Sept. 15, 1953 D. M. SUTHERLAND 2,651,976

GRINDING DISK

Filed Nov. 5, 1952 3 Sheets-Sheet 1

FIG_1_

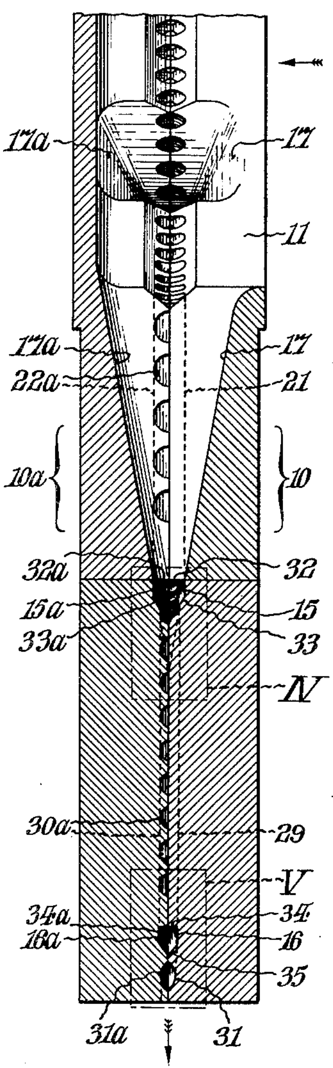


FIG_6_

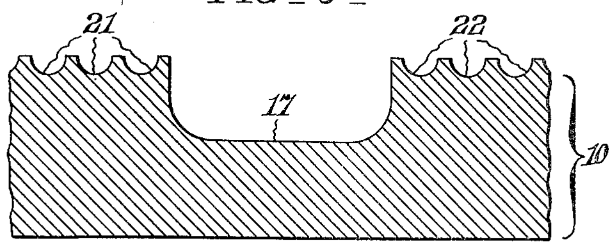


FIG_7_

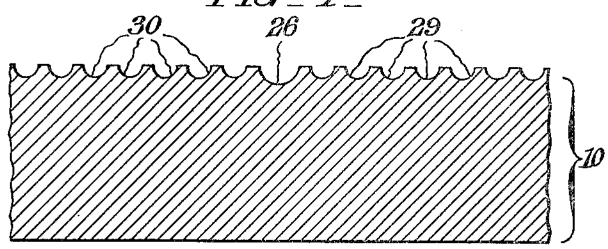


FIG_5_

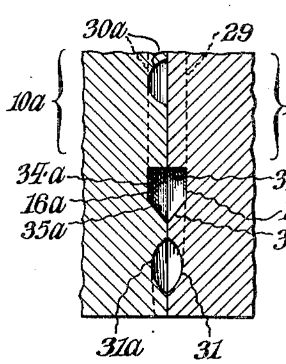


FIG_4_

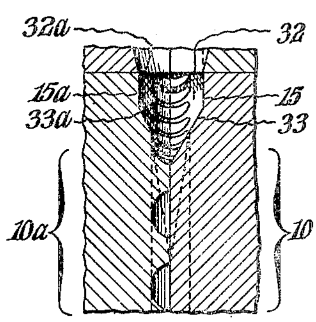
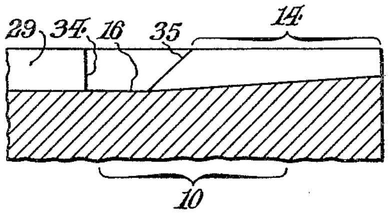


FIG_8_



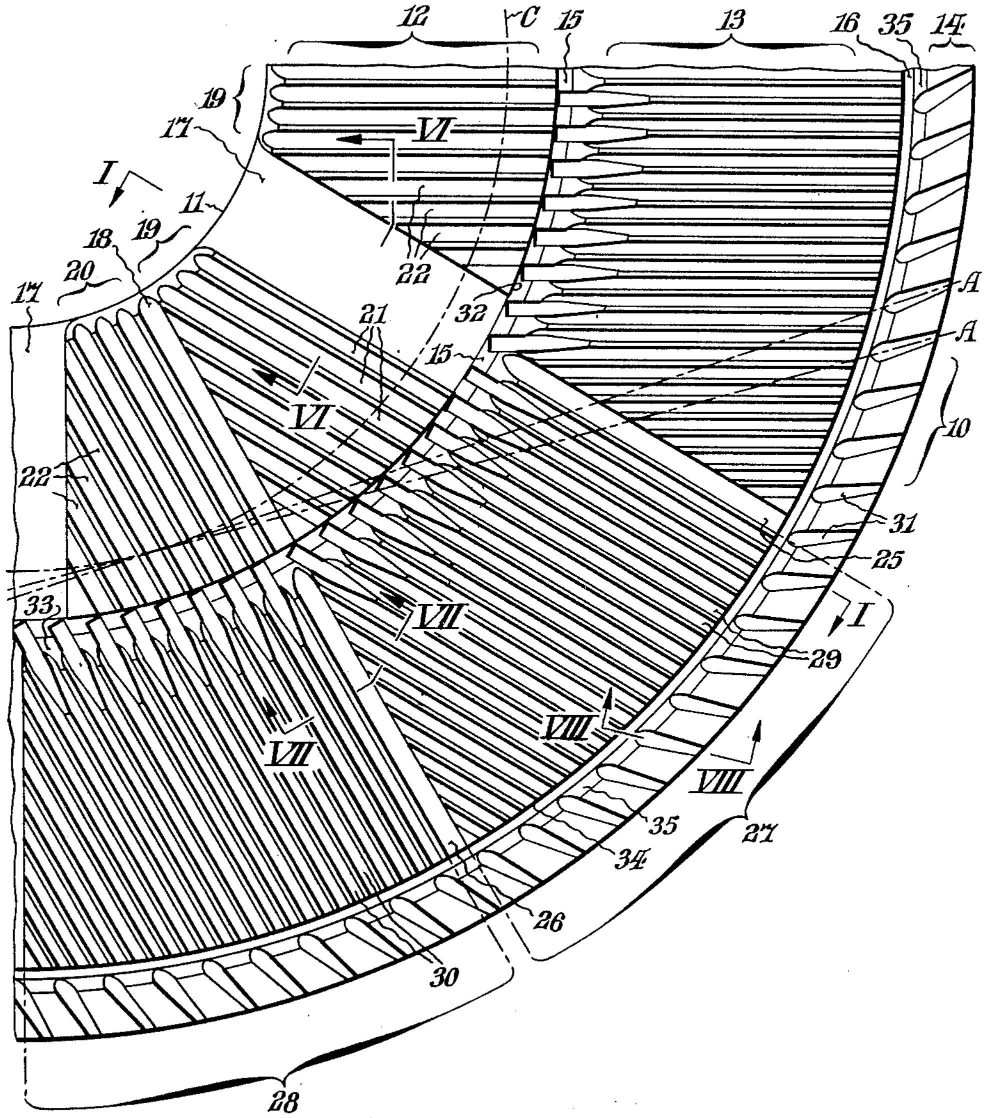
INVENTOR.
Daniel Manson Sutherland,
BY Paul & Paul
ATTORNEYS.

Sept. 15, 1953 D. M. SUTHERLAND 2,651,976

GRINDING DISK

Filed Nov. 5, 1952 3 Sheets-Sheet 2

FIG. 2



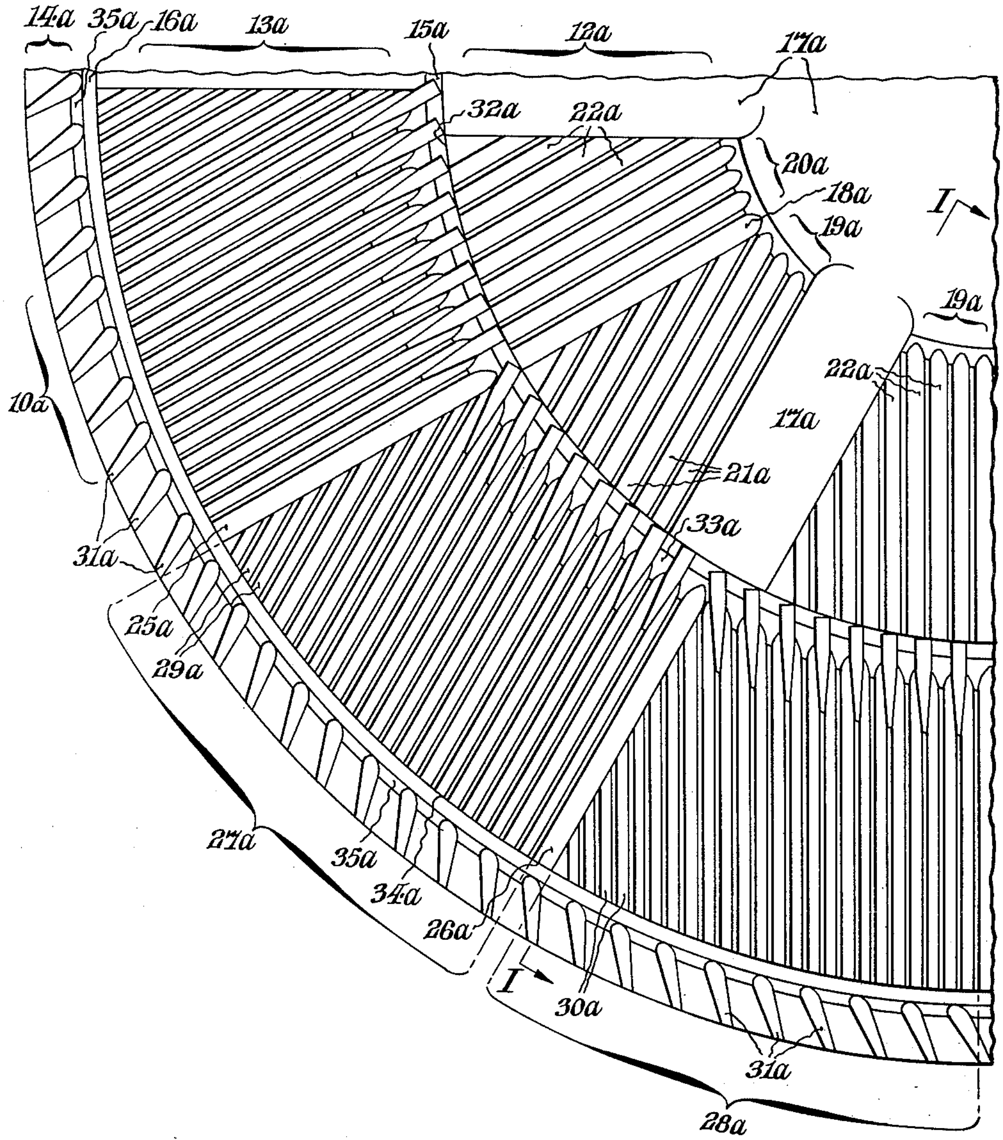
INVENTOR.
Daniel Manson Sutherland,
BY Paul & Paul
ATTORNEYS.

Sept. 15, 1953 D. M. SUTHERLAND 2,651,976

GRINDING DISK

Filed Nov. 5, 1952 3 Sheets-Sheet 3

FIG_3_



INVENTOR.
Daniel Manson Sutherland,
BY Paul & Paul
ATTORNEYS.

Patented Sept. 15, 1953 2,651,976

UNITED STATES PATENT OFFICE

2,651,976

GRINDING DISK

Daniel Manson Sutherland, Morrisville, Pa., assignor to Lionel M. Sutherland and Douglas G. Sutherland, as trustees

Application November 5, 1952, Serial No. 318,818

14 Claims. (Cl. 92—26)

1

This invention relates to grinding disks. More particularly, it has reference to grinding disks of a channeled and grooved type for use in pairs in attrition mills, such as disclosed in U. S. Patent 2,035,994 granted to me on March 23, 1926, and adapted, for example, in the reduction of wood pulp to the fineness required for the manufacture of paper or cardboard therefrom.

My present invention is directed in the main toward predetermining, through an improved arrangement of the channeling and grooving in the opposing surfaces of the disks, more even distribution and control in the flow of the pulp between them, and more uniformly progressive breaking down of the pulp than possible with grinding disks as heretofore constructed, for the attainment of a more homogeneously treated delivered product of the desired fineness and increased output from the mills.

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 a pair of opposing grinding disks conveniently embodying my invention shown in the positions which they occupy in the attenuating mill, said section being taken as indicated by the arrows I—I respectively in Figs. 2 and 3.

Fig. 2 is a fragmentary view showing the channeled and grooved grinding face of one of the disks.

Fig. 3 is a view similar to Fig. 2, showing the channeled and grooved grinding face of opposing disk.

Figs. 4 and 5 are enlarged fragmentary views corresponding to Fig. 1 showing in greater detail the construction within the confines of the broken line rectangles **4** and **5** respectively in said Fig. 1.

Figs. 6, 7 and 8 are fragmentary views in section taken as indicated respectively by the angled arrows VI—VI, VII—VII and VIII—VIII in Fig. 2, and drawn to a much larger scale.

Throughout the drawings, two opposing grinding disks are comprehensively designated **10** and **10***a* respectively, and in Fig. 1 they are shown in juxtaposition relation as they would be when positioned in attrition mills. It is to be understood that to effect the grinding, one disk may be held stationary while the other is revolved about its axis, or the two may be revolved simultaneously in opposite direction, or they may be rotated in the same direction but at different speeds.

As shown, Figs. 1 and 2, disk **10** is provided with a circular axial opening **11** and that its grind-

2

ing face has a relatively wide inner annular area **12**, an intermediate annular area **13** of substantially the same width and a comparatively narrow marginal area or check ring **14** at its periphery. As further shown in Fig. 2, two concentric annular channels **15** and **16** separate the areas **12**, **13** and **14**. Extending through the innermost annular area **12** is a plurality of relatively wide circumferentially-spaced square bottomed radial channels **17**, and alternating with these channels are much narrower medially disposed round bottomed radial channels **18** which, together with the channels **17**, set apart segmental surface areas **19** and **20**. Disposed crosswise of each segmental area **19** in parallel relation to the corresponding channel **17** is a series of narrow round bottomed grooves **21**, and disposed crosswise of the immediately adjacent segmental area **20** in parallel relation to the radial channel **18** is a series of round bottomed grooves **22** of which the width is less than that of the radial channel **18**. Again referring to Fig. 2, round bottomed radial channels **25** and **26** are also provided in the intervening annular area **13** of the grinding surface of disk **10**, these channels being equal in number to the radial channels **17** and **18** in area **12** and in line with them. The radial channels **25** and **26** are all of the same width as the radial channels **18**. The segmental portions **27** and **28** set apart by the radial channels **25** and **26** of area **13** and corresponding to the segmental portions **19** and **20** of area **12** are respectively provided with transverse grooves **29** and **30** which are somewhat narrower and of less depth than the grooves **21** and **22** of the area **12**, and exceed the latter in number, but extend in the same directions.

The marginal area or check ring **14** of the grinding face of disk **10** is provided, in turn, with circumferentially spaced crosswise grooves **31** of which the number is considerably less than the total of the grooves **29** and **30** of the intermediate annular area **13**. As shown in Fig. 2, longitudinal axes A of the grooves are tangential to a circle C whereof the diameter is smaller than that of the disk, and from Fig. 8, that they taper in width and decrease in depth outwardly toward the periphery of the disk.

It is to be particularly noted from Figs. 1 and 5 that the depth of the innermost annular channel **15** is equal in depth to that of the cross grooves **21** and **22** of the annular area **10**, and that said channel is flat bottomed, that the inner circumferential edge portion **32** thereof is at right angles to the bottom, and that its circumferential outer edge portion 33 is sloped on a bevel. It is also to be noted from Fig. 1 that the depth of the wide radial channels 17 increase gradually in depth from that of the grooves 21 and 22 at the innermost annular channel 15 toward the center of the disk. Attention is further directed to the fact that the depth of the outermost annular channel 16 is equal to that of the crosswise grooves 29 and 30 of the intermediate area 12, and that said channel is flat bottomed like the channel 15, has an inner circumferential edge portion 34 at right angles to the bottom, and an outer circumferential portion 35 which is sloped at a bevel. Another important characteristic to be observed is that the maximum depth of the grooves 31 in the marginal or check ring area 14 corresponds to the depth of the annular channel 16 with which they directly communicate.

For convenience of machining disk 10 may be made in two parts which, as shown in Figs. 1, 2 and 5 are cross hatched in different directions.

Companion disk 10*a*, see Fig. 3, is an exact duplicate of disk 10 except for the absence of a central opening. Accordingly, in order to obviate the necessity for repetitive description, all corresponding characterizing features of disk 10*a* are designated by the reference characters previously employed, however, with addition, in each instance, of the letter "*a*" for convenience of more ready distinction.

When the disks 10 and 10*a* are positioned in the mill with their grinding faces opposed as in Figs. 1, 4 and 5, the grooves of the one will pass the grooves of the other in intersecting angular relation as said disks are differentially rotated, with the result that a grinding and shearing action will take place between them. In the operation of the mill, the pulp is continuously fed under pressure into the central opening 11 of disk 10 and flows, by way of the radial channels 17, 17*a* and 18, 18*a* and cross grooves 21, 21*a* and 22, 22*a* into the annular channel 15, 15*a*, then, by way of the radial channels 25, 25*a* and the cross grooves 29, 29*a* and 30, 30*a*, to the annular channels 16, 16*a*, wherefrom it will be eventually ejected through the cross grooves 31 and 31*a* of the check rings 13 and 13*a* at the peripheries of the disks. By reason of the described arrangement and proportioning of the channels and grooves, the flowing pulp is evenly spread out radially between them and is uniformly discharged at their peripheries after reduction of the fibers, at a rate which is definitely controlled by reason of the variation in the widths of the radial channels and the cross grooves, the cross sectional shaping of the annular channels, and the non-radial disposal and the described shaping of the grooves in the check rings.

Having thus described my invention, I claim:

1. A grinding disk for use in attrition mills having a grinding face with a relatively wide crosswise grooved inner annular area, a crosswise grooved intermediate annular area of substantially the same width, a crosswise grooved narrower marginal check ring area at the periphery, and concentric annular channels separating said areas, the longitudinal axes of the grooves in the marginal or check ring area being tangential to a concentric circle of which the diameter is smaller than the diameter of the disk.

2. A grinding disk according to claim 1, wherein the grooves in the marginal check ring area taper in width and decrease in depth outwardly from the outermost annular channel.

3. A grinding disk according to claim 1, wherein the crosswise grooves of the inner annular area are all of the same width and depth; wherein the crosswise grooves of the intermediate annular area are likewise all of the same depth but narrower and shallower than those of said inner area and greater in number; and wherein the maximum depth of the groove in the marginal or check ring area is equal to the depth of the crosswise grooves in said intermediate area.

4. A grinding disk according to claim 1, wherein the outer of the two annular channels is flat bottomed, the inner circumferential edge portion of said channel is at right angles to the bottom, and the outer edge portion is sloped on a bevel.

5. A grinding disk according to claim 1, wherein the outer of the two annular channels is flat bottomed, the inner circumferential edge portion of said channel is at right angles to the bottom, and the outer edge portion is sloped on a bevel; and wherein the innermost annular channel is cross sectionally configured like said outermost annular channel.

6. A grinding disk according to claim 1, wherein the crosswise grooves of the intermediate area exceed in number those of the inner area; and wherein the number of crosswise grooves of the marginal or check ring are less than the number of crosswise grooves of said intermediate area.

7. A grinding disk for use in attrition mills having a grinding face with relatively wide inner and intermediate annular areas and a narrower marginal or check ring area at the periphery, concentric annular channels separating said areas, circumferentially spaced radial channels in the inner and intermediate annular areas, crosswise grooves in the segmental face portions of the inner and intermediate areas set apart by the radial channels aforesaid, and circumferentially spaced grooves in the marginal or check ring area with their longitudinal axes tangential to a concentric circle smaller in diameter than the diameter of the disk.

8. A grinding disk according to claim 7, wherein the grooves in the marginal or check ring area taper in width and decrease in depth outwardly from the outermost annular channel.

9. A grinding element according to claim 7, wherein alternate radial channels in the inner annular area are relatively wide, wherein the intervening radial channels of said area are narrower, and wherein the radial channels in the intervening area are of substantially the same width as the narrow channels in the inner annular area.

10. A grinding disk according to claim 7, wherein the crosswise grooves in the segmental portions of the inner annular area are all of the same width and depth and correspond in depth to that of the innermost annular channel; wherein the crosswise grooves of the intermediate annular area are likewise all of the same depth but narrower and shallower than those of the inner area and correspond in depth to that of the outermost annular channel; and wherein the maximum depth of the grooves in the marginal or check ring area is equal to the depth of the crosswise grooves in the segmental portions of said intermediate area and of said outermost annular channel.

11. A grinding disk according to claim 7, wherein the crosswise grooves in the segmental portions of the inner annular area are all of the same width and depth and correspond in depth to that of the innermost annular channel; wherein the crosswise grooves of the intermediate annular area are likewise all of the same depth but narrower and shallower that those of the inner area and correspond in depth to that of the outermost annular channel; wherein the maximum depth of the grooves in the marginal or check ring area is equal to the depth of the crosswise grooves in the segmental portions of said intermediate area and of said outermost annular channel; and wherein the wide radial channels of the intermediate area increase in depth gradually from that of the crosswise grooves of the segmental portions at the innermost annular channel toward the center of the disk.

12. A grinding disk according to claim 7, wherein the outer of the two annular channels is flat bottomed, the inner circumferential edge portion of said channel is at right angles to the bottom, and the outer edge portion is sloped on a bevel.

13. A grinding disk according to claim 7, wherein the outer of the two annular channels is flat bottomed, the inner circumferential edge portion of said channel is at right angles to the bottom, and the outer edge portion is sloped on a bevel; and wherein the innermost annular channel is cross-sectionally configured like said outermost annular channel.

14. A grinding disk according to claim 7, wherein the crosswise grooves of the intermediate area exceed in number those of the inner area; and wherein the number of crosswise grooves of the marginal or check ring area is less than the number of crosswise grooves of said intermediate area.

DANIEL MANSON SUTHERLAND.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,160,964	Warren	Nov. 16, 1915
2,035,994	Sutherland	Mar. 31, 1936
2,156,321	Sutherland	May 2, 1939