# United States Patent [19]

**Moore, Sr.**

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[54] **DOUBLE-REVOLVING DISC REFINER**


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[52] **U.S. Cl.** .................................................. **241/251**

[51] **Int. Cl.** .................................................. **B02c 7/06**

[58] **Field of Search** .................... 241/244, 250, 251, 241/255, 256



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,219,282 | 11/1965 | Horstman | 241/255 X |
| 1,039,326 | 9/1912 | Schroeder | 241/251 |
| 1,758,539 | 5/1930 | Schuchardt | 241/251 |



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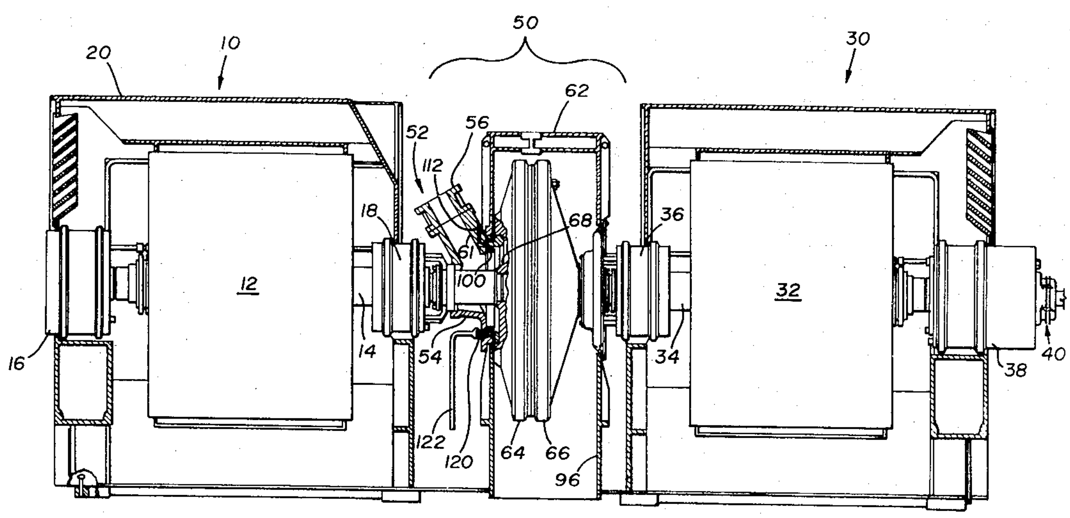
[57] **ABSTRACT**

An improved double-revolving disc refiner wherein an annular shield member is attached to the input member of the refiner so as to project into the feed-end disc, thereby blocking off leakage paths around seals positioned at the joint of the input member and feed-end disc. Means are included for injecting a water phase into the clearance space between the shield member and the disc's seal, so as to force the water phase to flow downstream with respect to the stock flow through the joint, out of the clearance space and away from the joint.


**6 Claims, 7 Drawing Figures**



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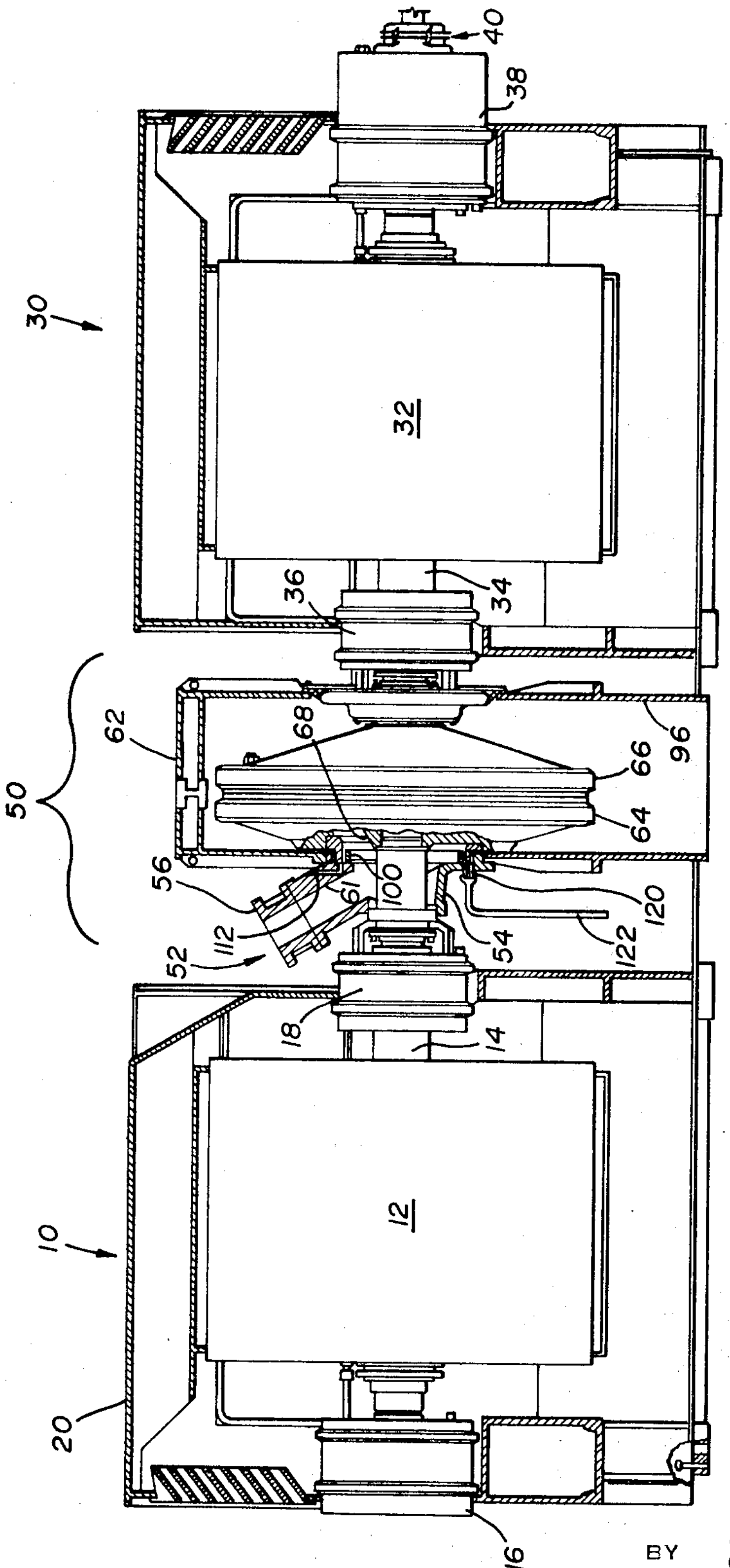


*Fig. 1*

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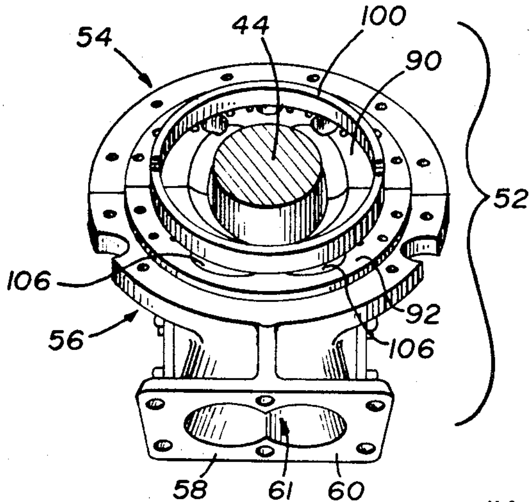


Fig. 2

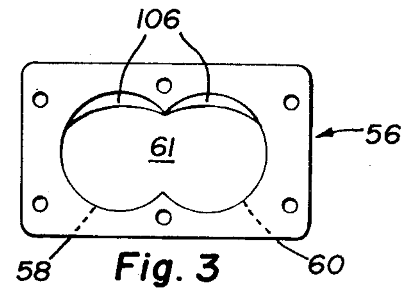


Fig. 3

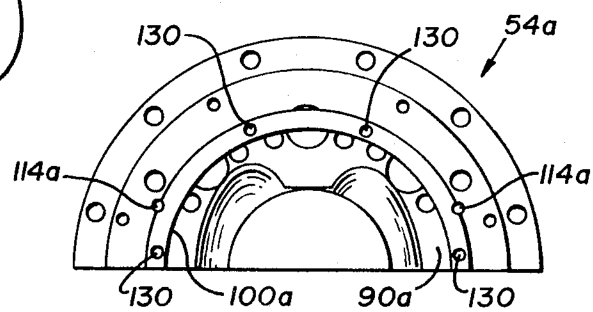


Fig. 6

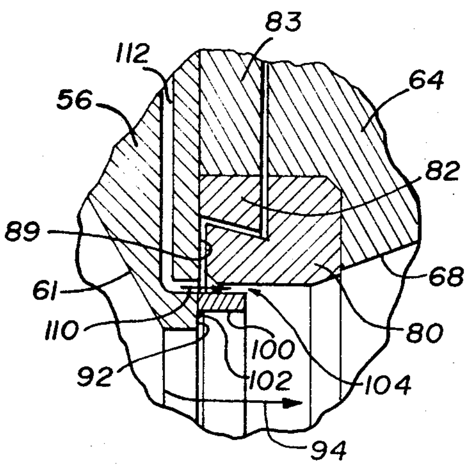


Fig. 4

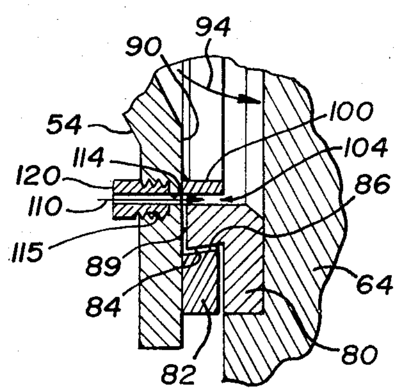


Fig. 5

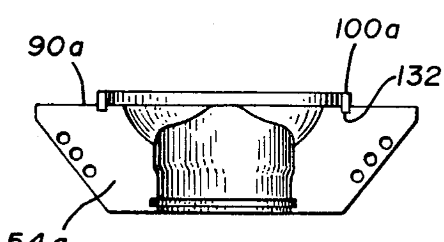


Fig. 7

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## DOUBLE-REVOLVING DISC REFINER

### BACKGROUND OF THE INVENTION

The process of making hardboard, a dense, durable substitute for natural wood, includes the steps of chipping lumber, refining the chips into individual cellulosic fibers, forming a wet mat from the fibers, and simultaneously heating and compressing the mat to form the hardboard. The refining step utilizes, as the step indicates, a refiner usually of the type which forces chips and chip fragments obtained from a digester to pass between two counter-rotating discs, which separate or refine the fragments into individual fibers. This step is crucial, as any chip fragments which bypass the refiner and find their way into the board mat without first being refined cause unacceptable blemishes in high quality hardboard. Such blemishes not only destroy the otherwise random appearance of the fibers in the board, they cause swelling on the surface which prevents the board from taking a flat, highly glossed surface such as is necessary for high quality board.

For the last several years, attempts to use a refiner having a high capacity or rate of input of stock have failed to produce high quality board due to the fact that chip fragments have bypassed the rotating discs. Such bypassing of chips was in the nature of leakage which occurred at the joint between the feed-end disc and the input housing, the former rotating at a high rate of speed with respect to the latter. It is customary to incorporate seal rings at the aforesaid joint, but prior to the invention even seal rings did not prevent chip fragments from being forced into the joint until the seal rings had worn so much that the fragments completely bypassed the refiner and fell into the discharge chute.

Such wear on the seal rings placed a premium on careful and accurate alignment of the rings when assembled, such as after each maintenance disassembly, as well as on a design which permitted adjustment of the rings to take up the slack due to the wear. In spite of these expensive and time-consuming steps, the chip fragments continued to leak and wear the rings. It was found necessary, therefore, to attempt to correct the situation by replacing the seal rings as they wore out beyond their adjustment capabilities. However, not only have replacement rings been difficult to obtain from the manufacturer of the refiner, their use has been prohibitively expensive both in cost and inactive down time. For example, the seal rings on the Bauer No. 412 Refiner made by the Bauer Brothers Co. cost about $1,000 to replace, and in the making of hardboard such replacement has been found to be necessary on that refiner as much as ten times a year. Each seal replacement ties up the use of the refiner and requires accurate realignment.

Because of all these difficulties, both the manufacturers and the users of high capacity refiners have been attempting to find a solution to the leakage problem ever since such refiners were first used to make high quality hardboard. Such attempts have included the redesign of the seal rings themselves, but until the development of this invention, these attempts have generally failed.

### SUMMARY OF THE INVENTION

The disclosure concerns an improved fiber refiner having rotatable free-end and control-end discs, the joint between the feed-end disc and input housing or member of which has been designed so as to prevent essentially all fragment leakage and so as to greatly reduce seal ring wear, thereby maintaining quality. More specifically, there is provided in a refiner in which the rotating disc adjacent to the input member is sealed with respect to the member by a ring positioned in a male sealing relationship with respect to the member, an annular shield member attached to the input member so as to be in a male relationship with respect to the ring. Such shield member covers the potential leakage path. Also, there is provided means for injecting a water phase into the path formed between the male-fitting shield member and the ring so as to flow opposite to chip fragments attempting to leak out via this path, so as to further enhance the wearability of the construction.

Accordingly, it is an object of the invention to provide an improved refiner wherein stock leakage is substantially eliminated without the need for continually replacing seal rings.

It is a related object of the invention to provide a refiner which is capable of continuously and inexpensively producing uniformly high quality hardboard.

It is a further object of the invention to provide in such a refiner means for countering the tendency of stock to follow a leakage path out of the refiner.

Other objects and advantages will become apparent upon reference to the following drawings and detailed description.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned, fragmentary elevational view of an improved cellulosic refiner constructed in accordance with the invention;

FIG. 2 is a perspective view, partially in section, of portions of the input member, illustrating both a portion of the improvement as well as the mounting relationship of the input member with respect to the feed-end drive shaft;

FIG. 3 is an end elevational view of the input member illustrated in FIG. 2;

FIG. 4 is an enlarged, fragmentary, sectional view similar to FIG. 1 but illustrating only the top portion of the joint of the feed-end disc and the input member;

FIG. 5 is an enlarged, fragmentary sectional view similar to FIG. 4, but illustrating the bottom portion of the joint;

FIG. 6 is an end elevational view of one portion only of the input member, illustrating another embodiment of the invention; and

FIG. 7 is a side elevational view of the input member portion illustrated in FIG. 6.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the invention is described hereinafter in connection with a particular high capacity refiner, it is not limited thereto and can be applied to any refiner in which leakage of the stock at the feed end disc is a problem. For example, high pressure refiners which force stock between double-revolving discs by means of steam are considered to be as defective in stock leakage as those not operating under steam pressure. Furthermore, the invention, hereinafter described in connection with the refining of wood chips to make hardboard, is not limited to that use alone. Rather, any use of the refiner having the construction of the invention is contemplated as being included.

Any reference herein to "top," "bottom," or other directional adjectives is meant to refer to that portion of the described structure as it is positioned when assembled in the refiner.

Turning now to FIGS. 1 and 2, there is illustrated a high capacity cellulosic fiber refiner, such as the Bauer No. 412 Refiner referred to above, which has been improved by means of the instant invention. Such refiner conventionally includes a feed end 10, a control end 30, and a refining stage 50. The feed end 10 comprises a feed-end motor 12, a feed-end drive shaft 14 driven by the motor 12, bearing housings 16 and 18 supporting the shaft 14, and a motor enclosure 20. The control end 30 comprises parts which are mirror images, essentially, of the feed end 10, namely a motor 32, drive shaft 34, and bearing housings 36 and 38. In addition, however, bearing housing 38 is provided with a thrust plate, not shown, which cooperates with a hydraulic cylinder 40 so as to adjust the clearance between the rotating discs in the refining stage 50. That stage 50 has an input member 52, otherwise known as the stock inlet. The input member is split into two portions 54 and 56, the top portion 56 of which has twin inlet spouts 58 and 60. (See FIG. 2.) These spouts define a passageway 61 which opens into a feed end disc 64 contained within a disc enclosure 62. Also enclosed therein is the counter-rotating control end disc 66, each of the discs being mounted on its respective drive shaft. This construction permits disc 64 to rotate with respect to the input member 52. The disc 64 is peculiar in that it has three passageways 68 leading from passageway 61 to the outer edge of the disc. Only one passageway 68 is shown.

Turning now to FIG. 4 and 5 in particular, the disc 64 is provided with a stock inlet sealing ring 80 attached thereto by bolts, not shown, which ring is conventionally mounted so as to be positioned in a male sealing relationship with respect to the input member 52. For example, a special input member seal 82 can be attached to input member 52, dimensioned so as to accommodate seal ring 80 therewithin. To permit relative adjustment of the seal ring 80 and the seal 82 due to wear heretofore experienced, the mating surfaces 84 and 86 of the seal ring and the seal, respectively, have been beveled as shown particularly in FIG. 5. Except for the construction provided by the invention, hereinafter described, the seal ring 80 fits against portion 56 and 54 of the input member 52 (FIG. 4 and 5), in such a way as to define a space or path 89 which extends generally perpendicularly from the passageway 61 at the junction of the disc and the input member. Path 89 thus becomes a potential leakage of chips out of the refiner and into the discharge chute, in spite of the fact that portions 54 and 56 of the input member 52 are provided with shoulders 90 and 92, respectively, which project inwardly beyond the limits of the passageway within disc 64 (FIG. 4).

The assembly and operation of the refiner described above is conventional, and is adequately described, for example, in the operation manual entitled "Double Revolving Disc Refiner No. 412" published by Bauer Brothers Co. of Springfield, Ohio. Briefly a fiber source such as digested wood chips, which are now softened fragments, are fed into the twin spouts 58 and 60 from a defibering stage. If the motors 12 and 32 are about 1,000 horsepower each, the rate of input can be the high capacity type of about 50 to 100 tons a day. The chips and chip fragments are forced through passageways 61 and 68 around drive shaft 14, in the direction of the arrow labeled 94 (FIGS. 4 and 5). The centrifugal force of the rotation drives them into the gap between the two discs 64 and 66, where they are milled into individual fibers, which fibers drop out a discharge chute 96 (FIG. 1). From there they are conventionally washed and cleaned, or sent through a pump-through refiner, after which they are formed into a wet mat.

## THE IMPROVEMENT

Turning now to FIGS. 2 through 5 in particular, in accordance with one aspect of the invention, an annular shield member 100 is attached to the input member 52 so as to occupy a male relationship with respect to the sealing ring 80. Specifically, the member 100 is attached to the shoulders 90 and 92 of the portions 54 and 56, thus covering the path 89. Like the input member 52 itself, the shield member 100 is split to permit mounting of the member 52 around the drive shaft. In the embodiment shown in FIGS. 1–5, the shield member is welded as at 102 (FIG. 4). Because of the relative rotation of ring 80 with respect to shield member 100, a clearance or spacing 104 is provided between them, this spacing extending and being directed only downstream, with respect to the direction of stock flow as indicated by arrow 94, proceeding from the shoulders 90 and 92 of the input member. This construction changes the potential chip leakage path from one which is about a 90° angle turn from normal stock flow, to one which amounts to a complete reversal of flow. It will be appreciated that this reversal is resisted by the overall flow by the stock as indicated by arrow 94. The construction can also be described as one in which the position of the sealing ring has been altered so as to be confined within a groove defined by seal 82 of input member 52 and by shield member 100.

To further prevent stock flow from passing other than through the confines of the shield member 100, the two portions of the shoulder 92 which conventionally are cut away and represent the outermost limit of the passageway 61 in portion 56, are filled in by metal pieces 106 cut to size and welded to the housing (FIGS. 2 and 3).

In accordance with yet another aspect of the invention, it has been found that the introduction of a water phase into the spacing 104 to flow downstream as indicated by arrows 110 further counters any reversal flow of chips and thereby cooperates with shield member 100 to prevent leakage of chips. Specifically, referring to FIGS. 4 and 5, the top portion 56 is drilled or otherwise machined so as to include a passageway 112 which opens out into the beginning of spacing 104. Two of these may be provided, for example, in the top portion. Similarly two holes 114 are preferably machined into shoulder 54 (see also FIG. 6) and larger holes 115 are drilled coaxially therewith and threaded (FIG. 5). The holes 114 can even pass partially through the outer portions of the shield member 100. A nipple 120 is screwed into each of the two holes 115. A hose 122 (FIG. 1) is attached to each nipple 120, and a similar nipple and hose (not shown) can be connected to the passageways 112 in top portion 56. Water or steam is then delivered to the passageways 112 and nipples 120, and thence out into spacing 104, thus flowing in a direction parallel to and cocurrent with the flow of fibers conveyed into the refiner by said input member. In the case of water, the line pressure delivered to the nipples must exceed 80 psi.

Other sources of water will be readily apparent. For example, a ring of many nipples **120** or passageways **112** could be provided instead of two each as described above, if a more uniform delivery of the water phase is desired. Also, the use of two nipples **120** only, on bottom portion **54** of the input member, can provide adequate counter-washing.

FIGS. **6** and **7** illustrate an alternate embodiment of the invention, specifically one in which the shield member is bolted on instead of being welded. Parts similar to those previously described are identified by the same numerals, to which the distinguishing suffix "a" has been added. Thus, bottom portion **54*a*** has attached to shoulder **90*a***, a shield member **100**a which projects above the face of the shoulder the same distance as in the previous embodiment. Holes **114**a are drilled through the housing as in the previous embodiment. However, unlike the previous embodiment, shield member **100*a*** is removably attached to the input member by means such as machine screws **130** (FIG. **6**). To further secure the shield member, the face of the shoulders, such as shoulder **90*a***, is machined to provide a groove **132** dimensioned to accommodate the trailing edge of the shield member (FIG. **7**), recessed within the shoulder.

It will be readily appreciated that the embodiment of FIGS. **6** and **7** has the advantage of removability.

The shoulder member in either embodiment can be made from a variety of materials and in a variety of sizes. One representative example which is in no way limiting is a construction wherein member **100** or **100*a*** projects outwardly from the shoulder a distance of three-fourths of an inch, has an annular thickness of seven-sixteenths of an inch, and in the case of the removable embodiment, is recessed into a groove one-fourth of an inch deep. Such a shield member was constructed from **304** stainless steel, but **316** stainless is just as suitable.

The use of the above-described specific shield construction in combination with water injection obtained by two nipples **120** in a Bauer No. 412 Refiner was found to provide a marked improvement in the quality of hardboard made with this refiner, and a drastic reduction of wear on the part of the seal ring **80** and the seal **82**.

Although the invention has been described in connection with certain preferred embodiments, it is not limited thereto. Rather, it is intended that it cover all equivalents, embodiments, and alternate arrangements, as may be included within the scope of the following claims.

What is claimed is:

**1.** In a cellulosic fiber refiner comprising at least one rotatable disc, means for rotating the disc, an input member for conveying a source of the fibers to said disc, the member having at least one passageway opening into said disc, and a sealing ring attached to the disc positioned in a male sealing relationship with respect to said member; the improvement comprising an annular shield member attached to said input member so as to be in a male relationship to said ring, said shield member covering the potential leakage path created by the junction of the sealing ring and the input member adjacent to said passageway.

**2.** The improved refiner as defined in claim **1**, wherein said ring is positioned with respect to said passageway so as to define a potential leakage path extending generally perpendicularly from said passageway, and said shield member is spaced from said ring so as to permit relative rotation between said shield member and said ring, said spacing extending only downstream from said leakage path with respect to the flow of the source of fibers to said disc, whereby fiber sources must execute generally a complete reversal of flow to leak out through said leakage path.

**3.** The improved refiner as defined in claim **2**, and further including means for injecting a water phase into said spacing in a direction parallel to and cocurrent with the flow of fibers conveyed into the refiner by said input member, whereby the water phase counters any fiber source which might otherwise make said reversal of flow.

**4.** In a cellulosic fiber refiner comprising at least one rotatable disc, means for rotating the disc, an input member for conveying a source of the fibers to said disc, the member having at least one stock passageway opening into said disc, and a sealing ring attached to the disc; the improvement comprising an annular shield member attached to said input member so as to be in a male relationship to said ring, the space between said ring and said shield member being directed downstream only, with respect to the flow of the source of fibers through said passageway, and means for injecting a water phase into said space downstream with respect to said fiber source flow, whereby the water phase counters any fiber source which might otherwise flow into said space.

**5.** The improved refiner as defined in claim **4**, wherein said ring is confined within a groove formed by said shield member and said input member.

**6.** The improved refiner as defined in claim **4** and further including a groove in the face of said input member adjacent to said disc and wherein said shield member is removably attached to said input member within said groove.

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