12** and bears against the inner casing **22**. The piston **42** has a central flange **44**, axially movable within the casing **40**.

Rigidly secured to the casing **40** of the servomotor is a pilot valve **45**. Said pilot valve comprises a piston **46** provided with a central flange **47** and two lateral flanges **48** and **50**. It has a central chamber **52** and two lateral chambers **54** and **56** adjacent of which the inner diameter of the valve suits to the outer diameter of the flanges. The axial dimension of the piston **46** is kept below the longitudinal dimension of the chamber **52** by a very small value such as one hundredth or a few hundredths of a millimeter. In the same manner the flanges **48**, **50** have an axial dimension which is only inconsiderably minor than the longitudinal dimension of the chambers **54** and **56**. In a middle position all flanges are straight in front of their respective chambers.

A pipe **58** connecting the central chamber **52** of the pilot valve with an oil sump **60** is provided with a pump **62** and connected with a return pipe **63** controlled by a spring-loaded valve **64**. From a space **65** of reduced diameter equal with that of the flanges, which is located between the chambers **52** and **54** of the pilot valve a pipe **66** leads to the chamber **67** located on one side of the flange **44** of the servomotor **42**. A pipe **68** connects a further space **69** of reduced diameter of the pilot valve located on the other side of the central chamber **52** with a chamber **70** located on the opposite side of the flange **44**. The lateral chambers **54**, **56** are in connection with the sump **60** through return pipes **71** and **72**.

An arm **74** rigidly secured onto the piston **42** of the servomotor carries a set screw **76**, screwed in thereto and extending coaxially with the pilot piston **46** and adapted to act on the end of said piston projecting out of the valve casing. The opposite end of said piston is loaded by a spring **78** tending to displace the piston towards the set screw.

A cylinder **80** secured to the arm **74** houses a piston movable therein and on both sides subjected to the action of spring membranes **83**, **84**. The upper side of the cylinder **80** is through a pipe **86** in connection with the space **69** of the pilot valve, the lower side of said cylinder being connected through a pipe **88** with the space **65**. A pin **90** rigidly secured to the piston **82** projects out of the cylinder **80** between the piston **46** and the set screw **76** where said pin has the shape of a wedge or a guide cam **92**.

The device operates in the following manner:

From the sump **60** the central chamber **52** of the pilot valve is fed with oil of constant pressure through the pipe **58**. In FIG. 1 the piston **46** is shown in a neutral middle position, in which the pressure oil is distributed equally to the spaces **65** and **69**, the pressure thus being the same in these as well as in the both chambers **67** and **70** of the servomotor. If the piston **46** is moving to the left in the figure, the pressure will increase in the space **69**, while it will decrease in the space **65**. This is due to the fact that the middle flange **47** opens a bigger connecting area between the central chamber **52** and the space **69** at the same time as the lateral flange **50** chokes the passage between the space **69** and pressureless chamber **56**. On the other hand the connection between the space **65** and the middle chamber **52** is choked and further a bigger passage is opened between the space **65** and the pressureless lateral chamber **54**. This results in that a higher pressure acts on the piston flange **44** of the servomotor in the chamber **70** than in the chamber **67**. If the valve piston **46** moves in the opposite direction the result will be reversed, which means that the pressure increases in the chamber **67** and decreases in the chamber **70** of the servomotor. The material to be ground fed between the grinding discs **28** and **30** is thus subjected to a pressure the magnitude of which depends on the position of the piston **46** of the pilot valve and which is determined by means of the set screw **76**.

The piston **46** of the pilot valve is kept by the spring **78** continuously pressed against the adjusting screw **76** and thus follows the latter in its axial movements. In case the pressure between the grinding discs **28** and **30** increases due to the accumulation of material in the gap between said discs and the rotating grinding disc **28** together with the piston **42** is displaced to the left, the set screw **76** is entrained also, since it is secured to the arm **74** connected with the piston **42**. The piston **46** of the pilot valve follows with the set screw **76**. The result will be in accordance with the operative steps explained above that the oil pressure increases in the space **69** of the pilot valve and consequently in the chamber **70** of the servomotor also. In the chamber **67** of said servomotor the oil pressure will be reduced in a corresponding degree. An increased pressure is mobilized to act on the piston **42** of the servomotor in order to restore the earlier gap between the grinding discs. This gap is desired to be of an order of magnitude of only one hundredth or some hundredths of a millimeter. If, on the contrary, the grinding discs, due to non-arrival of fed material, should tend to approach one another, the piston **42** of the servomotor and the set screw **76** will follow and cause the piston **46** of the pilot valve to move to the right hand. This movement will result in an increase of the pressure in the space **65** of the pilot valve and in the chamber **67** of the servomotor and a corresponding reduction of the pressure in the space **69** and the chamber **70** of the servomotor. Due to the feature that the difference in the axial dimensions of the flanges **47**, **48** and **50** of the piston **46** of the pilot valve and the longitudinal dimensions of the chambers **52**, **54** and **56**, respectively, surrounding said flanges, is very small, as was set out hereinbefore, the piston **46** needs to be displaced over extremely small distances only for creating a change of the grinding pressure. By readjustment of the set screw **76** the magnitude of the gap between the grinding discs **28**, **30** can be increased or decreased as desired. It is easily understood that the piston of the servomotor and the pilot valve operate under mutual actuation on one another to adjust the grinding pressure in response to the magnitude of the grinding gap.

The wedge-formed member **92** and the members cooperating with said member have as their object to compensate for the compressions and stretches, respectively, which appear in the apparatus parts transmitting the grinding pressure. As during the grinding operation a pressure is exerted on the piston of the servomotor in a direction towards the stationary grinding disc **30**, the apparatus parts participating in the pressure transmission will be compressed, while an elongation or stretching will take place in those parts of the base **10**, which are located between this grinding disc and the casing **40** of the servomotor. This compression and elongation amount, as already stated, to many times the size of the grinding gap. The elongation causes the casing of the pilot valve **45** to be displaced to the left. The effect of the compression and the elongation is thus accumulated with regard to the change of position between the set screw **76** and the valve casing **45**. When the parts exposed to pressure are compressed, the set screw **76** is evidently moved to the right in FIG. 1. Without the cam member **92** the piston **46** of the pilot valve due to this change of position would choke the connection between the pressure chamber **52** and the space **69** and in corresponding degree open the connection between the pressure chamber and the pressureless chamber **56**, so as to cause a reduction of the pressure in the chamber **70** of the servomotor, whereas in the chamber **67** of the servomotor the result would be reversed.

It will be easily understood from these explanations that if the gap between the grinding discs tends to increase an increased pressure is produced in the space **69** of the pilot valve. This increased pressure is transmitted through the pipe **86** to the cylinder **80** so as to cause its piston **82** to be displaced downwards. As a consequence the cam member **92** is also moved downwards and thereby admits a displacement of the piston **46** of the pilot valve to the left. This displacement is dimensioned so as to correspond to the compression of the apparatus parts exposed to pressure and the elongation or stretching of the parts subjected to drawing stresses. In this way the piston **46** can be kept in such a position in relation to the casing of the pilot valve that the pressure acting in the chamber **70** of the servomotor is the pressure required for the performance of the grinding operation with the desired and predetermined grinding gap. The axial position of the piston **46** is thus governed not only by the set screw **76** but also by the cam member **92** and the total effect of their actions is to pay attention also to the compression and elongation in the apparatus.

FIG. 2 shows an embodiment with a mechanically operating device for compensation of the compression and the elongation in the apparatus. Rigidly secured to the casing **32** is a bracket **96** in which one end of a rod **98** is pivotable about a pivot **100**. The other end of the rod is connected to a pivot **101** on a link **102** which is mounted on the pivot **103** in a bracket **104** rigidly secured onto the outer bearing casing **24** integral with the casing **40** of the servomotor on one hand, and on a pivot **106** of the casing **45** of the pilot valve. The bar

98 has a length approximately corresponding to the length of that part of the base of the apparatus which is subjected to elongation due to the action of the grinding pressure. The pivot 101 of the bar 98 is located between the pivots 103 and 106 and causes the arm 102 due to the elongation to turn clockwise according to FIG. 2, relatively to the bracket 104. The casing 45 of the pilot valve is thus displaced to the right. The length of the levers represented by the spacing between the pivots 101 and 103 at the one hand and the pivots 103 and 106 is determined so as to take into consideration also the compression in those parts which transmit the grinding pressure from the piston 42 of the servomotor to the casing 32 and which in accordance with the explanation above cause a displacement of the set screw 76 in the right-hand direction in the figure. The casing 45 of the pilot valve will in other words take such a position in relation to the piston 46 of the pilot valve adjacent the set screw 76 as if no compression nor elongation had taken place. Otherwise, the hydraulic system operates in the same manner as described hereinbefore in connection with FIG. 1.

In the embodiment according to FIG. 3 the piston 42 of the servomotor cooperates with a stationary stop which in a manner known per se determines the minimum of the width of the grinding gap existing between the grinding discs 28 and 30. According to the figure said stop consists of a ring 110 screwed onto the part of the piston of the servomotor projecting out of the casing 40. The piston of the servomotor cannot be moved more towards the rotationally stationary grinding disc than until the ring 100 bears against the end face 112 of the motor casing 40. The ring 110 is to determine the width of the grinding gap to assume a desired value.

In this embodiment there is no pilot valve. Instead the chambers 67 and 70 of the servomotor have pipes 112 and 114 respectively, opening thereinto and adapted to become connected by means of a multi-way valve 116 with one or the other of two pipes 118, 120, respectively, of which the former opens to the pressure side of the pump 62 and the latter into the sump 60. In the position of valve 116 shown in the FIG. 3 the pressure pipe 118 is in connection with the pipe 114. The chamber 70 of the servomotor is thus under pressure, while the chamber 67 is over the valve 116 connected to the return pipe 120 and without pressure. By turning the valve by 90° the pressure fluid is instead fed into the chamber 68, whereas the chamber 70 becomes pressureless.

The ring 110 is on its external face provided with teeth engaging a gear 122, carried on a shaft 124 of an electric motor 126. Provided on the casing 32 is an elongation meter 128 at a place subjected to elongation due to the action of the grinding pressure produced between the grinding discs. This meter is in a manner known per se of such type as to have its electrical resistance to vary with its length. The elongation meter is connected to a relay 130 which amplifies the impulses emitted the meter and transmits them to the electric motor 126 through a wire 132. The elongation meter thus sends impulses to the electric motor 126 in response to the changes in elongation corresponding to variations of the grinding pressure. If the gap between the grinding discs is increased due to an increased supply of material to be ground and as a consequence the elongation and compression in the apparatus parts are increased also, the elongation meter 128 causes the electric motor 126 to operate and to turn the ring 110 so as to become unscrewed, i.e. towards the left in the figure.

The rotating grinding disc 28 is thus capable of maintaining that position relative the stationary grinding disc 30 which corresponds to the width of the determined minimum gap. On a reduction of the elongation, as a consequence of a reduction of the grinding pressure the motor screws the ring 110 in the direction towards the casing 40 of the servomotor so as even now to produce a compensation and under all circumstances to prevent metallic contact between the grinding discs.

While several more or less specific embodiments of the invention have been shown and described, it is to be understood that this is for purpose of illustration only, and that the invention is not to be limited thereby, but its scope is to be determined by the appendant claims.

What we claim is:

1. In a grinding apparatus for treatment of fibrous material comprising a rotatable and non-rotative grinding member, of which the former includes a shaft supporting said rotatable grinding member and axially displaceable by means of a servomotor piston adapted to be actuated from both sides by a fluid for adjusting the spacing between said grinding members and for producing a grinding pressure between the same, means to actuate the piston of the servomotor, said means being adapted to cause a displacement of the rotatable grinding member relative the grinding member in response to compression and elongation, respectively, produced depending on the grinding pressure, in the pressure transmitting parts of the apparatus so as to keep the gap between the grinding members at a predetermined value.

2. In a grinding apparatus as claimed in claim 1, a part of electric elongation meter disposed on an apparatus exposed to elongation, a motor actuated by said elongation meter and a driving mechanism connected with said motor and adapted on actuation by an impulse from said elogation meter to displace the piston of the servomotor relatively to the casing surrounding said piston in response to the elongation or compression produced in the apparatus.

3. In a grinding apparatus as claimed in claim 1, conduits on each of both sides of said servomotor piston in connection through a pilot valve with a pressure source and with an outlet, respectively, the pilot valve having a stationary cylinder and a movable piston which are displaceable in relation to one another for adjustment of the grinding pressure exercised by said servomotor piston in response to the relative position between said piston and a base part of the apparatus exposed to elongation, the apparatus further comprising an element adapted to counteract a change in the relative position of the parts of said pilot valve caused by the compression and elongation produced in said base.

4. In a grinding apparatus as claimed in claim 2, adjusting means adapted to determine the position of the movable piston of the pilot valve, said adjusting means being connected with the piston of the servomotor and adjustable for alteration of the mutual position of said movable pilot valve piston and said servo-motor piston.

5. In a grinding apparatus as claimed in claim 3, said element being disposed to be under actuation by a pressure difference of the fluid created in the pilot valve for causing a displacement of the movable piston of said pilot valve relative to the servomotor piston so as to correspond to the displacement caused by the compression and elongation of the piston relative to the surrounding casing of the servomotor but in a direction opposite to said displacement.

6. In a grinding apparatus as claimed in claim 2, the pilot valve having its piston movable in relation to its cylinder but stationary in relation to the piston of the servomotor, said cylinder being stationary in relation to a place located on the base of the apparatus adjacent the stationary grinding member.

7. In a grinding apparatus as claimed in claim 4, said element having the form of a cam-like member determining the position of the piston of the pilot valve relative to said adjusting means and being displaceable by means of a piston-like member located in a casing in response to the pressure exercised by the fluid on the piston of the servomotor, said cam-like member having a surface formed so as to cause the spacing between said adjusting means and the piston part of said pilot valve

to be corrected in correspondence to the compression and elongation produced in the base of the apparatus.

8. In a grinding apparatus as claimed in claim 6, said cylinder of the pilot valve being connected with said place located on the base of the apparatus through a bar and a gear so as to cause the relative displacement of said cylinder relative to the piston part of the pilot valve to increase more than the valve corresponding to the elongation and thus also includes a change of position of the piston of the servomotor due to the compression of the apparatus parts exposed to pressure.

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J. SPENCER OVERHOLSER, *Primary Examiner.*