

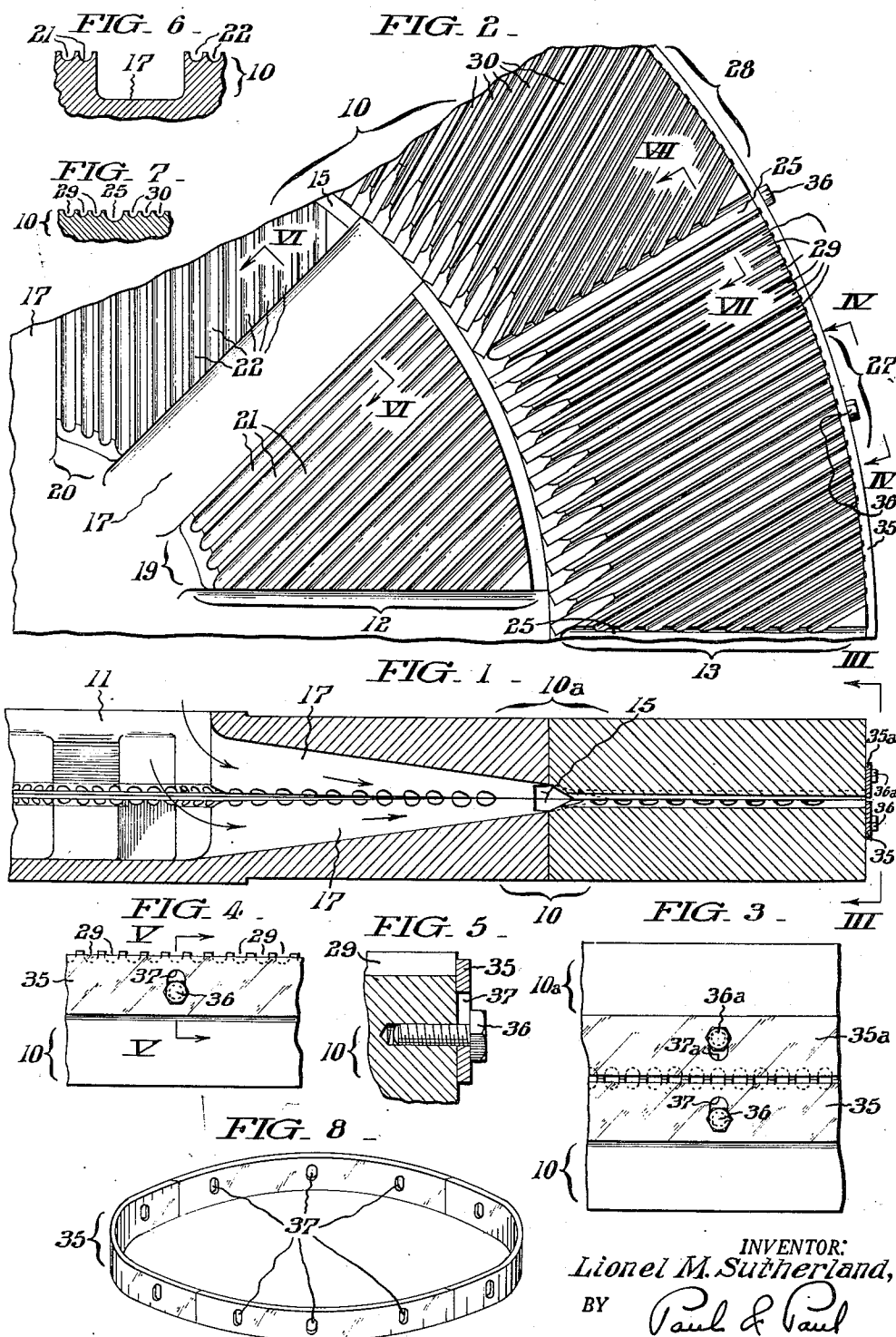
Jan. 22, 1957

L. M. SUTHERLAND
PULP REFINING APPARATUS

2,778,282

Filed March 10, 1955

4 Sheets-Sheet 1



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FIG. 9

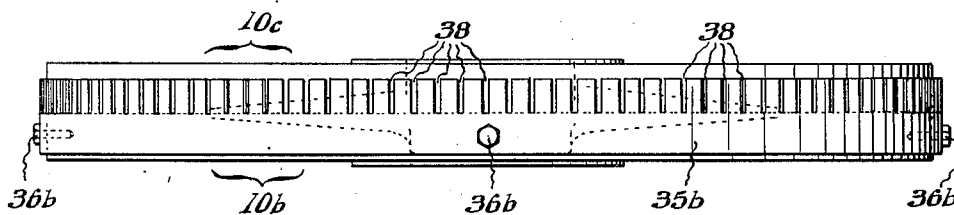


FIG. 10

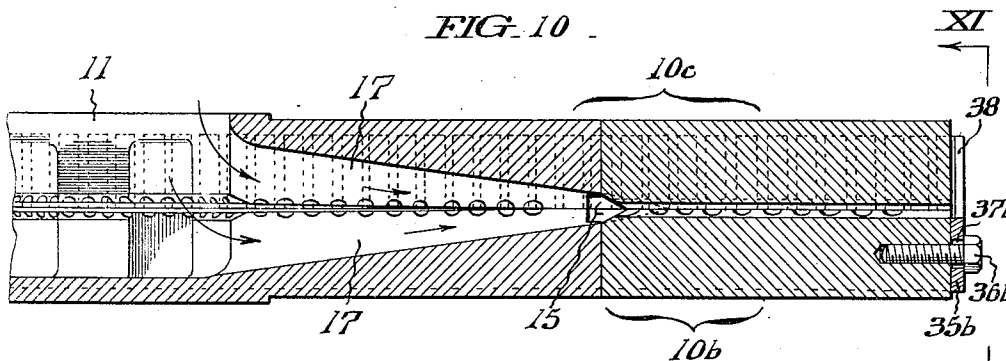
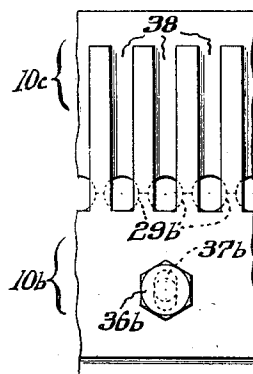


FIG. 11



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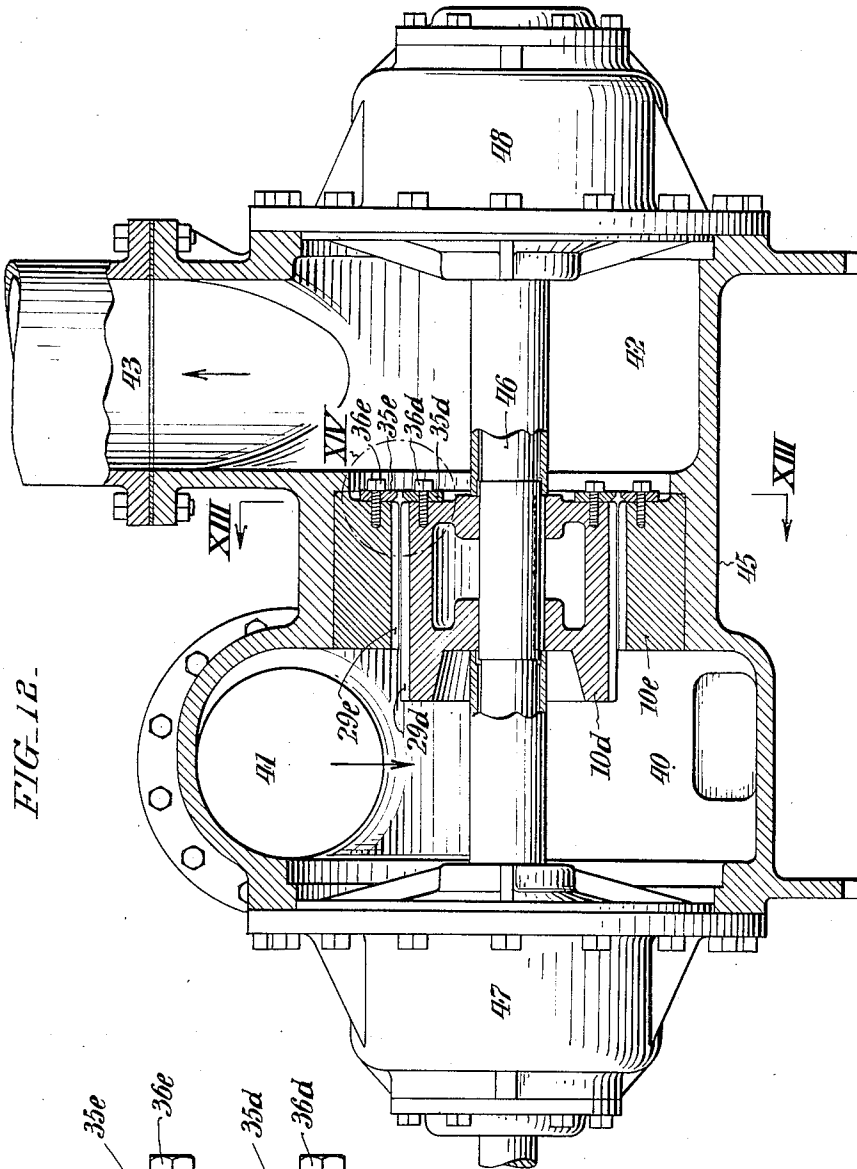


FIG. 12.

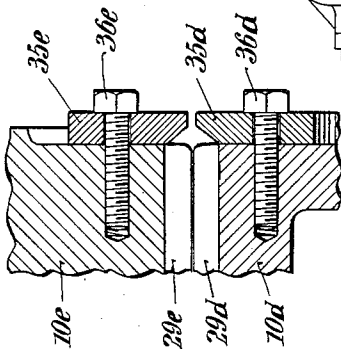


FIG. 14.

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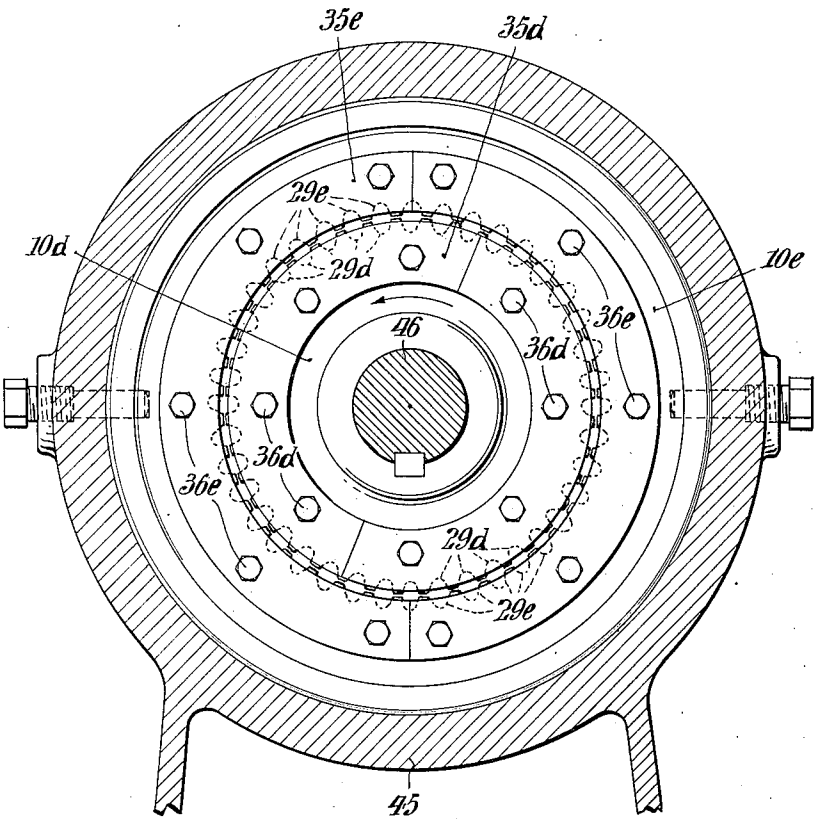
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FIG. 13.



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2,778,282

PULP REFINING APPARATUS

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Application March 10, 1955, Serial No. 493,375

7 Claims. (Cl. 92—26)

This invention relates to pulp refining apparatus wherein the refining is accomplished by passage of the pulp between grooved opposed grinding faces of a pair of relatively rotated members. In certain types of pulp refining apparatus such as disclosed in U. S. Patents Nos. 2,035,994 and 2,651,976 granted to Daniel M. Sutherland, Jr. and Daniel M. Sutherland respectively on March 23, 1936, and on September 15, 1953, the grinding members are in the form of flat disks whereof the opposing working faces have grooves which extend generally radially of the disks; and have marginal areas or peripheral check rings with relatively small grooves at circumferentially-spaced intervals, by means of which the pulp is discharged after having traversed the grooves in the opposite faces of the disks. In refining apparatus of the so-called "plug" type such as disclosed for example in a co-pending patent application Serial No. 267,147, filed by Daniel M. Sutherland on January 18, 1952, now Patent No. 2,765,712, one of the grinding members is in the form of a cylindrical rotor with generally longitudinal grooves in its circumferential surface, and the other member is in the form of a surrounding annulus or stator whereof the bore surface has generally longitudinal grooves opposed to those of the rotor. Likewise, the "plug" type apparatus may be in the form of a cone instead of a cylinder.

Experience over a considerable period of time has shown that excess wear takes place in the check ring areas of the prior art disks of the first mentioned type of apparatus when used in refining such materials as semi-chemical pulps and high yield kraft pulps. It has been my observation that the fibers in the outer annular grooves of the disks arrange themselves tangentially, that is, cross-wise of the normal radial flow of the stock between the disks, and that these fibers then have to make 90 to 120 degree angle turns in order to flow out through the check ring areas. In the case of coarse particles of match stick size, such turning is not possible and the fiber tends to collect in the outer grooves of the disks, thereby raising the consistency of the stock at these regions. Since, under these conditions, the stock is retarded in its normal flow and restrained, it acts as an abrasive in the ring areas, gouging out part of the latter and thus causing rapid wear which greatly reduces the life of the refiner disks.

One of the aims of the present invention is to overcome, in refiners of the first mentioned type, the above recited difficulties. This objective is realized in practice, as hereinafter more fully disclosed, by dispensing with the usual annular check rings and providing bands at the peripheries of the respective disks by which the flow of the stock from the outer ends of the radial grooves is expedited and the refiner thereby adapted for the treatment of pulps of different kinds without attendant clogging.

In connection with the second mentioned or plug type of refining apparatus, I aim to provide means for better control of the pulp flow during the processing than is possible with the rotors and stators as ordinarily con-

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structed in the past. This desideratum is realized in practice, also as hereinafter more fully set forth, through provision of rings respectively for the rotors and stators to partially overlap the discharge ends of the grooves in either or both of these members.

Other objects and attendant advantages will appear from the following detailed description of the attached drawings, wherein:

Fig. 1 is a fragmentary view in section of the opposing refining members or disks of one type of pulp refining apparatus, conveniently embodying my present invention.

Fig. 2 is a fragmentary view in plan of one of the disks.

Fig. 3 is a fragmentary view in elevation looking as indicated by angled arrows III—III in Fig. 1.

Fig. 4 is a fragmentary view in elevation looking as indicated by the angled arrows IV—IV in Fig. 2.

Fig. 5 is a fragmentary view in cross section taken as indicated by the angled arrows V—V in Fig. 4.

Figs. 6 and 7 are fragmentary detail views in section taken as indicated respectively by the angled arrows VI—VI and VII—VII in Fig. 2.

Fig. 8 is a perspective view of one of the flow control elements in the form of a band.

Fig. 9 shows, in edge elevation, a pair of mating refiner disks with another alternative form of control means embodying my invention.

Fig. 10 is a fragmentary view similar to Fig. 1 showing a section of the organization of Fig. 9 on a larger scale.

Fig. 11 is a fragmentary detail view looking as indicated by the angled arrows XI—XI in Fig. 10.

Fig. 12 is a view, partly in side elevation and partly in longitudinal section, of a refiner of the so-called plug type conveniently embodying my invention.

Fig. 13 is a cross section of the refiner taken as indicated by the angled arrows XIII—XIII in Fig. 12; and

Fig. 14 is a detail section within the confines of the circle XIV in Fig. 12, drawn to a larger scale.

In Fig. 1 of these illustrations, the two refiner disks designated 10 and 10a are shown with their working faces opposed in the relative positions which they occupy when installed in the refiner, which may be generally of the construction disclosed in United States Patent No. 2,035,944. The disk 10a is an exact duplicate of the disk 10 except that it has an axial opening 11 by way of which the pulp is introduced to pass outwardly between the two disks. It is to be understood that, to carry out the desired refining action one disk may be held stationary while the other is revolved, or the two may be revolved simultaneously in opposite directions, or they may be rotated in the same direction but at different speeds. The normal arrangement consists in mounting one disk in a fixed position and providing means to rotate the other disk.

The two disks have been illustrated as being identical, except as above explained. Therefore the following description of the disk 10, which is partially shown in plan in Fig. 2, will apply also to the disk 10a. From Fig. 2 it will be noted that the disk 10 has annular inner and outer areas 12 and 13 separated by an annular channel 15. Extending through the innermost annular area 12 of the disk 10 are relatively-wide, uniformly-spaced, radial channels 17 which, as shown in Fig. 6, are rectangular in cross section, and which, as shown in Fig. 1, gradually decrease in depth from the center of the disk to the annular channel 15. The segmental subdivisions 19 and 20 of the annular area 12 separated by the channels 17 are formed with narrow, round-bottomed grooves 21 and 22 which are substantially parallel to one edge of radial channel 17. Through the outer annular area 13 of the disk 10 also extend substantially radial channels 25

which are narrower than the channels 17, and which are offset circumferentially in relation to the latter channels. The segmental subdivisions 27 and 28 of the outer annular area 13 of the disk 10 are formed, in turn, with grooves 29 and 30 which are narrower than the corresponding grooves 21 and 22 of the segments 19 and 20, and which are substantially parallel to one edge of the radial channel 25. These extend from the annular channel 15 to the periphery of the disk. It will thus be seen that the working faces of the disks 10 and 10a are substantially similar to those of United States Patent No. 2,651,976 previously mentioned. However, the circumferential check rings are completely eliminated.

As an alternative, I may prefer to use one disk of either of the unbanded types disclosed in U. S. Patents Nos. 2,035,994 and 2,651,976 in combination with a disk of the type herein illustrated. Similarly, one disk may be of the present type, but without a band. In such a combination, the banded disk may be used on either side of the apparatus as desired.

For the purpose of controlling discharge of the pulp from between the disks 10 and 10a, I have provided them respectively with rings or bands 35 and 35a. One ring or band is separately illustrated in perspective in Fig. 8. These rings or bands are secured to the peripheries of the respective disks by means of headed screws 36, 36a the shanks of which are passed through transversely arranged slots 37, 37a in said rings or bands with capacity for axial adjustment. As will be readily understood from Figs. 1 and 3, by adjusting the rings or bands to increase or decrease the interval between their confronting edges, the rate of pulp discharged from the ends of the grooves in the outer annular face areas 13 of the disks can be closely regulated, and the apparatus may thus be adapted for the treatment of pulps of different kinds. As an aid to accomplishing this, the rings or bands are affixed to the peripheries of the refiner disks in such a way as to partially overlap the outer or discharge ends of the grooves 29 and 30 of the disks as shown in Fig. 1. Each ring or band is adjusted to a distance of the order .100 to .150 inch below the surface of its disk in providing this overlap. A band or bands arranged for adjustment during operation may be desirable for certain purposes where great flexibility of performance is desired.

In the operation of the refiner, the pulp is introduced under pressure through the opening 11 in the disk 10a and is forced out through the various channels and grooves of the two disks and discharged ultimately at the peripheries of the disks. Since the opposing faces of the disks 10, 10a are identical but reversely disposed, the ridges between the grooves of the respective disks variably intersect each other angularly during operation of the refiner so that a shearing action takes place between them whereby the pulp is progressively treated after which it passes through the control bands referred to above.

The bands or rings 35 and 35a may be made in one piece, or they may be formed in segments as shown in Fig. 8 for greater ease in manufacturing and handling.

As an alternative, the rings 35 and 35a may be made as wide as the thickness of the disks, less the desired spacing distance of their confronting edges above and below the grinding faces of said disks. Moreover, the rings 35 and 35a may be provided with mere clearance holes for the bolts 36 and 36a instead of transverse slots, and fixedly secured to the disks. In the latter instance, upon re-machining of the disks, the rings would be re-cut to provide the distance of .005 to .050 inch spacing of their active edges from the grinding surfaces of said disks.

In the embodiment of Figs. 9 and 10, the flow control means of my invention comprises a single band 35b secured with provision for adjustment by cap screws 36b, to the periphery of the lower of the two refiner disks 10b and 10c which, it is to be understood, are of the same construction as the disks 10 and 10a of Figs. 1 and 2. As shown, relatively deep transverse notches or slots 38

are cut or otherwise formed in one edge of the ring 35b, said notches corresponding in number to the slots 29b of the disk 10b. As further shown, the ring 35b is of a width to partially overlap the upper disk 10c, and is so positioned that the notches thereof are in registry with the distal ends of the grooves 29b in said lower disk as best seen in Fig. 11 or may partially occlude the grooves 29b as hereinbefore shown.

The plug type refiner illustrated in Figs. 12 and 13, generally speaking, is of well known construction in that its housing has, at one end, a spiralized induction chamber 40 with a tangential inlet 41 through which the pulp to be refined is introduced under pressure. At the other end of the housing is a similarly configured eduction chamber 42 from which the refined material is discharged by way of an outlet shown generally at 43. Connecting the chambers 40 and 42 is a hollow horizontal cylindrical portion 45 of the housing through which a shaft 46 extends axially, said shaft being rotatively supported in suitable bearings (not illustrated) in the end wall portions 47 and 48 of the housing. The pulp reducing members, corresponding to the disks of the first described embodiment, are here, in the form of a cylinder or rotor 10d which latter is fixed upon the shaft 46, and in the form of a surrounding annulus or stator 10e which is set into the portion 45 of the housing of the apparatus. The diameter of the rotor 10d is slightly less than the bore diameter of the stator 10e, and the confronting working faces of the two are provided with grooves 29d and 29e which extend generally in a longitudinal direction. As in the first described embodiment, the pulp flow through the apparatus is controlled by rings 35d and 35e which are secured, by means of screw bolts 36d and 36e, to the corresponding ends of the members 10d and 10e to overlap the flow space between said members at the discharge ends of the grooves 29d, 29e as best seen in Fig. 14. As in the first embodiment, the rings 35d and 35e may be made either continuous, or they may be made in segments. Instead of being true cylindric, the rotor 10d and the surrounding annulus 10e may be of conical configuration.

While the present invention has been illustrated and described particularly in connection with a disk type refiner and with a plug type refiner, it will be apparent that the invention is equally applicable to refiners of the intermediate conical type.

Having thus described my invention, I claim:

1. The combination, in a pulp refining apparatus, of a pair of spaced relatively rotated disks between which the pulp to be refined is passed; said disks respectively having grooves in their confronting working faces extending from their centers to their peripheries; and control elements in the form of bands affixed respectively to the peripheries of the disks to partially overlap the delivery ends of the grooves in said disks.

2. The combination, in a pulp refining apparatus, of a pair of spaced relatively-rotated disks between which the pulp to be refined is passed; said disks respectively having grooves in their confronting working faces extending from their centers to their peripheries; and control elements in the form of bands affixed respectively to the peripheries of the disks to partially overlap the delivery ends of the grooves in said disks, said bands being provided at circumferential intervals with slots for passage of the shanks of headed screws by which they are securable in axially adjusted positions to the peripheries of the respective disks.

3. The combination, in a pulp refining apparatus, of a pair of relatively rotated grinding members between which the pulp to be refined is passed, one of said members being in the form of a cylinder or cone having grooves extending generally longitudinally of its circumferential surfaces, and the other member being in the form of a surrounding annulus whereof the bore is slightly larger than the diameter of the first mentioned member and having at its interior grooves likewise extending gen-

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erally longitudinally thereof; and bands affixed respectively to corresponding ends of the relatively rotating members and partially overlapping the delivery ends of the grooves in the respective members.

4. The combination, in a pulp refining apparatus, of a pair of relatively rotated disks having opposing working faces with grooves by way of which the material to be refined is passed from the center of the disks for discharge at their peripheries; a band secured circumferentially about one of the disks and overlapping the peripheral edge of the other disk, said band having transversely-arranged slots in registry with the distal ends of the grooves in the disk to which it is secured.

5. The combination, in a pulp refining apparatus, of a pair of spaced relatively-rotated members having oppositely-grooved working faces between which the material to be refined is passed; and a control element in the form of a continuous band separately secured against and about

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the peripheral edge of at least one of said members and continuously overlapping partially the delivery ends of the grooves in such member for governing the rate of pulp discharge from the delivery ends of said grooves.

6. The invention according to claim 5 wherein one of the relatively rotated members is provided with an axial opening for the introduction of pulp to pass outwardly between the pair of space members.

7. The invention according to claim 5 wherein the continuous band means consists of a plurality of arcuate segments.

References Cited in the file of this patent

UNITED STATES PATENTS

2,035,994	Sutherland	Mar. 31, 1936
2,651,976	Sutherland	Sept. 15, 1953
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