Feb. 20, 1973 R. B. REINHALL 3,717,308

# GRINDING APPARATUS FOR FIBROUS MATERIAL

Original Filed July 5, 1969 2 Sheets-Sheet 1

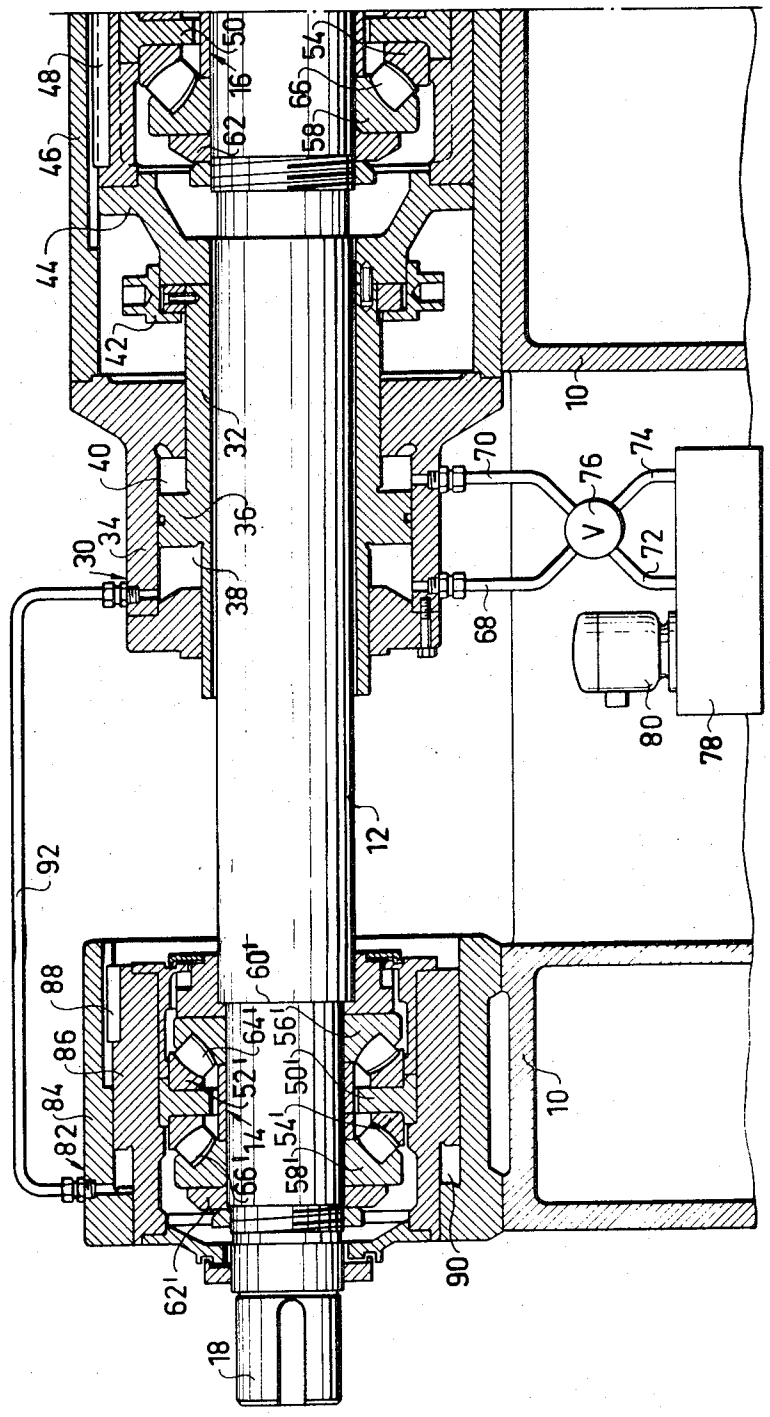



Fig.1

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# GRINDING APPARATUS FOR FIBRUOS MATERIAL

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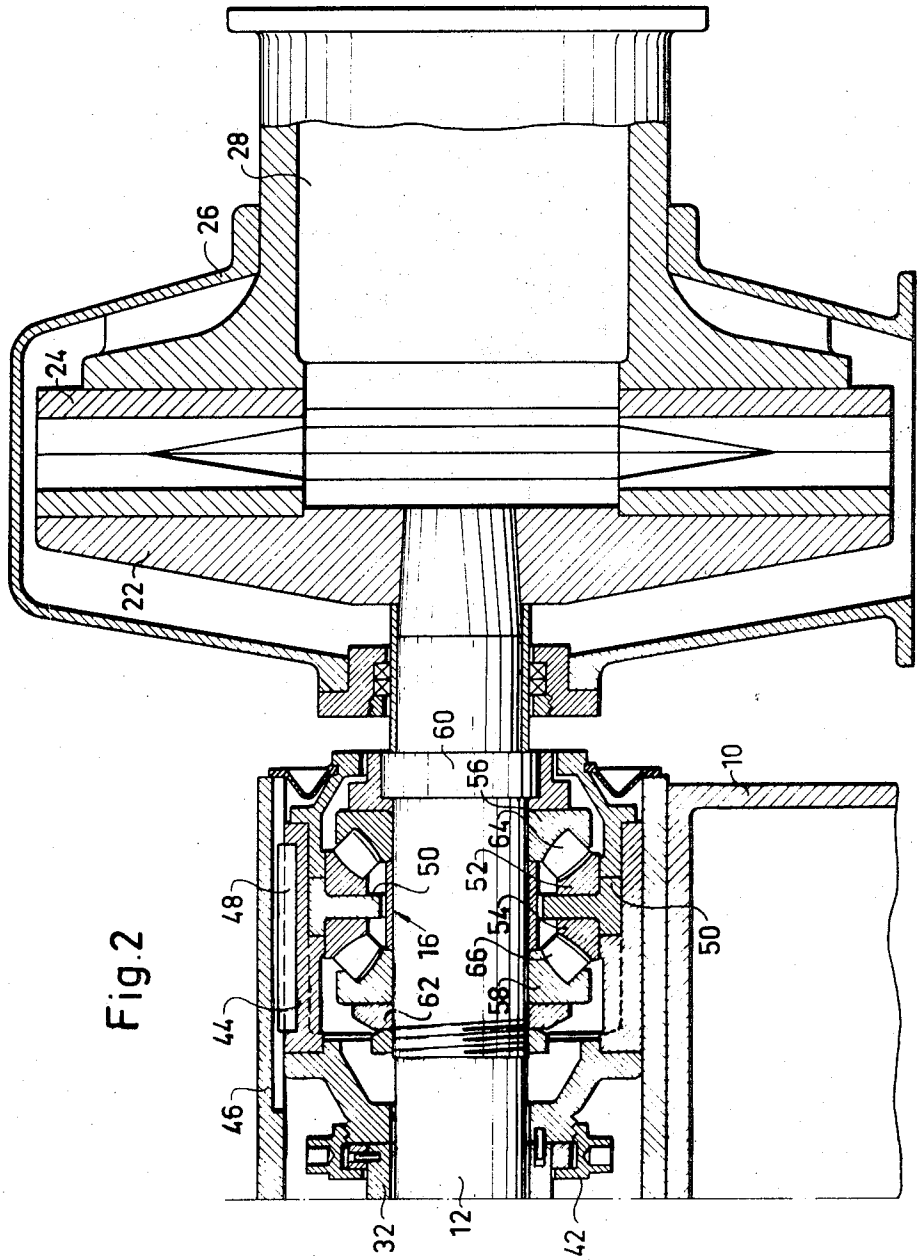



Fig.2

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3,717,308

# GRINDING APPARATUS FOR FIBROUS MATERIAL

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Continuation of abandoned application Ser. No. 830,641, July 5, 1969. This application Mar. 6, 1972, Ser. No. 231,946

Int. Cl. B02c 7/06; F16c 41/02

U.S. Cl. 241—244 2 Claims

## ABSTRACT OF THE DISCLOSURE

Grinding apparatus for fibrous material comprising a pair of grinding discs, at least one of which is carried by an axially displaceable shaft supported in two spaced combined radial and axial thrust bearings, each being associated with a servomotor for providing the axial displacement, one of the servomotors being operative to augment the grinding pressure exerted on the grinding discs by the other servomotor and to minimize bearing play in a radial direction.

## BACKGROUND OF THE INVENTION

This application is a continuation of application Ser. No. 830,641, filed July 5, 1969, now abandoned.

This invention relates to improvements in grinding apparatus such as defibrators or refiners for treating lignocellulose containing material, of the type comprising two grinding discs rotatable relatively to one another, of which discs at least one is supported by a rotatable shaft and by means of a non-rotating—first—servomotor composed of a piston and a causing, for example, and through an axial thrust bearing is axially displaceable relatively to the other grinding disc for creating a grinding pressure between the grinding discs. As such grinding apparatus are built with steadily increasing disc diameters and grinding surfaces and in some cases a plurality of grinding members are mounted on the same shaft it has become increasingly difficult to find axial thrust bearings which are capable of absorbing the more and more increasing strains on the same. This has resulted in that in modern grinding apparatus the load limit values for axial thrust bearings available in the market are utilized almost totally. A further increase of the grinding pressure in the apparatus and therewith the axial loads will result in shorter life-time of the axial thrust bearings with shorter intervals caused thereby between necessary replacing of bearings. Also the safety of operation is endangered.

One main object of the invention is to eliminate said inconvenience by providing a grinding apparatus of the type set forth the shaft of which according to one main feature of the invention is devised simultaneously to be actuated by at least one additional, non-rotatable—second—servomotor co-acting with its own axial thrust bearing.

Another object of the invention is to provide a grinding apparatus of the type in consideration, which has the grinding pressure acting on the shaft distributed on a plurality of servomotors with a reduction resulting thereof of the axial load on each of the individual combined axial and radial thrust bearings of the servomotors.

A further object of the invention is to provide a grinding apparatus permitting the maximum pressure acting on the grinding disc shaft to be increased in response to the capacity of the second servomotor or servomotors without reducing the life-time of the axial thrust bearings.



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.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 show together a vertical axial sectional view of a grinding apparatus constructed according to the invention.

## DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawings, reference numeral **10** denotes the base frame of the apparatus in which a shaft **12** is mounted in two bearings generally denoted **14** and **16**. At its one end the shaft **12** is adapted to be coupled to a driving motor (not shown). At its opposite end the shaft bears a grinding disc **22** and is together with the same axially adjustable relatively to a stationary grinding disc **24**. The grinding discs **22, 24** are encased by a grinding casing **26** and the material to be ground is introduced through a central axial channel **28** to be guided outwardly and treated by grinding surfaces formed on the sides of the grinding discs facing one another in a manner known per se which thus will not be described more in detail. Concentrically with, and around, the shaft **12** adjacent the grinding disc **22** is mounted a servomotor referred to as the first here also called the primary servomotor, generally denoted **30** and preferably consisting of a cylindrically shaped piston **32** which is axially displaceable but not rotatable within a stationary housing **34**. The piston **32** has a flange **36**, which subdivides a cylindrical space formed in the casing **34** into two chambers **38, 40**, separated from one another.

By means of a coupling **42** the piston **32** is rigidly secured to the casing **44** of the bearing **16**, said casing being axially slidable within an external casing **46** supported by the base frame **10**, but is prevented from rotating relatively to this latter by means of a spline or some other adequate coupling means **48**.

Mounted in the bearing casing **44** is a central bearing element **50** housing two non-rotating bearing rings **52, 54**. Fixed onto the shaft **12** are two bearing rings **56, 58** rotatable with the shaft but axially fixed on said shaft between a flange **60** and a screw cap **62**. The bearing rings are formed with inclined rollerways facing one another for rollers **64, 66**. It will be easily understood that the bearing **16** is capable of transferring axial pressure in both directions and also to absorb radial load from the shaft.

A hydraulic pressure fluid such as oil can be fed into the chambers **38, 40**, respectively, of the servomotor **30** through associated conduits **68, 70**, respectively. Said conduits **68, 70** as well as conduits **72, 74** are connected to a valve **76**. The conduits **72, 74** are connectable to either an oil sump **78** or a pump **80** which produces required working pressure. When pressure liquid is fed into the chamber **38**, the piston **32** will be displaced to the right in the figure and therewith the rotating grinding disc **22**

in a direction towards the stationary grinding disc **24**. Then the chamber **40** is free from pressure. By adjustment of the valve **76** pressure fluid can instead be fed into the chamber **40** whereas the chamber **38** is connected with the oil sump **78** whereby the grinding disc **22** is advanced in a direction away from the grinding disc **24**. Servomotors of this kind are known from applicants U.S. Pat. No. 2,964,250, for example. The valve **76** is adjusted manually or by automatic actuation in a manner known per se.

In accordance with the invention in addition to the first servomotor **30**, a second servomotor **82** is disposed about the shaft more remote from the grinding disc assembly, which secondary servomotor comprises an outer casing **84** rigidly secured onto the base frame **10** and a piston **86** which is arranged in said casing and suitably concentrical with and around the bearing **14**. This bearing **14** may principally be of the same type as the bearing **16** and its individual parts have been given the same reference numeral, but with a prime indicia added thereto. The bearing **14** replaces the radial thrust bearing which otherwise would be required for supporting the shaft **12** at its rear end remote from the grinding discs.

The piston **86** forms preferably also part of the casing fo the bearing **14**, which is axially slidable arranged in the stationary outer casing **84** of the servomotor. By means of a spline coupling **88** the piston **86** is prevented from rotating relatively to the casing **84**. The servomotor **82** may be constructed in the same manner as the servomotor **30**, but most suitably it has one pressure chamber **90** only, which through a conduit **92** is connected with the pressure chamber **38** of the servomotor **30**. When presure fluid is fed to the last-mentioned chamber through the conduit **68** from the pump **80** this pressure will become active in the pressure chamber **90** which will result in that the two servomotor pistons **32**, **36** are subjected to an axial force which through the bearings **16** and **14**, respectively, is transferred to the shaft **12** and further to the grinding disc **22**.

Participating in this transfer of power with regard to the servomotor **30** are the piston **32**, the bearing casing **44**, the bearing element **50**, the bearing ring **52**, the roller **64**, the bearing ring **56** and the shaft flange **60**. The servomotor **82** and the bearing **14** become operative in the same manner with regard to the power transfer to the rotating shaft **12**. For attaining a predetermined required grinding pressure between the grinding discs **22**, **24** the loads on the individual bearings are thus reduced in accordance with the invention. For this reason one can construct grinding apparatus and grinding discs which can be exposed to higher grinding pressures than had been possible hitherto with regard to the maximum of permitted loads on the axial thrust bearing.

The power required to advance the grinding disc **22** in a direction away from the grinding disc **24** is, of course, substantially less than that required to produce a desired grinding pressure. Therefore, it is not necessary to provide the second servomotor **82** with double pressure chambers. Furthermore, the chamber **40** may include a smaller flange area on which the oil pressure is active than the chamber **38**. The axial pressure exerted by each of the servomotors **30**, **82**, respectively, may be equally great, or the pressure prevailing in the pressure chamber of the secondary servomotor or motors may be less than that prevailing in the first servomotor. The working pressure of the servomotors may be reduced in inverse proportion to the axial spacing from the rotatable grinding disc **22**.

The control of the oil pressure in the servomotor systems may be effected in known manner by means of hydraulic-electric pilot means or by control pulses resulting from increase in temperature of the pulp suspension or control pulses resulting from qualitative properties of the pulp, such as in the form of dewatering capacity, vacuum on suction rollers of a papermaking machine etc.

The servomotors may, of course, be of other kind than those which work with a pressure fluid.



Since the rear combined axial and radial thrust bearing **14** is under axial load from the servomotor **82**, the extremely valuable advantage is gained that all supporting bearings for the grinding disc shaft are free from play.

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 is claimed is:

**1.** A grinding apparatus for fibrous material comprising:

(a) a pair of grinding discs,
(b) at least one of said grinding discs being carried by a rotatable shaft,
(c) a first combined radial and axial thrust bearing supporting said shaft,
(d) a first servomotor connected to said first thrust bearing and surrounding said shaft and being operative to provide axial displacement of the shaft and the grinding disc carried thereby with respect to the other one of said discs,
(e) said first servomotor comprising a housing and a piston adapted to reciprocate longitudinally therein,
(f) said piston having a flange dividing said housing into two pressure chambers,
(g) means for selectively supplying fluid under pressure to said chambers,
(h) the pressure in one of said chambers being operative to produce a grinding pressure on said discs,
(i) the pressure in the other one of said chambers being operative to release grinding pressure,
(j) a second combined radial and axial thrust bearing supporting said shaft being remote from said first thrust bearing,
(k) a second servomotor associated with said second thrust bearing in fluid connection with the grinding pressure producing chamber of said first servomotor to create an axial thrust on said shaft to augment the grinding pressure exerted on said grinding discs by said first servomotor and to minimize bearing play in a radial direction.

**2.** A grinding apparatus for fibrous material comprising:

(a) a pair of grinding discs,
(b) at least one of said grinding discs being carried by a rotatable shaft,
(c) a first combined radial and axial thrust bearing supporting said shaft,
(d) a first servomotor connected to said thrust bearing and surrounding said shaft and being operative to provide axial displacement of the shaft and the grinding disc carried thereby with respect to the other one of said discs,
(e) said first servomotor comprising a housing and a piston adapted to reciprocate longitudinally therein,
(f) said piston having a flange dividing said housing into two pressure chambers,
(g) means for selectively supplying fluid under pressure to said chambers,
(h) the pressure in one of said chambers being operative to produce a grinding pressure on said discs,
(i) the pressure in the other one of said chambers being operative to release grinding pressure,
(j) a second combined radial and axial thrust bearing supporting said shaft being remote from said first thrust bearing,
(k) a second servomotor comprising a housing and a second piston,
(l) said second piston being operable to move said second thrust bearing,
(m) said housing including a pressure chamber,
(n) means for supplying fluid under pressure to said last mentioned pressure chamber to create an axial thrust on said shaft to augment the grinding pressure

exerted on said grinding discs in addition to the pressure exerted on said grinding discs by the pressure of said first servomotor and to minimize bearing play in a radial direction.

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