April 15, 1969 V. W. CANCILLA 3,438,586

TWO-PIPE DISC REFINER

Filed Aug. 15, 1966

Fig. 1

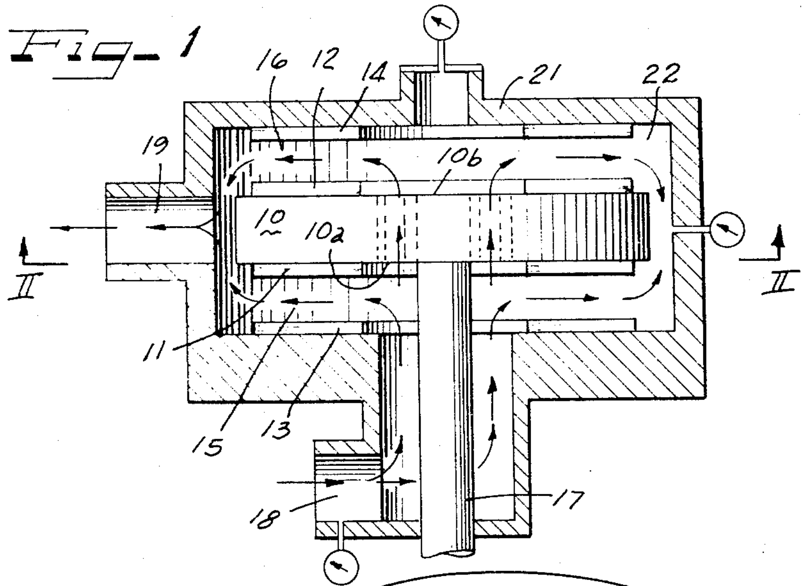
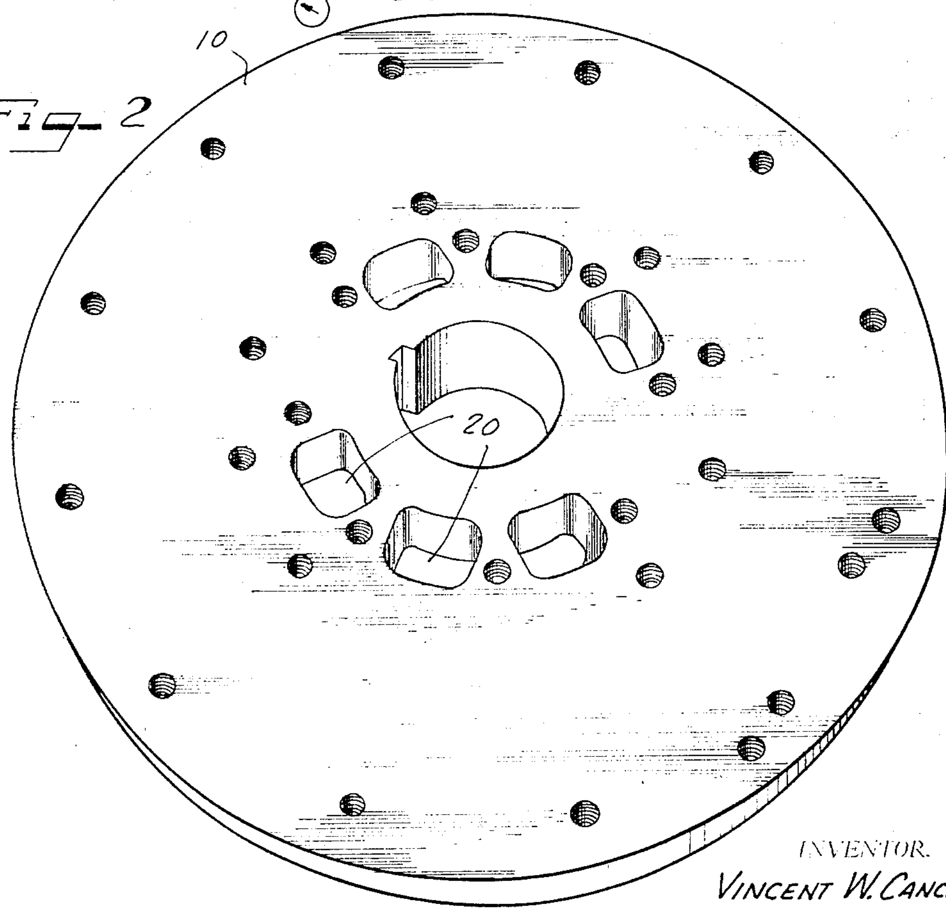


Fig. 2



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TWO-PIPE DISC REFINER

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ABSTRACT OF THE DISCLOSURE

A four-disc refiner wherein the hydraulic pressures on both sides of the rotating disc are balanced so that the disc maintains a centered position between the stationary discs.

The present invention relates to improvements in refiners and more particularly to a refiner of the type which is used for refining paper pulp stock and particularly to a four-disc refiner.

In a four-disc stock refiner a rotating disc carries refining plates on its surfaces which face stationary refining discs. Stock is fed to the refiner at the center of the disc and flows outwardly between the stationary discs and the rotating disc. The working faces of the rotating disc are subjected to hydraulic forces of the stock flowing through the refining zones between the stationary and rotating discs. To maintain the rotor in a center position relative to the stationary discs it is necessary, unless an extrinsic large balancing force is applied, to have the hydraulic forces on both sides of the rotating disc the same. It is conventional in many refiners to drive the disc with a shaft which projects from one face of the disc so that the exposed surface area of the disc face from which the shaft projects is smaller in area than the other face. This causes an imbalance in forces.

It is accordingly an object of the present invention to provide a four disc refiner wherein the hydraulic pressures on both sides of the rotating disc are balanced so that the disc maintains a centered position between the stationary discs.

A still further object of the invention is to provide a unique way of having a lower pressure on the outer face of the disc of a refiner than on the side having the driving shaft.

A still further object of the invention is to provide an improved four-disc refiner having a simplified piping arrangement wherein only one supply pipe may be used for the slurry inlet and one pipe used for the slurry outlet.

A still further object of the invention is to provide a four-disc refiner wherein the rotating discs can be serviced and inspected or changed without disconnecting pipes or flow connections.

A feature of the present invention is the provision of a four-disc refiner with a refining rotating disc having inner and outer faces with annular refining surfaces thereon, a supporting shaft carrying the rotor disc at its end and projecting from the inner face of the disc, stationary refining surfaces in a housing facing the inner and outer surfaces of the rotor and defining first and second refining zones respectively with inner and outer rotor surfaces, a stock flow inlet passage leading to the first refining space along the shaft, and a second stock flow passage preferably leading from the inlet passage through the rotor to the second refining space with the stock encountering a pressure drop through said passage so that lesser unit hydraulic pressure is felt on the outer face of the rotor disc and the overall axial forces on the disc are balanced.

Other objects, advantages and features will become more apparent with the teaching of the principles of the present invention in connection with the disclosure of the preferred embodiment thereof in the specification, claims and drawings, in which:

FIGURE 1 is a schematic view shown in section of a refiner embodying the principles of the present invention; and

FIGURE 2 is a detailed plan view of a rotor shown as it would appear along line II—II of FIGURE 1 with the shaft and other portions removed.

On the drawing

FIGURE 1 shows a refiner with a rotor disc **10**. The disc is relatively flat and circular in shape as illustrated in FIGURE 2 and is provided with an inner face **10*a*** and an outer face **10*b***. On the inner face are annular refining surfaces **11** usually in the form of refining cutters or blades attached to the disc in a manner which will be appreciated by those versed in the art and need not be described in detail. On the outer face **10*b*** is an annular refining surface **12**. Facing the refining surfaces **11** and **12** are stationary refining surfaces **13** and **14**. These stationary annular surfaces are mounted in the inner chamber **22** of a housing **21** enclosing the refiner.

The space between the rotary refining surface **11** and the stationary refining surface **13** forms a first refining zone **15**. The space between the refining surface **12** and the stationary refining surface **14** forms a second refining zone **16**. In other words the inner refining surface **11** faces the first refining zone **15** and the outer refining surface **12** faces the second refining zone **16**.

The rotor is carried and driven by a shaft **17** floatingly supported in the housing and suitably carried on bearings and driven. The mounting of the shaft will be fully understood by those versed and need not be described in detail. The shaft projects from the inner face **10*a*** of the rotor and is suitably secured thereto with the shaft shown as admitted from the disc **10** in FIGURE 2.

Stock is fed to the refiner along the shaft **10** through an inlet passage **18**. The inlet passage is shown as extending annularly coaxially around the shaft **17** to supply stock uniformly to the first refining zone **15**.

To supply stock to the second refining zone **16** a stock flow passage is provided preferably in the form of flow ports **20** through the rotor. The rotor is thus preferably made in spoked form and the stock flow passages have a predetermined size relationship to the inlet passage **18** in order to cause a predetermined pressure drop.

As will be observed, the outer face **10*b*** of the rotor has an overall larger exposed area than the inner face **10*a*** inasmuch as the shaft **17** covers a portion of the exposed area. Thus the hydraulic pressure of the stock will act on a smaller area on the face **10*a*** than on the face **10*b***.

To compensate for this difference in area the pressure of the stock on the face **10*b*** is controlled to be of a reduced pressure. This control is obtained by predetermining the size of the rotor inlet passages **20** so that predetermined pressure drop is obtained and the overall hydraulic force on the face **10*b*** will be balanced or substantially the same as the overall hydraulic force on the face **10*a***.

While different stock slurries have different flow characteristics and the degree of resistance to flow varies in the stock flow passing through the openings **20** in the rotor, rotor openings have been discovered which will effect a proper pressure drop with different types of stock and different pressures. In a preferred form the openings **20** have a size elationship to the inlet **18** so that a pressure drop of 0.4 to 0.6 p.s.i. occurs for every 10 p.s.i. of stock inlet pressure in the passage **18**.

The preferred range of pressure drop across the rotor (enclosed with the openings **20**) is in the range of .04 to .06 times the inlet pressure.

The following provides an example of a range of sizes which have been accomplished using the principles of the present invention with refiners a size from 12 inches to 54 inches:

Refiner size, inches	Size inlet pipe	Area inlet pipe	Area rotor openings	Rotor openings area req'd, 50% inlet	Percent of req'd area in rotor openings	Area rotor	Shaft	ΔP factor
1								
22	3	7.0	9	3.5	260	114	7	.06
0	4	12.6	19.4	6.3	309	295	16	.054
26	6	28.3	27	14.2	191	504	31	.06
34	6	28.3	45	14.2	318	880	47	.053
42	8	50.3	57	25.2	225	1,336	64	.048
54	10	78.5	112	39.3	285	2,168	87	.04

The following indicates the relationship between rotor area and disc area on the inner surface **10**a of the disc with an example being given for a 20-inch refiner.

Rotor area=disc area−rotor opening

Inlet p.s.i.×(area rotor−area shaft)=(inlet p.s.i−press drop)×area rotor

$$\Delta P=\frac{\text{area shaft}}{\text{area rotor}}\times\text{inlet p.s.i.}=\frac{16}{295}\times\text{p.s.i.}=.054\times\text{p.s.i.}$$

A further example of a structure employed in accordance with the principles of the present invention is as follows:

Rotor diameter=34⅜″—area=925 sq. in.
Shaft diameter=7¾″—area=47 sq. in.
2-pipe Duo Flo open area in hub=45 sq. in.
Effective rotor area=rotor area−open area
E.R.A.=925−45=880 sq. in.

To balance hydraulic forces on both sides of rotor the difference in pressures must be:

$$\Delta P=\frac{\text{shaft area}}{\text{E.R.A.}}\times\text{inlet pressure}=\frac{47}{880}\times\text{inlet p.s.i.}=.053\times\text{inlet p.s.i.}$$

Assume inlet 30 p.s.i.

ΔP=.054×30=1.6 p.s.i. pressure drop requested

Thus it will be seen that I have provided an improved disc refiner which meets the objectives and advantages above set forth and which accomplishes automatic hydraulic balanced forces on the rotor. The housing can have a single inlet and single outlet pipe and servicing and inspection of the rotor can occur without disconnection of lines.

I claim as my invention:

1. A refining mechanism comprising in combination,
a refining rotor disc having inner and outer faces with annular refining surfaces thereon,
a supporting shaft carrying the rotor disc at its end and pojecting from the inner face of the disc,
stationary refining surfaces facing the inner and outer surfaces of the rotor and defining first and second refining zones respectively with the inner and outer rotor surfaces,
a stock flow inlet passage leading along the shaft to the inner face of the rotor disc to supply stock to the first refining space,
a stock flow passage means leading from the inlet passage to the outer face of the rotor disc to supply stock to the second refining space,
the area of the inner face of the rotor disc exposed to stock being smaller than the area of the outer face,
said passage means being of a size so that the total pressure drop of stock flowing through said passage means is equal to the difference between the axial force of the stock on the inner face of the disc and the force of the stock on the outer face of the disc.

2. A refining mechanism in accordance with claim **1** wherein said passage means comprises a flow passage means through the rotor disc.

3. A refining mechanism in accordance with claim **1** wherein said passage means comprises a plurality of uniformly spaced and uniformly sized openings positioned uniformly relative to the rotor axis.

4. A refining mechanism in accordance with claim **1** wherein the passage means in sized relative to the stock flow inlet to afford a pressure drop in the range of .04 to .06 times the inlet pressure in said inlet passage.

5. A refining mechanism in accordance with claim **1** wherein the area of said passage means relative to said inlet passage is such that there is a pressure drop of .5 p.s.i. for every 10 p.s.i. of stock inlet pressure in said flow inlet passage.

6. A refining mechanism in accordance with claim **1** including a housing supporting said stationary refining surfaces with an outlet passage leading from said refining zone at the outer periphery of said disc.

7. A refining mechanism in accordance with claim **6** wherein said inlet stock flow passage and said outlet passage are the only passages leading to and from said housing.

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GERALD A. DOST, *Primary Examiner.*

U.S. Cl. X.R.

241—256, 297

Dedication

3,438,586.—*Vincent W. Cancilla*, Pittsfield, Mass. TWO-PIPE DISC REFINER. Patent dated Apr. 15, 1969. Dedication filed May 6, 1977, by the assignee, *Beloit Corporation.*

Hereby dedicates to the Public the entire term of said patent.

[*Official Gazette August 23, 1977.*]