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(54) Flexible link disk drive for multiple disk refiner.

(57) A multiple disk refiner (10) which includes a housing (11) having an inlet (12) and an outlet (13) for a fiber suspension passing therethrough. Within the housing (11) there is a plurality of rotary refiner disks (20 to 25) positioned for rotation in the housing (11) and having refiner surfaces for providing a refining action on the fiber suspension as it passes from the inlet (12) to the outlet (13). A second plurality of refiner disks (28, 31, 33, 35, 36, 39) interleaved with the rotary refiner disks (20 to 25) and having refiner surfaces confronting the refiner surfaces of the rotary refiner disks (20 to 25) are positioned to provide narrow working gaps (30, 32, 34, 37, 38, 40) between the sets of disks. In accordance with the present invention, a plurality of flexible links (51, 58) interconnect a drive with the rotary refiner disks (20 to 25) to provide rotational drive to the disks while accomodating axial deflection between the rotary refiner disks (20 to 25) and the drive.

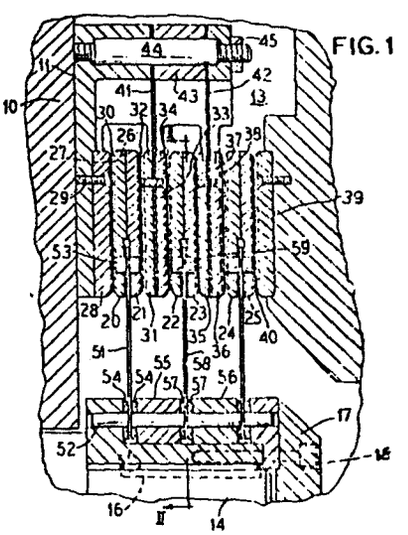

FIG. 1

EP 0 187 611 A2

The present invention is directed to a refining apparatus of the type used in the treatment of fibrous suspensions in paper making and involves a flexible link interconnection between a rotary drive means and refiner disks which provide the refining action.

Paper stock, as it comes from beaters, digesters or other pulping machines is usually refined by passing the stock between grinding or refining surfaces which break up the fibrous materials and serve to create further separation and physical modification of the fibers.

A typical pulp refiner is disclosed in Thomas U.S. Patent No. 3,371,873. This type of refiner includes a rotating disk which has annular refining surfaces on one or both sides. The disk refining surfaces are in confronting relation with non-rotating annular grinding surfaces and provide therebetween a refining zone in which the pulp is worked. The rotating disk and the refining surfaces are made of a substantially inflexible material such as cast iron or a hard stainless steel. The non-rotating grinding surfaces are made of a similar material and are rigidly mounted so as to resist the torque created by the rapidly rotating disk and the pressure on the pulp material passing through the refining zone gap. Axial adjustment of the refining zone gaps is effected by axial shifting of the shaft on which the disk is mounted.

Rigid disk refiners of this type must be manufactured and assembled to close tolerances in order to set the refining zone gap width correctly. Because the loads applied to the rigid disk are large during the refining process, a large and extremely rugged design is necessary so that the refining surface relationships do not change under load. This results in the rigid disk refiners being very costly due to the necessarily close tolerance machining, the need for large quantities of

high-strength disk material, the bulky overall structure, the restrictive machine capacity, and the excessive assembly time requirements.

Substantial improvements in pulp refiners have recently been accomplished with the advent of the multi-disk refiner which operates at a low intensity. For example, in Matthew and Kirchner pending U.S. Serial No. 486,006 entitled "Flexible Disk Refiner and Method", assigned to the same assignee as the present application, there is provided a refining apparatus including a plurality of radially extending, relatively rotatable and axially confronting refining surfaces between which the suspension must pass while being refined during relative rotation of the surfaces. Means are provided for effecting flow of the material radially between and across the surfaces. The particular improvement of that application comprises using resiliently flexible refining surface supporting means which permit adjustment of the relatively rotating refining surfaces axially relative to each other depending upon the operating pressures, thereby attaining optimum material working results from the refining surfaces.

In any low consistency refiner, several rotating refining disks are driven from a common central drive hub. During operation, the disks must be free to float back and forth axially by a matter of several millimeters. Usual methods of providing axial freedom are subject to blockage and binding by accumulations of pulp fibers from the slurry which surrounds the rotating disks. In the aforementioned co-pending application, there was disclosed a thin, fiberglass laminate diaphragm which has sufficient axial flexibility to permit disk movement but is torsionally strong enough to transmit the desired levels of rotational power. However, after the diaphragms have been in operation for

a relatively short period of time, the various openings present in the diaphragms for purposes of slurry flow and for promoting axial flexibility become enlarged due to the abrasive nature of the particles in the slurry. The enlargement of these openings eventually contributes to failure at the laminate diaphragms.

The present invention provides a refiner assembly utilizing a multiple array of disks. One set of disks may be rotating and the other stationary, or both sets may be rotating in opposite directions. The sets of disks are located in a housing which has an inlet and an outlet for a fiber suspension passing therethrough. Drive means are provided for rotating one or both sets of disks in the housing. The two sets of disks have refining surfaces which confront each other to provide a slight working gap therebetween into which the fiber suspension is passed as it goes from inlet to outlet. In accordance with the present invention, a plurality of flexible links are provided which interconnect the drive means with the rotary refiner disks to provide rotational drive to the rotary refiner disks while accomodating some axial deflection or floating in the axial direction.

In the preferred form of the invention, means are provided for pivotally connecting one end of each link to the drive means, while the opposite ends of the links are received about pivot pins so as to provide for limited pivotal movement thereabout. The pivot pins extend between oppositely facing pairs of the rotary refiner disks.

In the preferred arrangement, there are at least two pairs of the flexible links in quadrature with each other.

A further description of the present invention will be made in conjunction with the attached sheet of drawing in which:

Figure 1 is a fragmentary view of a multi-disk refiner embodying the improvements of the present invention,

Figure 2 is a partial cross-sectional view taken substantially along the line II-II of Fig. 1, and

Figure 3 is a fragmentary view partly in cross section and partly in elevation illustrating somewhat diagrammatically the manner in which the flexible links are capable of flexing during operation of the refiner.

In Fig. 1, reference numeral 10 indicates generally a multi-disk refiner of the type with which the improvements of the present invention can be employed. The refiner includes a housing 11 having an inlet portion 12 and a discharge portion 13. A shaft 14 is mounted for rotation within the housing 11 which is keyed to a hub 15 by means of a key 16. A cover plate 17 is secured to the hub by means of bolts 18.

In passing between the inlet 12 and the outlet 13, the fiber suspension must pass between interleaved rotor and stator refiner disks which reduce and fibrillate the fibrous materials in the suspension into smaller, discrete fibers. Illustrated in the drawings are pairs of rotor disks 20 and 21, 22 and 23, and 24 and 25. The rotor disk 20 has ribs 26 which confront ribs 27 formed in an end plate 28 which is secured to the housing 11 by means of screws 29. The working gap between the confronting sets of ribs is identified at reference numeral 30.

Refiner disk 21 has refining ribs which confront ribs formed in a stator disk 31 to provide a working gap 32 therebetween. Another stator disk 33 is mechanically connected to the stator disk 31 and provides confronting ribs to the rotor disk 22, thereby providing a working gap 34 therebetween.

A second pair of stator disks 35 and 36

cooperate with the confronting rotor disks 23 and 24, respectively, to provide working gaps 37 and 38, respectively. Finally, refiner ribs on the rotor disk 25 cooperate with a stationary end plate 39 to provide a working gap 40.

The stator disks are supported within the housing by means of flexible diaphragms 41 and 42 illustrated in Fig. 1. These diaphragms are composed of suitable materials such as a fiberglass laminate. The ends of the membranes 41 and 42 are secured to the housing on opposite sides of a ring 43 held in place by means of double-threaded pins 44 which are securely held by nuts 45.

While the form of the invention illustrated in the drawings makes use of rotating rotor disks cooperating with stationary stator disks to achieve the refining action, the invention is also applicable to sets of disks which all rotate, with alternate pairs of disks rotating in opposite directions.

The present invention is particularly concerned with the manner in which the rotor disks are supported for rotation from the drive means while permitting some limited axial flexibility to accomodate axial deflection between the disk and the drive hub. As illustrated, there is provided a flexible link 51 having one end received about an elongated pivot pin 52 and having its opposite end received about a shorter pivot pin 53. The end of the link 51 engaging the pin 52 is received between a pair of washers 54. Spacing rings 55 and 56 together with washers 57 serve to position centrally disposed flexible links 58 having their terminal ends embracing pivot pins 59. As best illustrated in Fig. 2, the confronting faces of the refiner disks 22 and 23 are relieved as indicated at reference numeral 60 to accomodate shifting movement

of the links.

In the form of the invention illustrated, there are eight pivot-ended flexible links equally spaced around and torsionally positioned from the drive hub. Each link may consist of several thicknesses of thin, heat-treated steel which accomodate axial deflection between the disk and the hub by bending about their flat axes, in the same manner as a flat leaf spring without exceeding the elastic limit. At the same time, a tensile load along the link axis transmits rotational power from the hub to the disk. As a result of the controlled flexure deflection of the links, the distance between the pairs of pivot pins of the hub and the pairs of pivot pins in the disk (pins 59 and 52) decreases which causes a slight angular shift between the hub and the disk which is easily accomodated by the pin ends of the links. Concentric alignment between hub and disk is maintained by a minimum of two pairs of opposing links in quadrature to each other so that eight links, consisting of four opposing sets, is more than adequate to maintain concentricity.

The ability of the flexible link to accomodate a slight axial shift during operation is best illustrated in Fig. 3. The link 58 is shown with an arcuate contour in a somewhat exaggerated amount to illustrate that the flexing of the links is sufficient to automatically adjust the width of the working gaps 34 and 37 to equal dimensions during the refining operation.

The flexible link mechanism of the present invention thus transmits rotary motion from a common drive hub to multiple concentric disks with a variable axial spacing. The laminated metallic construction effectively replaces fiberglass laminates and the like which were subject to erosion by the fiber slurry surrounding the disk assembly.

It should be evident that various modifications can be made to the described embodiments without departing from the scope of the present invention.

CLAIMS

1. A multiple disk refiner comprising: a housing having an inlet and an outlet for a fiber suspension passing therethrough, a drive means mounted for rotation in said housing, a plurality of rotary refiner disks positioned for rotation in said housing and having refiner surfaces for providing a refining action on said fiber suspension as it passes from said inlet to said outlet, a second plurality of refiner disks interleaved with said rotary refiner disks and having refiner surfaces confronting the refiner surfaces on said rotary refiner disks along narrow working gaps, and a plurality of flexible links interconnecting said drive means with said rotary refiner disks to provide rotational drive to said rotary refiner disks while accomodating axial deflection between said rotary refiner disks and said drive means.

2. A refiner accoridng to claim 1 which includes: means pivotally connecting one end of each link to said drive means and pivot pins in said rotary refiner disks receiving the opposite ends of said links for limited pivotal movement thereabout.

3. A refiner assembly according to claim 2 wherein said pivot pins extend between an oppositely facing pair of rotary refiner disks.

4. A refiner according to claim 1 wherein: said second plurality of refiner disks are stationarily mounted in said housing.

5. A refiner according to claim 4 which includes flexible membrane means securing said second plurality of refiner disks to said housing.

6. A refiner assembly according to claim 1 which includes at least two pairs of said flexible links in quadrature with each other.

7. A refiner assembly according to claim 1 wherein said flexible links are composed of thin strips of streel.

8. A refiner assembly according to claim 3 wherein

said pairs of rotary refiner disks have recesses formed at their abutting surfaces to accomodate said pivot pins.

9. In a multiple disk refiner including a drive shaft and a plurality of rotary refiner disks in spaced relation along said drive shaft and driven thereby, the improvement which comprises: a coupling means interconnecting said drive shaft with said disks, said coupling means including elongated flexible links each having one end coupled to said drive shaft and its opposite end secured to said disks, said links being sufficiently flexible to accomodate slight axial displacement between said drive shaft and said disks.

10. A refiner according to claim 9 wherein each flexible link is capable of spring-like bending about its flat axis.

11. A refiner according to claim 9 which includes: pin means in said disks anchoring said opposite ends of said links.

12. A refiner according to claim 11 wherein: said refiner disks are positioned in back to back relationship, with one of said pins extending between an adjoining pair of disks.

13. A multiple disk refiner including: a housing having an inlet and outlet for directing a stock suspension therethrough, a drive means arranged to rotate within said housing, a plurality of spaced pairs of rotary refiner disks in said housing, each pair including refining surfaces on opposite sides and relatively flat abutting inner surfaces, a plurality of refiner disks interleaved between said pairs of rotary refiner disks and presenting opposed refining surfaces to said refining surfaces on said rotary refiner disks while leaving a working gap therebetween through which said stock suspension flows,

and a plurality of flexible flat links coupling said drive means to said pairs of rotary refiner disks.

14. A refiner according to claim 13 which includes: pin means extending between each pair of rotary refiner disks and providing a pivotal connection for the ends of said links.

15. A refiner according to claim 13 wherein each flexible flat link is capable of spring-like bending about its flat axis.

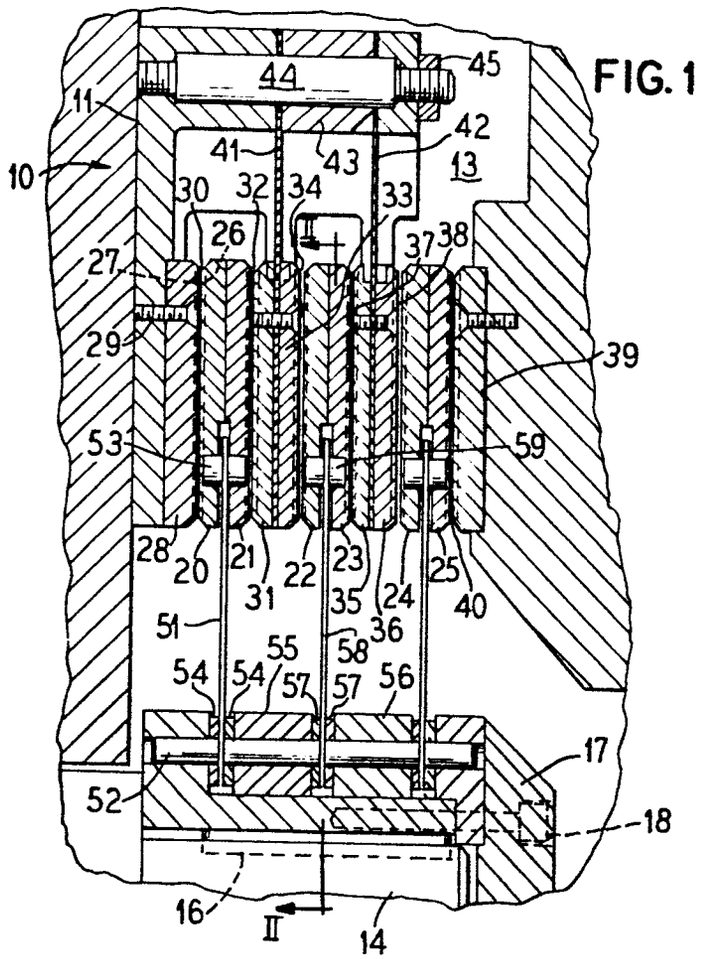

FIG. 1

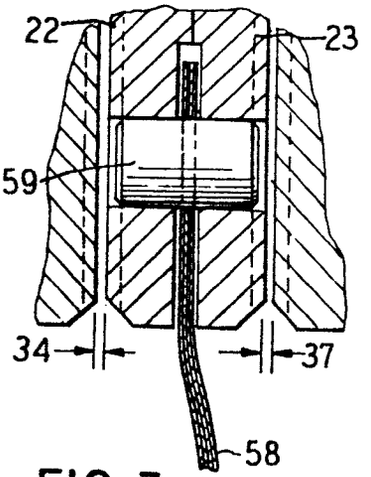

FIG. 3

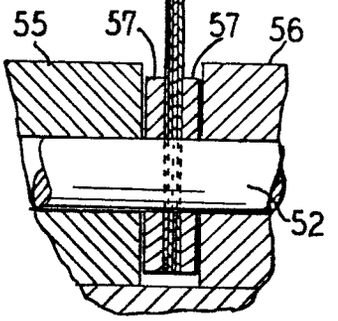

FIG. 2