Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 1

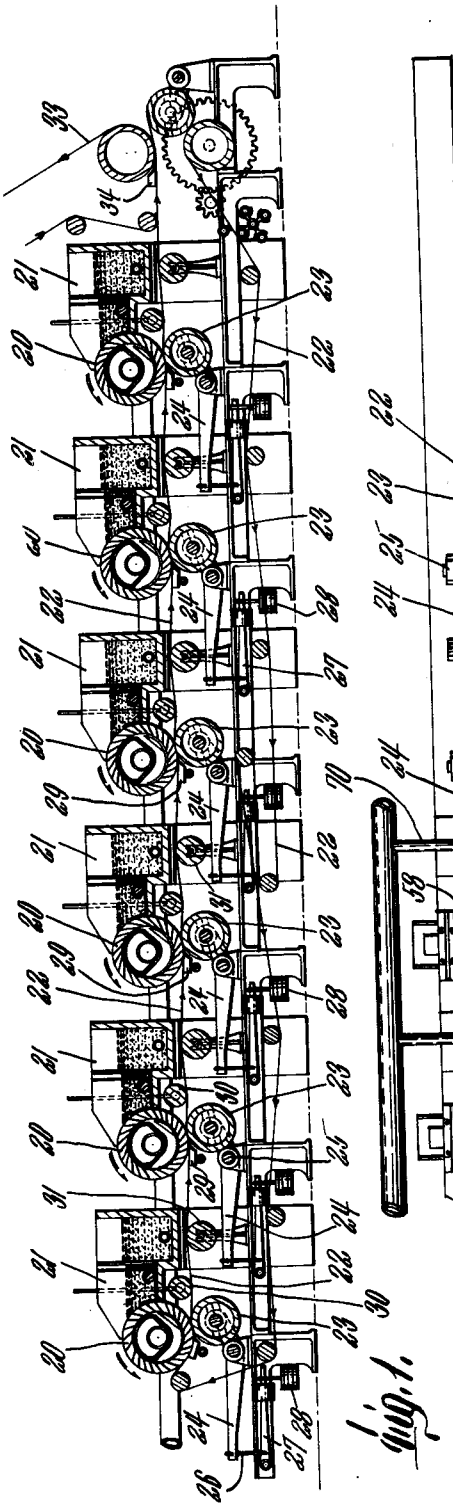


Fig. 1.

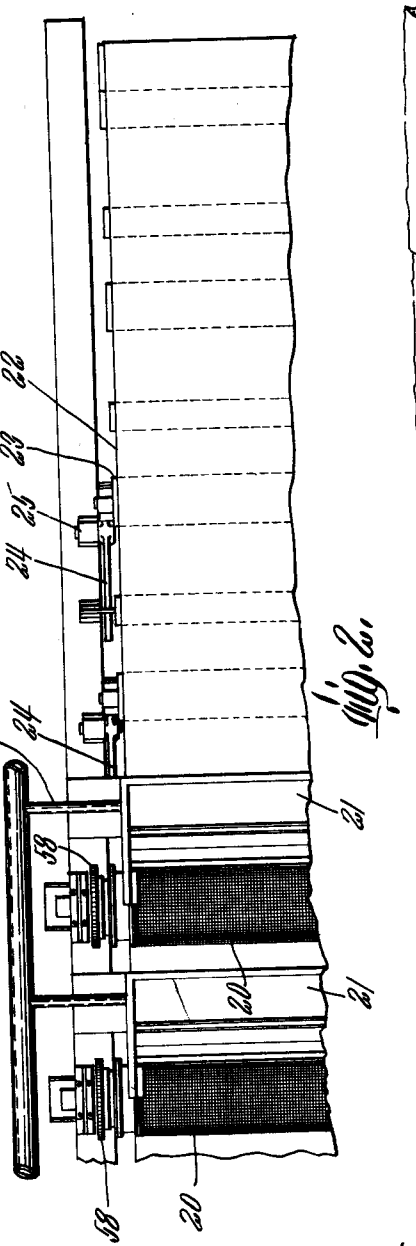


Fig. 2.

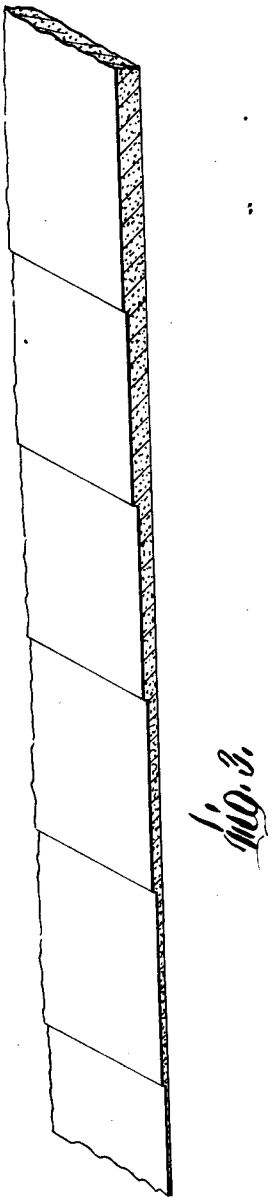


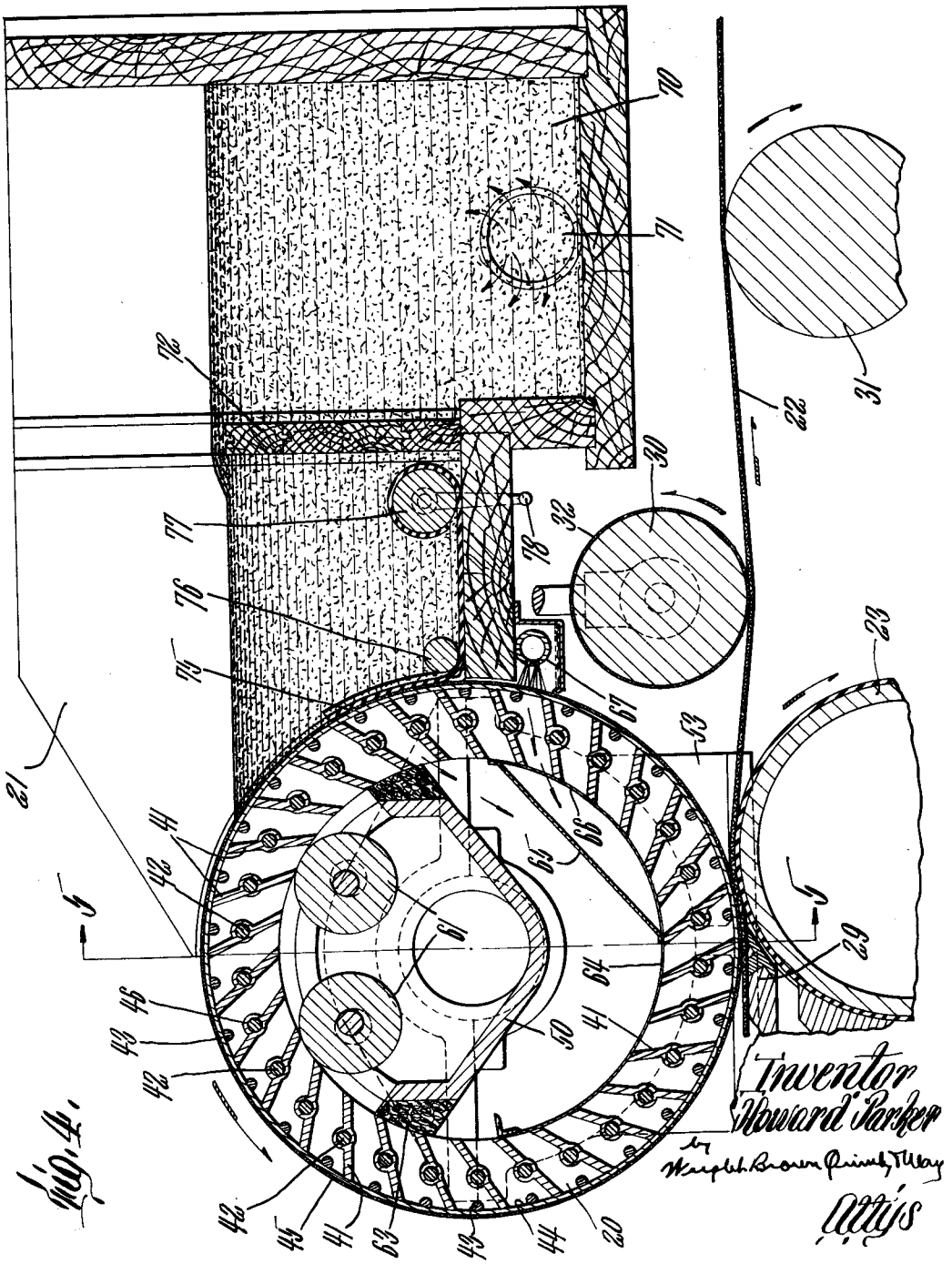
Fig. 3.

Inventor
Howard Parker
by Wright Brown Quinby & Macy
Attys

Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 2



Inventor
Howard Parker
by Wright Brown Quinby & May
Attys

Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 3

Fig. 5.

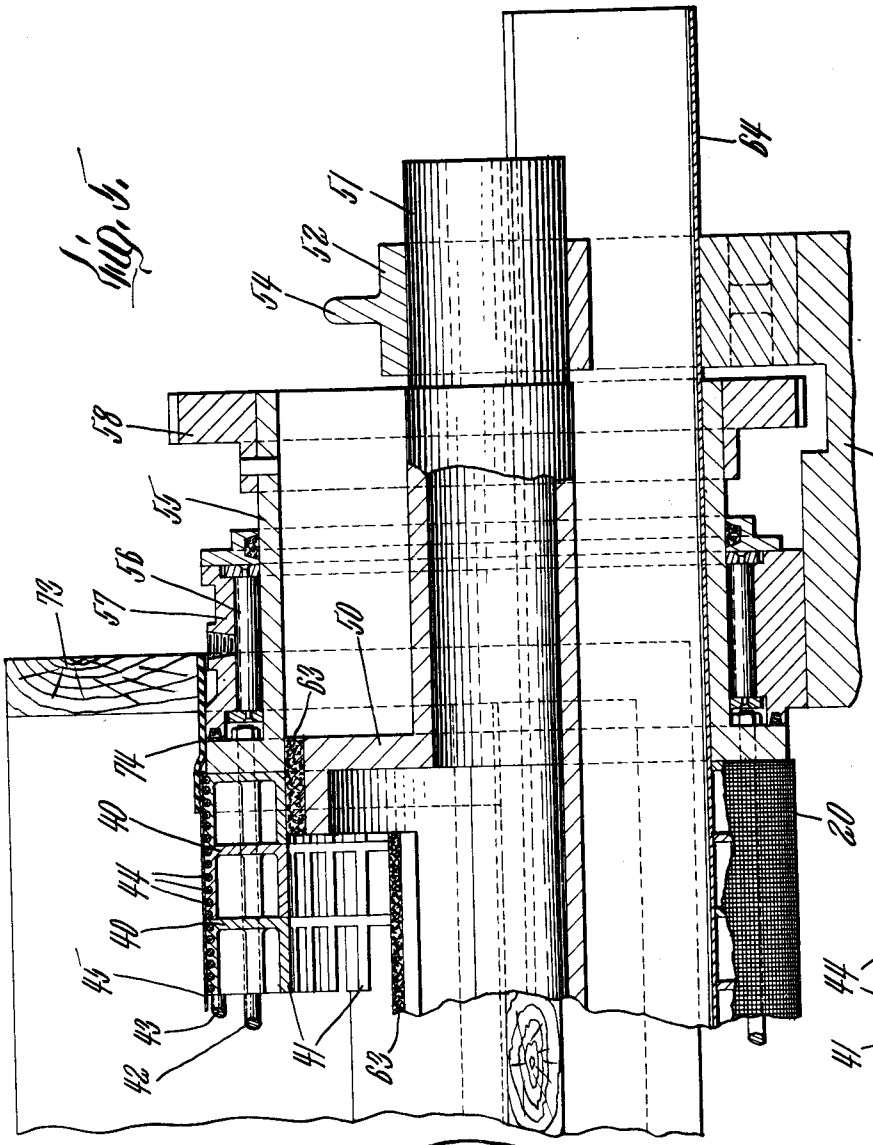
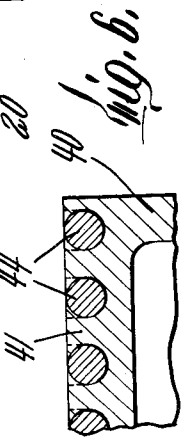
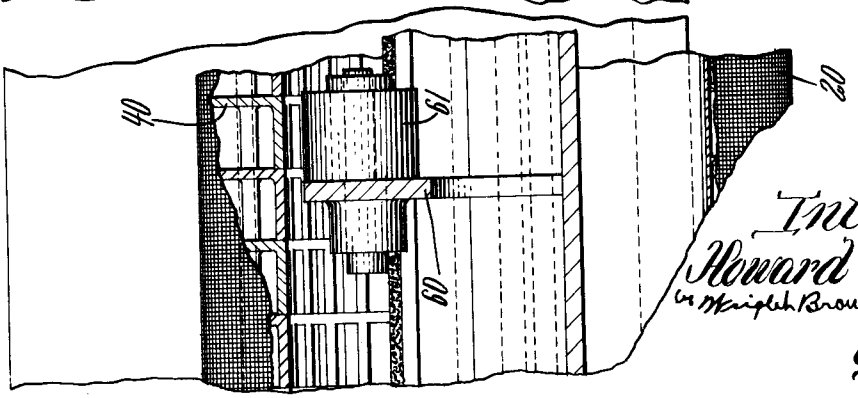


Fig. 6.





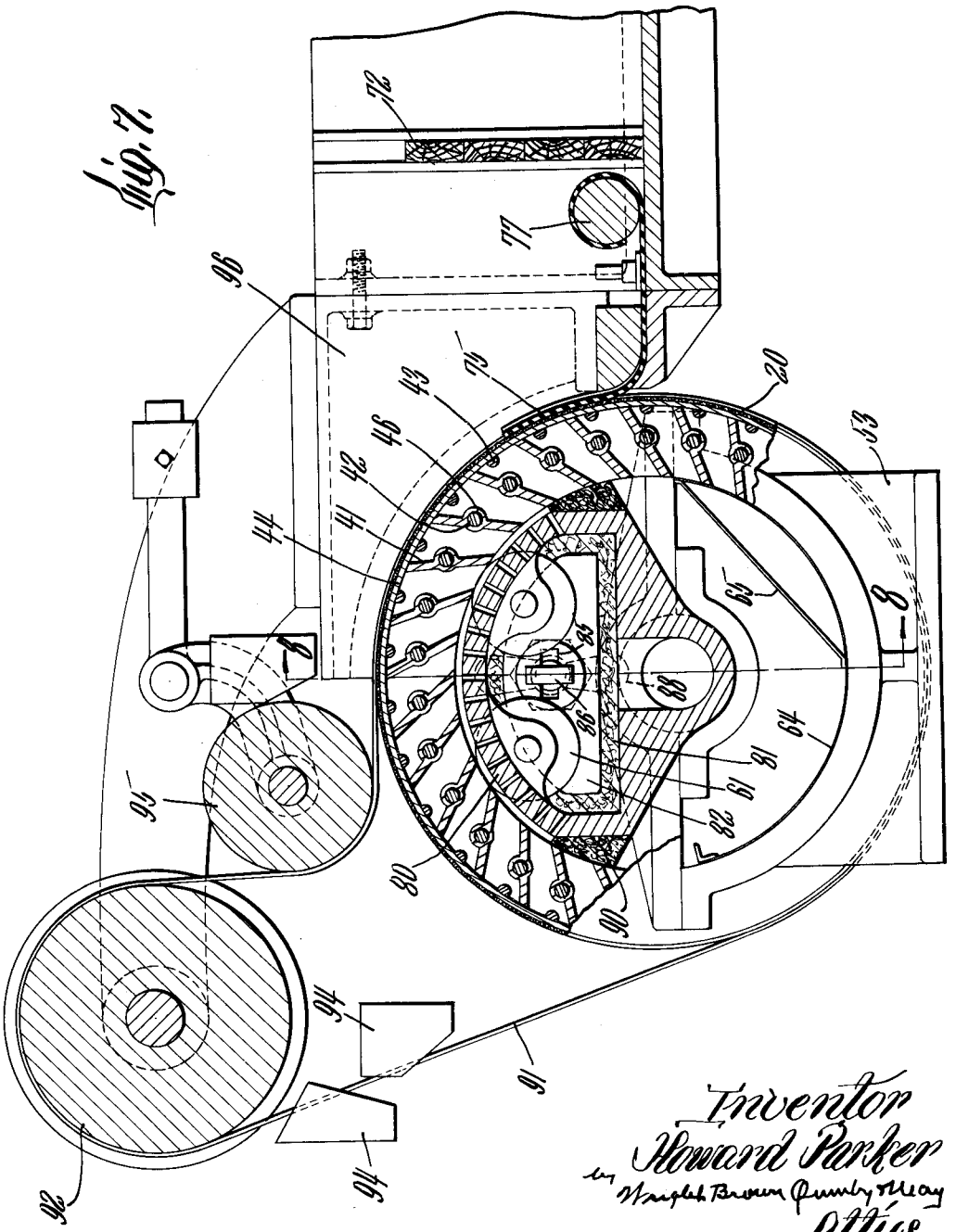
Inventor
Howard Parker
by Wright Brown Quinby & Mac
Attys

Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 4

Fig. 7.



Inventor
Howard Parker
by Wright Brown Quinby & May
Attys

Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 5

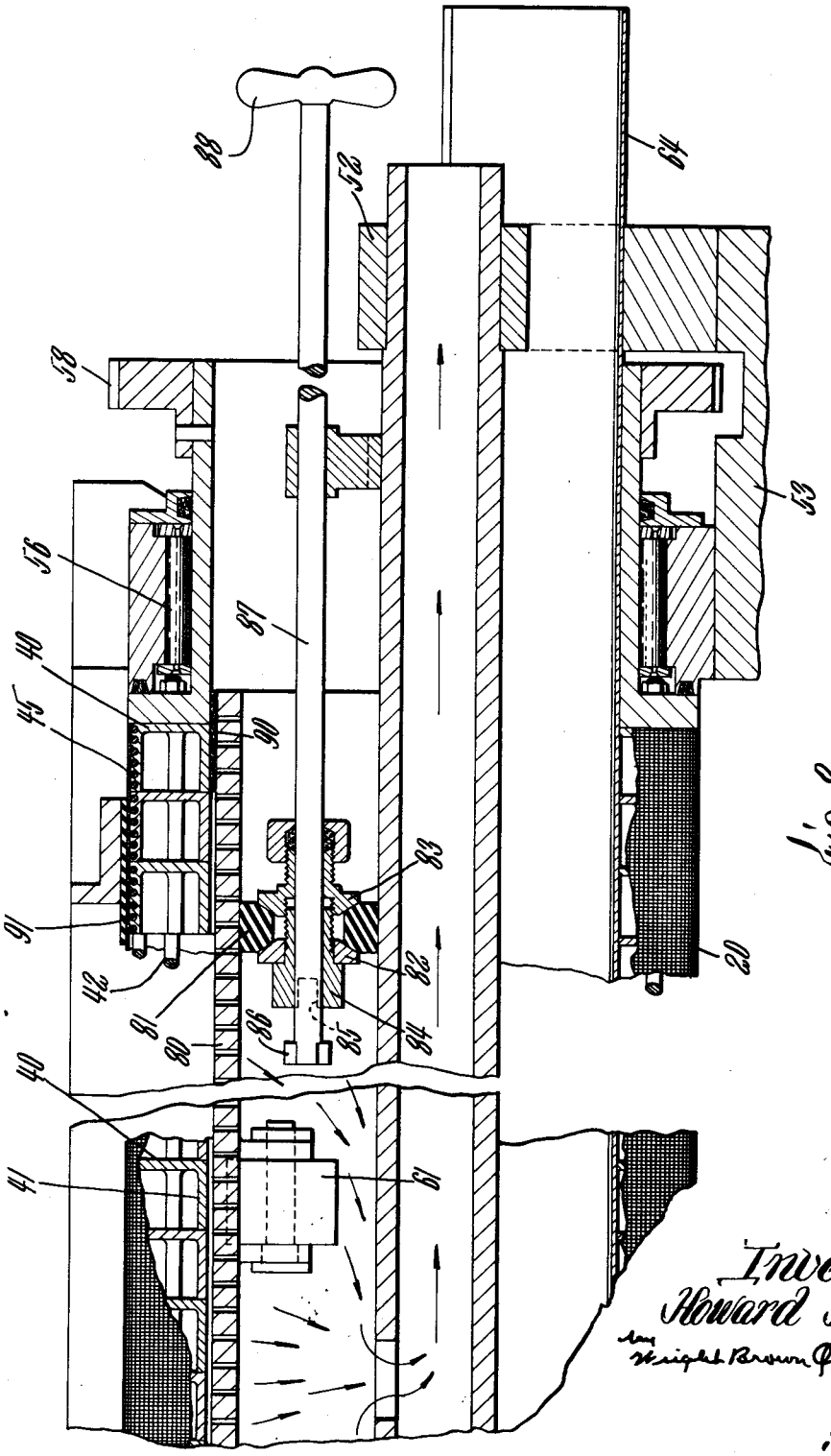


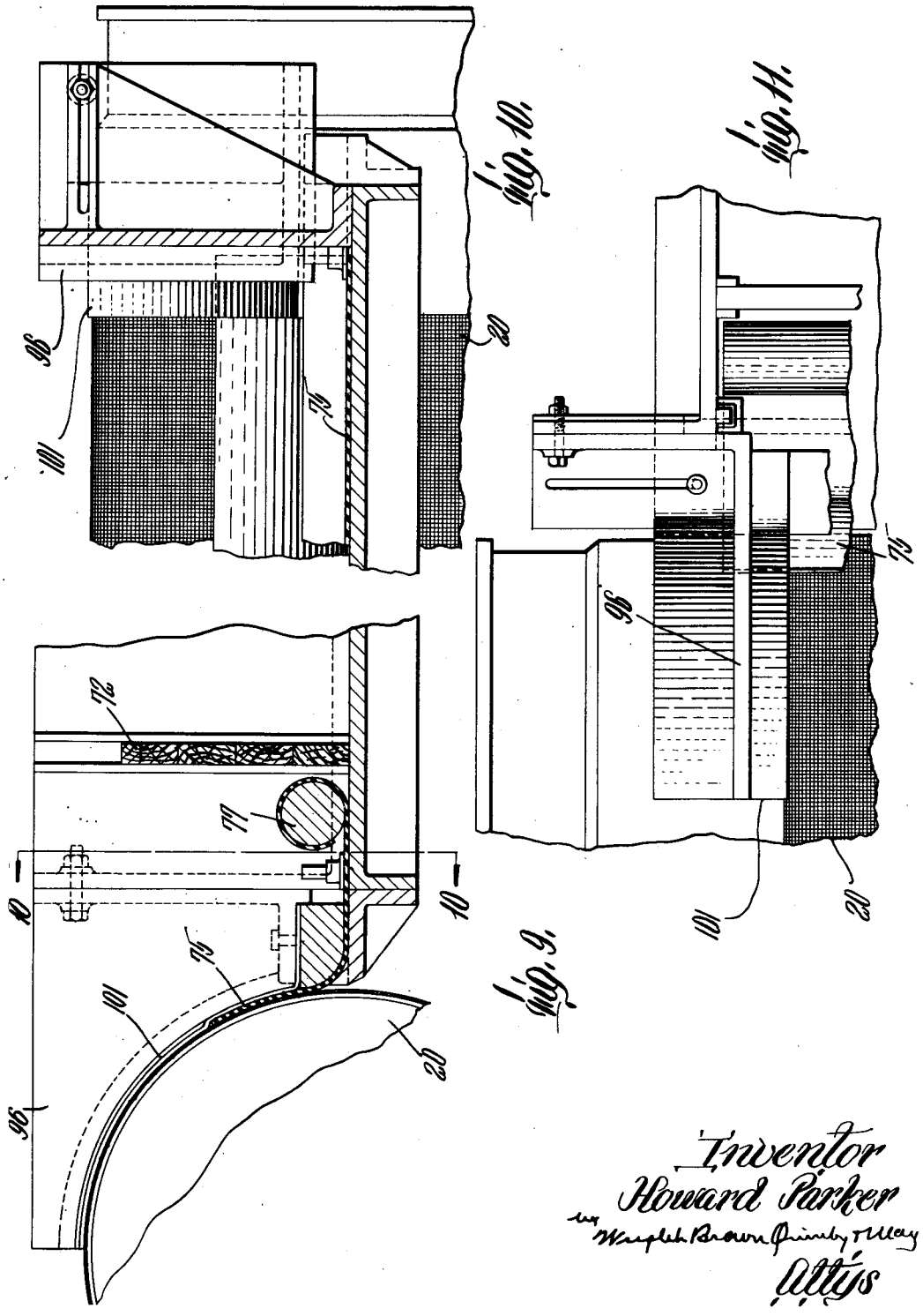
Fig. 8.

Inventor
Howard Parker
by Wright Brown Quinby & May
Attys

Oct. 11, 1932. H. PARKER 1,881,914

MULTIPLE CYLINDER PAPER MAKING MACHINE

Filed Feb. 4, 1930 6 Sheets-Sheet 6



Inventor
Howard Parker
by Wright Brown Quinby & May
Attys

Patented Oct. 11, 1932 1,881,914

UNITED STATES PATENT OFFICE

HOWARD PARKER, OF BERLIN, NEW HAMPSHIRE, ASSIGNOR TO BROWN COMPANY, OF BERLIN, NEW HAMPSHIRE, A CORPORATION OF MAINE

MULTIPLE CYLINDER PAPER MAKING MACHINE

Application filed February 4, 1930. Serial No. 425,777.

This invention relates to the art of paper making and more particularly to a method of and apparatus for making multi-ply paper of superior quality at high speed. It is an object of the invention to provide apparatus capable of effecting a stronger interfelting of wet plies than has been heretofore possible, principally by causing the moisture in the plies to pass through in a uniform direction. It is also an object of the invention to provide mechanism by which certain characteristics of the individual plies may be readily modified. This includes improved construction of the cylinder molds themselves to permit the use of localized suction therein and at the same time to ensure the production of a uniform pulp web thereon. The improvements also include a device for adjustably regulating the "loading" of the pulp on the cylinder mold.

Other advantageous features of the invention will be apparent to one skilled in the art from the disclosure thereof in the following description and on the drawings, of which,—

Figure 1 is a longitudinal section of a multiple cylinder machine embodying the invention.

Figure 2 is a fragmentary plan view of the apparatus shown in Figure 1, some of the cylinders and pulp vats being omitted to show the felt beneath.

Figure 3 is a fragmentary perspective view of a multi-ply sheet of paper in the course of being built up.

Figure 4 is a portion of Figure 1 on a larger scale.

Figure 5 is a section on the line 5—5 of Figure 4.

Figure 6 is a fragment of Figure 5 on a larger scale.

Figure 7 is a section of a modified form of paper making machine.

Figure 8 is a section on the line 8—8 of Figure 7.

Figure 9 illustrates in section a further modified form of the invention.

Figure 10 is a section on the line 10—10 of Figure 9.

Figure 11 is a fragmentary plan view of the apparatus illustrated in Figure 9.

Referring to Figures 1 and 2, a series of cylinder molds 20 are shown, associated with each of which is a suitable pulp vat 21 opening onto an upper quadrant of the cylinder. This location of the pulp vats permits the passage of an endless felt 22 horizontally beneath the successive cylinder molds and tangent to the bottoms thereof. A press roll 23 is employed with each cylinder mold to press the felt yieldingly against the mold. For this purpose the press roll 23 may be supported on a lever arm 24 fulcrumed at 25, the opposite arm having a link 26 connecting it to a secondary lever arm 27 which carries one or more adjustable weights 28. This arrangement results in a definite pressure being exerted against the felt where it is in contact with the bottom of each roll so that immediately after the sheet of wet pulp formed on the mold is transferred to the felt, it is squeezed with the felt between the mold and its press roll. Just before the felt enters the nip between each mold and its roll, it passes over a suction box 29, the suction thus being applied, as shown in Figure 4, along the line at which the pulp sheet on the mold comes in contact with the felt. The object of this arrangement is to effect a stronger and more complete interfelting of the fibers of the successive plies which are adjoined together on the felt as it passes beneath the successive cylinder molds. This is done by causing the water in the wet pulp sheets to pass through the built-up paper sheet in a single direction. Since gravity is at all times active on water contained in a pulp sheet, it is desirable to arrange the apparatus so that all the forces acting to drive the water through the sheet, or plies thereof, act in the same direction with gravity. Thus as the wet pulp sheet rotates around the cylinder from the upper portion of the cylinder where it is formed to the lower portion of the cylinder where it is transferred to the felt, the centrifugal force of rotation of the cylinder tends to cause the moisture in the pulp sheet to move outwardly. This outward direction becomes a downward direction when the sheet approaches the point

of juncture with the felt 22. The suction boxes 29, which are placed adjacent to the lowest point of the cylinder molds, also drag the water in a downward direction through the felt and the pulp thereon so that, with the exception of a slight capillary force, all the forces acting on the moisture in the sheet at the lines of juncture of the plies act in a downward direction and hence maintain a flow of water through the sheet in a uniform direction. This results in an efficient interfelting between the successive plies so that the resulting sheet of paper is strengthened thereby. The felting action is promoted by the pressing together of the joined plies immediately after they come together, this being accomplished by the press rolls 23.

The cylinder molds are preferably driven from a common source (not shown), the individual molds being synchronized by automatically controlled variable speed connections well known to the art, these driving connections being controlled by suitable rolls 30, each of which rides on a stretch of the felt 22 between each cylinder mold 20 and an idle guide roll 31. As shown in Figure 4, the rolls 30 are preferably covered with wire 32 to prevent the rolls from picking up the pulp sheet from the felt 22. They may, however, be hollow porous rolls similar to what is known in the art as dandy rolls. After the sheet has been built up completely by the interfelting of all the successive plies deposited on the felt 22, the sheet may be transferred to another felt 33 and carried off to drying rolls or elsewhere as desired. A suction box 34 may be employed to facilitate the transfer of the pulp web from the felt 22 to the felt 33.

Figures 4 and 5 illustrate in more detail various features of the construction of the individual cylinder molds and associated apparatus by which the characteristics of the individual plies may be controlled so as to produce a paper sheet having the desired characteristics. The cylinder mold itself may be in the form of a hollow cylindrical shell to permit the use of an adjustable suction mechanism therein. As shown the cylinder may have a cellular structure composed of a number of flat rings 40, from one face of which extend longitudinally a number of vanes 41, these vanes being preferably inclined with respect to radial directions when viewed in transverse section, as shown in Figure 4. The vanes 41 act as spacers between successive rings 40, as shown in Figure 5, the rings and vanes being assembled with tie-bolts 42 by which they are held together to form the cylindrical shell. The tie rods are set up tightly to hold the rings 40 together in the form of a rigid hollow cylinder. The peripheries of the rings 40 may also be notched to receive longitudinally extending rods 43, the outer faces of which are flush with the outer edges of the rings 40 and the vanes 41. The outer edges of the vanes 41 are also notched, as shown in Figure 6, to receive a heavy wire 44 which is wound around the cylinder flush with the outer surface thereof to support the wire screen 45 on which the pulp sheet is formed. After the wire 44 is wound in the notches of the vanes 41, the metal of the vanes may be peened over, as shown in Figure 6, to form a substantially continuous outer surface on each vane 41.

The cellular structure of the mold is not only more economical than a single perforated shell, but is also superior in operation. This is due to the close spacing of the openings immediately beneath the wire screen 45, or, in other words, the narrow supporting surfaces for the screen 45. By this construction a pulp web is laid on the mold, which is free from irregularities due to watermarking, so that the formation of "wild" sheets is avoided.

The vanes 41 may be provided with bosses 46, as shown in Figure 1, these bosses being longitudinally drilled to receive the tie rods 42 with a snug fit. Thus the vanes of successive rings are lined up from one end of the mold to the other so that the alined vanes together form longitudinally extending members arranged at an angle to radial directions. As a result of this structure, the passage of white water from the pulp vat through the cylinder shell of the mold is facilitated during the upward movement of the surface of the shell adjacent to the pulp vat. During the latter part of its downward movement, prior to engagement with the felt 22, the members formed by the vanes 41 are tilted outwardly and downwardly so that any residual white water clinging to their faces flows outwardly under the force of gravity and centrifugal action so that a small amount of moisture is returned to the pulp sheet on the mold just as it joins the felt 22 or a pulp sheet already on the felt, this small amount of additional water being sucked by the box 29 downwardly through all the plies on the felt 22 to promote a firm interfelting of the fibers of the plies which are being joined at this point. The moisture returned into the sheet for this purpose should, of course, be insufficient to wash the sheet from the surface of the mold.

More rapid operation of a machine of the kind illustrated and described is made possible by the use of suction to assist in the passage of the white water through the pulp mat as it is formed on the surface of the cylinder mold. To this end a suction box 50 may be provided within the interior of the cylinder shell 21, this suction box opening outwardly so as to apply suction to the upper portion of the shell. As shown in Fig-

ure 5, a suitable suction pipe 51 may extend from the box 50 outwardly through an end of the mold, this pipe being supported by a bracket 52 mounted on the frame 53 and provided with a stiffening rib 54. The pipe 51 is preferably coaxial with the cylinder mold 29 so that the box 50 may thus be rotationally adjusted to shift the application of suction within the cylinder mold.

As shown in Figure 5, the cylinder mold 20 may be provided with suitable extensions 55 having roller bearings 56, or the like, running in a suitable race 57 mounted on the frame 53. A gear 58 may also be mounted on the extension 55 to drive the cylinder mold. Another set of roller bearings 56 may be supplied at the opposite end of the cylinder mold. While these bearings support the ends of the mold, it is desirable to support the mold also at intermediate points on account of the downward drag of the suction which tends to cause a binding of the shell on the edges of the suction box. To this end the box itself may be heavily constructed and provided with a suitable number of internal brackets 60 carrying bearing rollers 61 which are adjustable, as shown in Figure 4, to support the intermediate portions of the cylinder shell by engagement with the inner surface thereof. The side and end edges around the opening in the suction box 50 are preferably provided with suitable packing 63 to minimize air leakage into the box.

As shown in Figure 4, the box 50 divides the interior of the cylinder shell into upper and lower compartments, the lower compartment being provided with a suitable trough 64 adapted to catch any stray white water which may get through the cylinder shell below the suction box. This trough extends outwardly through the open end of the cylinder, as shown in Figure 5. A partition member 65 may also be provided in the trough 64 to form a separate passage for the reception of wash water through an opening 66 in the side of the trough, this wash water being supplied by a suitable spray pipe 67 directed against the outer surface of the mold at a point below the bottom of the pulp vat 21.

The pulp vat itself may be for the most part of ordinary construction, this vat having a reception chamber 70 which is directly supplied with stock through a pipe 71. The stock forms a pool in the chamber 70 which overflows a suitable dam 72 and enters the vat 21 where it comes in contact with a portion of the surface of the cylinder mold 20. Extending inwardly from the sides 73 of the vat 21 are flexible deckles 74 which may be of rubber or of other suitable material and which extend over the edges of the wire screen forming the outer surface of the cylinder mold. Extending upwardly from the bottom of the vat 21, and in contact with the surface of the mold 20, I may provide an adjustable shield or apron 75 which may be formed of a sheet of rubber or equivalent material. This sheet extends from side to side of the vat and its edge is adjustable up and down on the surface of the cylinder. The sheet may conveniently be passed under a guide roll 76 and across the bottom of the vat 21 to a roll 77 to which is attached a crank and handle 78. The roll 77 may be releasably held against rotation by bearing friction, or by any suitable positive device such as a ratchet and pawl. When the roll, as shown in Figure 4, is rotated in a clockwise direction, the opposite edge of the apron 75 is permitted to move upwardly with the motion of the cylinder mold so that it masks a greater area of the portion of the cylinder mold which is exposed to the interior of the pulp vat 21. This results in the deposition of a thinner sheet of pulp on the mold since the apron 75 masks that portion of the mold surface which otherwise would be exposed to the bottom portion of the pool of pulp in the vat 21 where the hydraulic head is greatest. If it is desired to increase the thickness of the pulp mat picked up by the cylinder mold, the roll 77 is rotated in a counterclockwire direction draw the edge of the apron 75 downwardly and thus to expose a greater area of the mold surface directly to the pool of pulp in the vat 21. Thus by manipulation of the rolls 77 in the several pulp vats the thickness of each ply may be individually regulated.

It may be desirable to vary the width of one or more of the plies which are formed on the successive cylinder molds. To this end one or more of the molds may be constructed as shown in Figures 7 and 8. The shell 20 may be formed as hereinbefore described and may be supported at its end by roller bearings 56, suitable rollers 61 being provided for the support of the intermediate portions of the cylinder shell. The suction box illustrated in Figures 7 and 8 is different from that hereinbefore described. As shown, it comprises a perforated wall 80 and movable end closures which comprise a rubber packing piece 81 adapted to be squeezed between a pair of members 82 and 83 so as to expand its periphery and thus to seal the ends of the suction box. The upper member 82, as shown in Figure 8, may be carried by a screw threaded member 84 which is in threaded engagement with the member 83 so that when these members are relatively rotated they approach or recede from each other so as to squeeze or release the packing member 81. In order to facilitate the rotation of the member 84, it may be slotted as at 85 to receive a key 86 carried on the end of a stem 87, the latter projecting out beyond the end of the cylinder so as to be readily turned by means of a handle 88. Thus the end closure can readily be shifted lon-

gitudinally of the cylinder and set up for water-tightness in any desired position within its motion. The perforated portion 80 of the suction box is spaced a short distance inwardly from the interior surface of the cylinder shell, this clearance being made watertight around the edges of the box by a suitable packing 90.

In order to vary the width of the pulp mat picked up by the cylinder, movable deckles 91 are provided, the deckles in this case being shown as endless traveling members which pass about the cylinder shell and also about a suitable idle roller 92. A pair of cleaners 94 may be provided to clean each deckle strip before it returns to contact with the cylinder mold. The roller 92, as well as an additional guide roller 95, is mounted on the side wall 96 of the pulp vat. This side wall is adapted to be adjustable longitudinally of the cylinder mold, and when so adjusted it carries with it the deckle 91 so that the width of the pulp mat is thus variable within limits. When the deckles 91 are shifted to vary the width of the pulp mat picked up by the cylinder molds, the movable ends of the suction box within the cylinder are also shifted correspondingly so as to restrict the suction to the area of the cylinder mold which is receiving the pulp mat.

A flexible shield 75 may be provided to vary the thickness of the mat picked up by the cylinder mold, this shield having its free edge extending upwardly on the surface of the cylinder mold, its opposite end being secured to a roll 77 by which the shield may be adjusted. In the form of mechanism shown in Figures 7 and 8, the side edges of the shield 75 lap over the deckles 91.

A slightly different arrangement of deckles and shields is illustrated in Figures 9, 10 and 11. In this form the side walls of the pulp vat are each provided with adjustable sections 96 which are movable longitudinally of the cylinder to vary the width of the mat of pulp picked up thereon. The deckle in this instance is shown as a stationary sheet 101 secured to the movable wall portion 96. The side margins of the shield 75 extend underneath the deckles 101 so that the latter slides readily over the shield. The deckle is provided of flexible sheet material so as to be capable of hugging the surface of the cylinder as shown in Figure 9. The operation of the deckles and shield is substantially identical with those described in connection with Figures 7 and 8.

I claim:

1. A method of making paper, which comprises forming a sheet of wet pulp, bringing said sheet into engagement with the upper face of another sheet of wet pulp whereby the moisture in the first sheet tends to pass into the second sheet by gravity, applying suction to the under face of said second sheet along the line of juncture of the sheets, and immediately thereafter pressing the sheets together.

2. A method of making paper, which comprises forming a sheet of wet pulp on a cylinder mold, leading a second sheet of wet pulp into contact with the first sheet under the mold whereby the moisture in the first sheet tends to pass into the second sheet under the action of gravity and centrifugal force, applying suction along the line of juncture of the two sheets, and immediately thereafter pressing the sheets together.

3. A method of making paper, which comprises forming a sheet of wet pulp, feeding said sheet in a substantially horizontal direction, forming a plurality of additional sheets of wet pulp, applying said additional sheets successively and additionally to the upper surface of the first sheet to build up a multi-ply web, applying suction below the web along the line of contact of each additional sheet to draw the moisture therein downwardly, and squeezing the web immediately after each application of suction.

4. Apparatus for making multi-ply paper, which comprises means for forming a plurality of sheets of wet pulp, means for feeding one of said sheets in a substantially horizontal position, means for feeding another of said sheets onto the upper face of said horizontal sheet, a suction device located against the lower face of said horizontal sheet along the line of juncture of the two sheets, and means for pressing the joined sheets.

5. Apparatus of the class described comprising a plurality of cylinder molds, a pulp vat associated with an upper quadrant only of each said mold, a felt passing under said molds and tangent to each, a press roll pressing upwardly against the bottom of each mold, said felt passing between each mold and its press roll, and a suction box against the under face of said felt adjacent to the nip between each mold and its roll.

6. Apparatus of the class described comprising a plurality of cylinder molds, a pulp vat against an upper quadrant only of each said mold, aprons extending upwardly from the bottom of some of said vats against the face of said molds, means for adjusting the heights of each said apron, a felt passing under said molds and tangent to each, a press roll pressing upwardly against the bottom of each mold, said felt passing between each mold and its press roll, and a suction box against the under face of said felt adjacent to the nip between each mold and its roll.

7. Apparatus of the class described comprising a plurality of cylinder molds, a pulp vat against an upper quadrant of each said mold, aprons extending upwardly from the bottom of some of said vats, each apron being arranged to lie against and mask a portion of the surface of the adjacent mold, means for

adjusting each apron to vary its area of contact with its mold, means for applying suction within the upper portion of said mold and means for removing from the bottom of said mold a pulp web picked up thereby.

8. Apparatus of the class described comprising a plurality of cylinder molds, each said mold consisting of a hollow cylinder having a cellular construction with longitudinally extending ribs inclined outwardly and forwardly in the direction of rotation with respect to radial directions, a pulp vat associated with an upper quadrant only of each said mold, a felt passing under said molds and in contact with each, and means for applying suction to the bottom face of said felt along the lines of contact between the felt and the successive molds.

9. In a paper making machine, a cylinder mold comprising a hollow shell, means for applying suction to a portion of said shell from within, said means comprising a suction box opening toward a predetermined portion of the inner surface of the shell, rollers carried by said box for supporting said shell, and means for adjusting said rollers.

10. In a paper making machine, a cylinder mold comprising a hollow shell, a pulp vat opening against an upper quadrant only of said mold, a flexible waterproof sheet in said pulp vat having a portion arranged to lie against the surface of said mold and to extend upwardly from the bottom of said vat to mask a portion of said mold surface, and means for adjustably varying the area of contact of said sheet with said mold.

11. In a paper making machine, a cylinder mold comprising a hollow shell, a pulp vat against an upper quadrant only of said mold, a partition within said cylinder having adjustable end walls, said partition and walls forming a suction chamber within the upper portion of the mold, means for angularly adjusting the partition, means for adjustably moving said end walls in an axial direction, and means for removing the pulp web on the mold at the bottom thereof.

12. In a paper making machine, a cylinder mold comprising a hollow shell, a pulp vat against an upper quadrant only of said mold, a flexible waterproof sheet in said pulp vat having a portion arranged to lie against the surface of said mold and to extend upwardly from the bottom of the vat, means for adjustably varying the height of said sheet, a pair of deckles resting against said mold, means for adjusting said deckles to vary the width of the pulp web picked up by said mold, means for applying suction within the upper portion of said mold, and means for removing said pulp web from the mold at the bottom thereof.

13. In a paper making machine, a cylinder mold comprising a hollow shell, a pulp vat associated with an upper quadrant only of said mold, means for spraying wash water on said mold below said pulp vat, means for supporting said mold including a partition member therein extending longitudinally to divide the interior of the shell into an upper and a lower chamber, support rollers adjustably carried by said partition member to take the weight of said shell, means for maintaining suction in said upper chamber, a second partition member in said lower chamber arranged to keep separate the wash water entering the chamber from the white water, and separate ducts for wash water and white water leading from said lower chamber.

14. For a paper-making machine, a hollow cylinder mold comprising a plurality of flat rings of uniform size and similar construction, each ring having a number of vanes extending from one face thereof from the inner periphery to the outer periphery of the ring, the outer edge of each vane being disposed in a common cylinder with the outer periphery of the ring, and having a series of notches therein, said rings and vanes having perforations therethrough parallel to the axis of the rings, tie-rods extending through alined perforations in successive rings and vanes, whereby the outer edges of all the rings and vanes define a cylinder, an elongated member wound helically about the cylinder formed by the rings and vanes in said notches, the outer surface of said elongated member being flush with the outer edges of the rings and vanes, and a wire screen supported by said outer surfaces and edges.

In testimony whereof I have affixed my signature.

HOWARD PARKER.