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GRINDING APPARATUS PRIMARILY FOR LIGNOCELLULOSE CONTAINING MATERIAL

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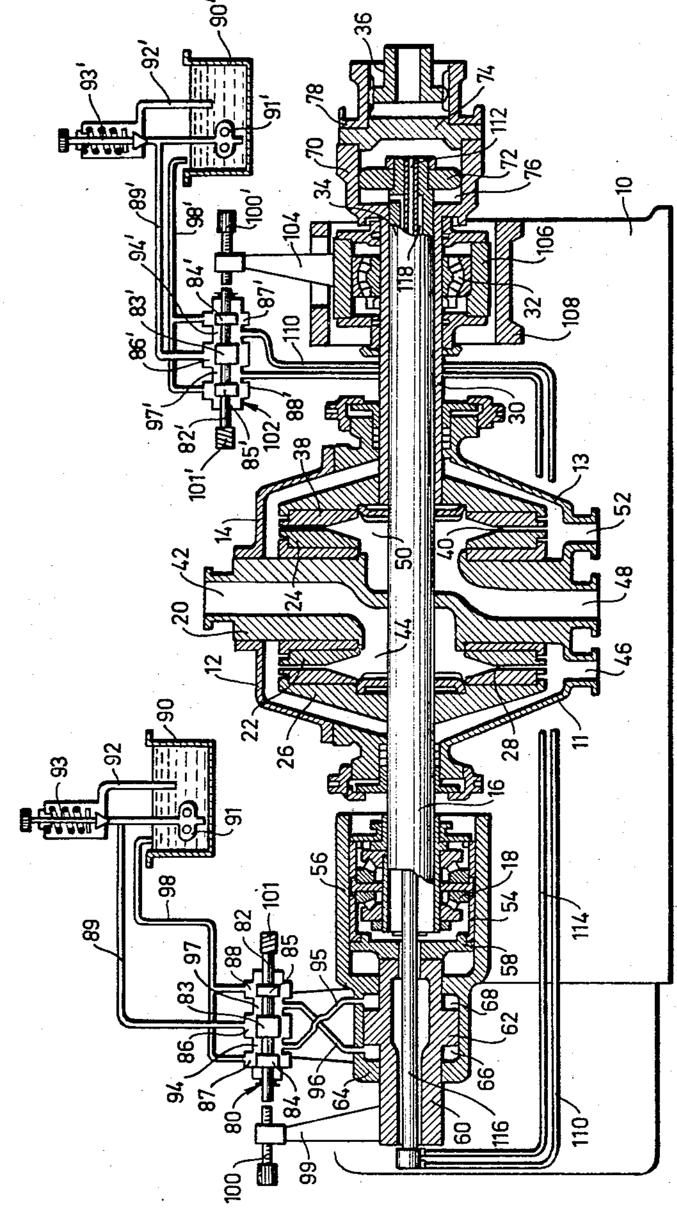


Fig. 1

INVENTORS:
ARNE JOHAN ARTHUR ASPLUND
ROLF BERTIL REINHALL
JOHAN GUNNAR INGE JOHANSSON

Fig. 2

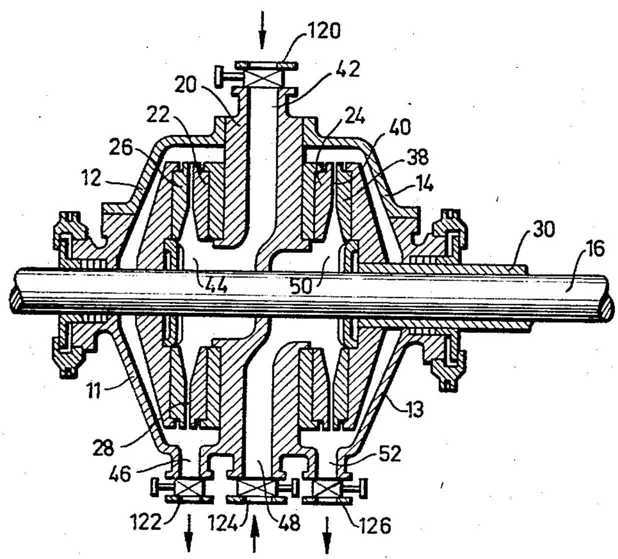
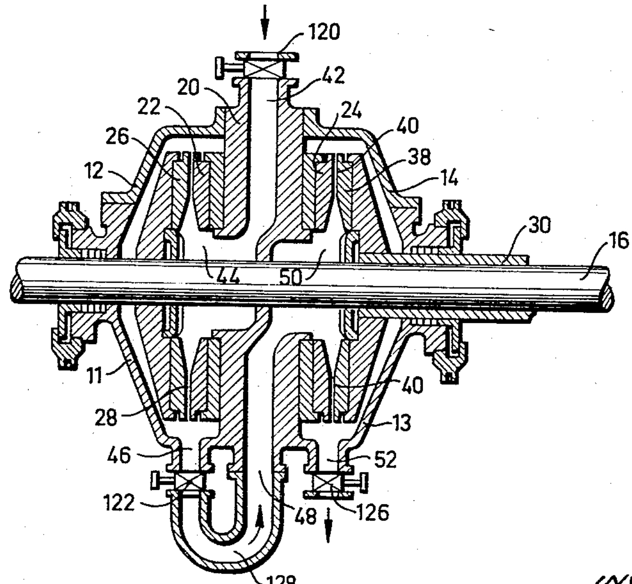


Fig. 3



INVENTORS
Arne Johan Arthur Asplund
Rolf Bertil Reinhall
JOHAN GUNNAR Inge Johansson
By [signature]
Attorney

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1

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GRINDING APPARATUS PRIMARILY FOR LIGNOCELLULOSE CONTAINING MATERIAL

Arne Johan Arthur Asplund and Rolf Bertil Reinhall, Lidingo, and Johan Gunnar Inge Johansson, Nasbypark, Sweden, assignors to Defibrator Aktiebolag, Stockholm, Sweden, a corporation of Sweden

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This invention relates to grinding apparatus.

More particularly this invention relates to a grinding apparatus, primarily intended for lignocellulose containing material and provided with two rotatable grinding discs disposed within a casing and each co-operating with a stationary grinding disc, inlet and discharge channels for the material to be treated being provided in the casing for each pair of co-operating grinding discs.

A grinding apparatus of this type can be given the double capacity compared with that of an apparatus with one pair only of co-operating grinding discs.

One main object of the invention is to provide an improvement of this type of grinding apparatus, denominated also as "double grinders" so as to permit to adjust the two pairs of grinding discs to the same or different grinding pressures irrespective of whether the channels or the paths of flow pertaining to them are coupled in parallel or in series.

A further object of the invention is to provide an improvement of the grinding apparatus in consideration, which renders possible an adjustment of the grinding pressure between the two pairs of grinding discs from a position where only one pair is in operation to a position where both pairs are loaded equally, and to all conceivable intermediate positions between said limits.

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 the specification and of which:

FIG. 1 is a vertical longitudinal section through a grinding apparatus constructed according to the invention.

FIG. 2 is a sectional view of the central part of the apparatus with the paths of flow pertaining to the pairs of grinding discs coupled in parallel to one another.

FIG. 3 is the same sectional view but with the paths of flow disposed in series.

Referring to the drawings, reference numeral **10** denotes a stationary base structure of the apparatus to which horizontally divided casings or housings **11**, **12** and **13**, **14** respectively, are connected. A shaft **16** passes through the casings and is at its one end mounted in a bearing **18** which preferably is of anti-friction or roller type and which is capable of absorbing beside radial thrust, also axial thrust in both directions. The two casings are separated from one another by a part **20** of the base structure **10**, which on either side supports a stationary grinding disc **22**, **24**, respectively. Rigidly secured to the shaft **16** is a grinding disc **26** rotating with said shaft and which together with the stationary disc **22** forms a grinding interspace **28**, through which the material to be disintegrated therein is passed in an upward direction.

The shaft **16** on the opposite side of the casings **11**, **12** and **13**, **14**, viewed from the bearing **18**, is concentrically surrounded by a tubular shaft **30** which is slidably supported by a radial thrust bearing **39**, preferably a spherical roller bearing. Disposed between the shafts **16** and **30** are splines **34** so that said shafts are axially displaceable relatively to one another but rotate together, the outer shaft through a coupling **36** being connected to a driving motor (not shown). The shaft **30** carries a grind-

2

ing disc **38** rigidly anchored thereon and co-operating with the stationary grinding disc **24**, a grinding interspace **40** being formed therebetween and through which the material to be treated is passed in a radial outward direction whereby this material becomes finely divided or disintegrated.

The material to be ground is supplied to the pairs of grinding discs **22**, **26** through a channel **42** which may extend in the base part **20** to a central space **44** adjacent the inner faces of said grinding discs. The pulp ground between them is discharged through a channel **46**. In the same manner, the other pair of grinding discs **24**, **38** has a supply channel **48** in the base part **20** which opens into a space **50** formed centrally inside said grinding discs. The pulp ground between said discs is discharged through a channel **52**. The channels **46**, **52** are located in the casings **11**, **12** and **13**, **14** enclosing the grinding discs.

The parts of the radial and axial thrust bearing **18** not participating in the rotation are enclosed by a ring member **54** formed with a cylindric external face which is axially slidable on a corresponding formed face of a casing **56** rigidly secured onto the base structure **10**. Connected to the ring member **54** is a disc **58** and to the latter a servo-motor piston **60** which has an outer annular flange **62** adapted to be displaced axially within a prolongation **64** of the casing **56**. Formed on either side of the flange **62** is a chamber **66**, **68** respectively adapted to be connected to a pressure source or an outlet in a manner to be described later more in detail.

The supply of pressure fluid to the servo-motor **60**, **64** is controlled by a pilot valve generally denoted **80** and of the type known per se as is disclosed, for instance, by the patent specification No. 2,997,704. The pilot valve **80** is rigidly connected with the prolongation **64** of the casing **56** of the servo-motor **60**, **62**. The pilot valve includes a piston or valve body **82** formed with a central flange **83** and two lateral flanges **84**, **85**. The pilot valve **80** has a central chamber **86** and two lateral chambers **87**, **88**. Between the two lateral chambers **87**, **88** and the central chamber **86**, the inner diameter of the valve housing is reduced to correspond to the external diameter of the flanges. The flange **83** has an axial dimension which, by a small unit of measure, such as of one hundredth or a few hundredths of one millimetre, is shorter than the length of the chamber **86**. In the same manner the flanges **84**, **85** have an axial dimension which is only slightly less than the length of the chambers **87**, **88**. In the middle position all flanges are positioned right in front of their pertaining chambers.

A pipe **89** connects the central chamber **86** of the pilot valve with an oil sump **90**, a pump **91** being provided in this pipe and a spring-loaded valve **93** in a return pipe **92** connected to said pipe **89**. From a space **94**, having the reduced diameter corresponding to that of the flanges of the valve body **82** and located between the chambers **86** and **87** of the pilot valve **80**, a pipe **95** extends to the chamber **68** on one side of the flange **62** of the servomotor. A pipe **96** connects a space **97** with the same reduced diameter of the pilot valve located on the other side of the central chamber **86** with the chamber **66** on the opposite side of the flange **62**. Through a return pipe **98** the lateral chambers **87**, **88** are in open connection with the sump **90**.

An adjustment screw **100** is passed through a threaded passage in an arm **99** fixed to the servo-motor piston **60**, said adjustment screw being coaxial with the valve body **82** of the pilot valve and adapted to act on the facing end of said valve body projecting from the valve casing. The other end of the valve body **82** is under the load of a spring member **101** tending always to keep the valve body pressed against the adjustment screw **100**.

Another pilot valve **102** has for its object to control the supply of pressure fluid to the servo-motor **70, 72**. This pilot valve is of the same construction as the pilot valve **80**. In FIG. 1 the same reference numerals have been used for both servo-motors with the addition of a suffix for the pilot valve **102**. The casing thereof is fixed in the base structure **10**. The arm **104** carrying the adjustment screw **100** is fixed in a ring member **106** surrounding the non-rotating part of the bearing **32**. The ring member **106** is axially displaceable within a surrounding stationary outer casing **180** and due to this feature follows the shaft **30** in the axial movements thereof.

Extending from the chamber **94¹** of the pilot valve **102** is a pipe **110** which is extended to the outer end of the hollow servo-motor piston **60** and here connected to a pipe **112** extending through the piston **60** and the shaft **16** to the chamber **78**.

As shown in FIG. 2 the grinding apparatus may be adjusted so that the both pairs of grinding discs **22, 26** and **24, 38**, respectively, operate in parallel with two fractions of pulp or material to be ground. The one fraction or stream of pulp is introduced through the channel **42** and the chamber **44**, and passes radially outwards between the grinding discs **22, 26** while a disintegration of fibre bundles or fibres is effected. The ground pulp is discharged through the outlet **46**. The other fraction or stream of pulp passes through the channel **48**, the chamber **50**, and the interspace between the discs **24** and **38** and is discharged through the outlet **52**. In the two fractions the quality of the material to be treated may be different prior to and/or after the grinding operation depending on the conditions. Disposed in the inlet and outlet channels may be locking and/or controlling or regulating valves **120, 122, 124** and **126**.

The two pairs of grinding discs may also operate in series which means that they may be passed by the same stream of material to be treated in the apparatus. For this purpose the channel **46** is connected with the supply channel **48** by means of a connecting pipe branch or coupling **128**, the valve **124** and possibly also the valve **122** being dispensed with. After the pulp fed through the channel **42** has been subjected to a grinding treatment in a first step between the discs **22, 26**, it is conveyed over to the internal space between the second pair of grinding discs **24, 38** where a grinding treatment in a second step is carried out on the pulp which then will be discharged through the channel **52**.

According to the invention, it is possible in both cases to adjust the pressure in the interspace between the two pairs of discs **22, 26**, and **24, 38** respectively, or the width of the interspaces **28, 40** within the widest limits by means of the two servo-motors. Assuming that the piston **82** of the pilot valve **80** takes such position that pressure fluid is supplied through the pipe **96** to the chamber **66**, the servo-motor piston **60** will then produce over the disc **58**, the ring member **54**, the axial thrust bearing **18** and the shaft **16**, a pressure, which will urge the disc **26** towards the stationary disc **22**. If, on the other hand, the pressure fluid is fed through the pipe **95** into the chamber **68**, pressure thus produced will urge the disc **38** in a direction towards the disc **24**. If the piston **82¹** of the pilot valve **102** takes such a position that the pressure fluid is supplied through the pipes **114, 116, 118** to the chamber **76** and the second servo-motor, the shaft **16** will be displaced to the right and the shaft **30** to the left viewed in the plane of FIG. 1, which implies that the two grinding discs **26, 38** are urged in a direction towards the respective stationary discs **22** and **24**. The pressure becomes equally great in the two interspaces **28, 40** and is otherwise absorbed within the rotating system and the stationary central base part **20** of the base structure. The axial thrust bearing **18** is totally relieved from thrust. By supplying pressure fluid to the chamber **78** of the servo-motor **70, 72** both rotating grinding discs are displaced in a direction away from their respective stationary discs.

The axial positions of the shafts **16, 30** and, consequently the width of the interspace **28, 40**, are regulated by adjusting the pistons **82, 82¹** relatively to the stationary casing of the pilot valves **80, 102**, which in the embodiment shown, is effected by means of the adjustment screws **100, 100¹**, respectively. When the predetermined grinding interspace prevails, the pistons **82, 82¹** of the two pilot valves assume an intermediate position. With regard to the servo-motors **60, 64**, this results in that the same pressure prevails in the two chambers **66, 68**. If the interspace **28** between the discs **22, 26** is increased due to, for instance, increased supply of material to be ground, the piston **60** of the servo-motor is forced to the left, as will be easily understood, thus moving the arm **99**. The valve piston **82** follows with the servo-motor piston due to action of the spring **101**. The chamber **97** is now connected with the chamber **86**, which latter is under the pressure created by the pump **91**. Instead, the pressure in the chamber **68** of the servo-motor drops as a consequence of a communication being established in the pilot valve between the portion **94** and the chamber **87** which is without pressure. The result will be that the servo-motor piston **60** is subjected to a pressure forcing it to the right, causing the disc **26** to be moved closer to the disc **22** and thus the predetermined width of the interspace **28** will be restored.

If, instead, the shaft **16** is displaced to the right, for instance, due to the stream of pulp passing through the interspace **28** being reduced for some reason, the pilot piston **82** is moved in the same direction. The result will be that pressure fluid is forced from the pump **98** through the chambers **86, 94** to the chamber **68** of the servo-motor **60, 64**. The shaft **16** moves now to the left so that a metallic contact between the grinding discs is avoided.

The description applies also to the pilot valve **102**. The pilot piston **82¹** follows the axial movements of the shaft **30** through intersection of the arm **104**, the ring member **106** and the bearing **32**. At the displacement of the shaft **30** and together therewith the piston **82¹** to the right, pressure fluid is fed from the pump **91¹** through the pipe **89¹**, the chambers **86¹, 97¹**, and the pipes **114, 116** and **118** to the chamber **76** in the servo-motor casing **70**. On the other hand the pressure in the chamber **78** drops. In this way a pressure difference is created which restores the balance. At the movement to the left of the shaft **30**, the piston **82¹** opens connection between the chambers **86¹, 94¹**, whereas the chamber **97¹** is brought into communication with the non-pressurized chamber **88¹**, whereby the shaft is caused to return to predetermined position.

It is easily understood that by adjustment of the adjustment screws **100, 100¹** all conceivable values for the grinding pressure between the two pairs of grinding discs can be created from only one pair being loaded until both are loaded equally. In the same manner the grinding pressures can be varied in response to all demands set forth regarding the grinding effect.

While one more or less specific embodiment of the invention has 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 appended claims.

What we claim is:

1. A grinding apparatus, primarily intended for lignocellulose containing material and provided with two rotatable grinding discs disposed within a casing and each co-operating with a stationary grinding disc, inlet and discharge channels for the material being provided in the casing for each pair of co-operating grinding discs, and a base structure for said apparatus; characterized in that each of the rotating discs is supported by a shaft of which shafts one is positioned concentrically around the other shaft and which shafts both are displaceable axially under the action of pressure fluid actuated servo-motors.

2. A grinding apparatus as claimed in claim **1**, characterized in that one of the servo-motors has a piston carried by the one shaft and a casing carried by the other shaft in which casing the piston is axially displaceable and into which conduits open for supply of pressure fluid to either side of the piston.

3. A grinding apparatus as claimed in claim 2, characterized in that the shaft carrying the piston is at its opposite end, through an axial thrust bearing which is mounted axially movable in the base structure, connected with the piston of the other servo-motor, the casing of which is fixed to the base structure and has conduits opening on either side of the last-mentioned piston for supply of pressure fluid to both sides of the piston.

4. The grinding apparatus as claimed in claim 1, characterized in that the two servo-motors are disposed to be actuated each by a pilot valve of a type known per se and controlling the supply of pressure fluid to both sides of the servo-motor in response to the magnitude of the interspace between the grinding discs.

5. The grinding apparatus as claimed in claim 1, characterized in that the casings are formed for application of the channels in parallel relation to, or by attachment of a socket, in a series with one another.

6. A grinding apparatus, primarily intended for lignocellulose containing material and provided with two rotatable grinding discs disposed within a casing and each cooperating with a stationary grinding disc, inlet and discharge channels for the material being provided in the casing for each pair of cooperating grinding discs, a base structure for said apparatus; characterized in that the said rotatable discs are supported by separate shafts, one of said shafts being positioned concentrically around the other shaft, said shafts being rotatable in one and the same direction, and being displaceable axially under the action of two servo-motors, one of said servo-motors being adapted to actuate both rotatable grinding discs simultaneously and in opposite directions, the other servo-motor being adapted to actuate only one of said grinding discs.

7. A grinding apparatus as claimed in claim 6, characterized in that one of the servo-motors has a piston carried by one of the shafts and a casing carried by the other shaft in which casing the piston is axially displaceable and into which conduits open for supply of pressure fluid to either side of the piston, said first mentioned shaft being at its opposite end, through an axial thrust bearing which is mounted axilaly movable in the base structure, connected with the piston of the other servo-motor, the casing of which is fixed to the base structure and has conduits opening on either side of the last-mentioned piston for supply of pressure fluid to both sides of the piston.

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ANDREW R. JUHASZ, *Primary Examiner.*