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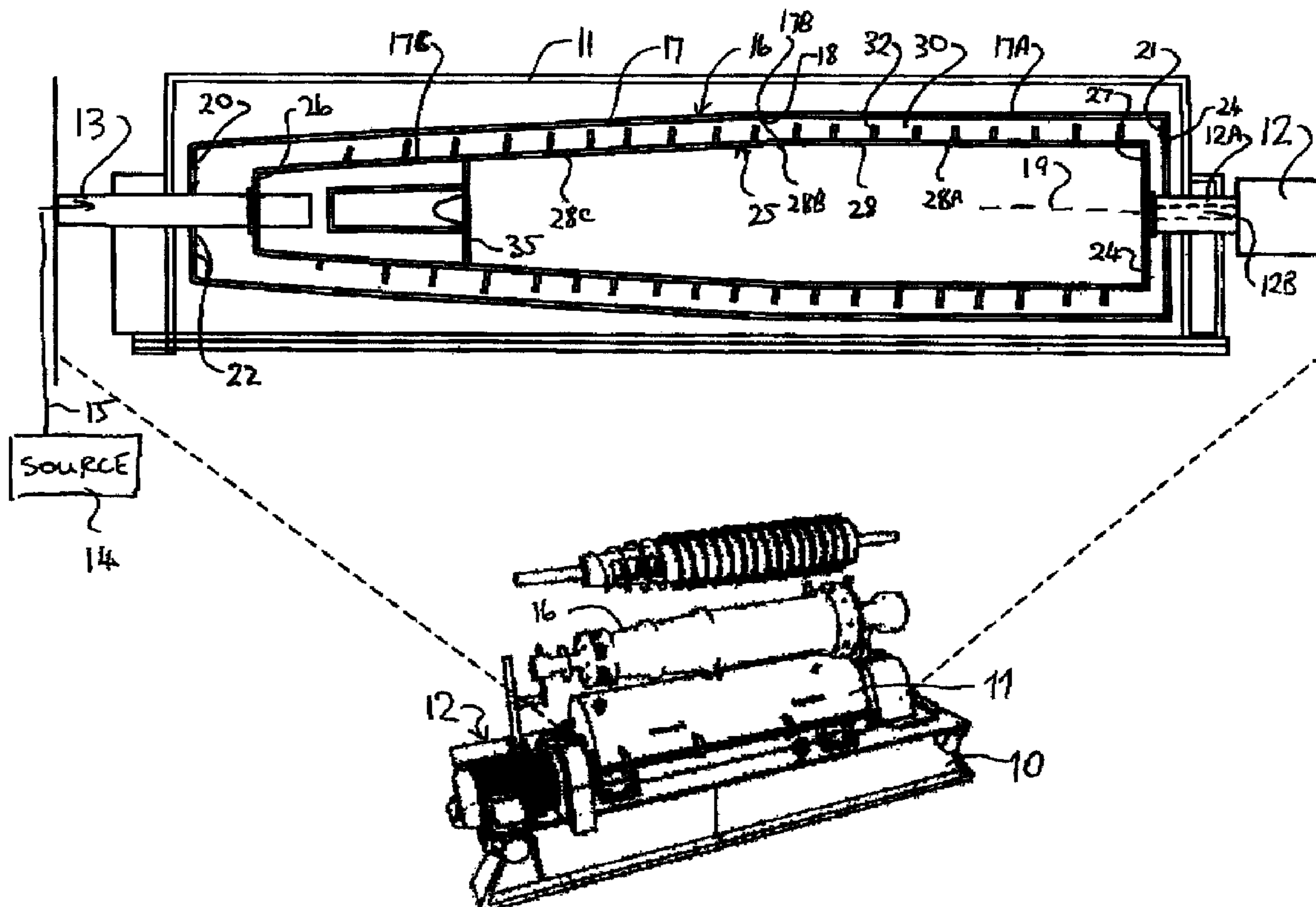
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(54) Titre : CENTRIFUGEUSE AVEC FACONNAGE DE LA CHAMBRE D'ALIMENTATION REDUISANT L'USURE

(54) Title: CENTRIFUGE WITH SHAPING OF FEED CHAMBER TO REDUCE WEAR



(57) Abrégé/Abstract:

A centrifuge of the type having an outer bowl and an inner rotor both of which are generally cylindrical and rotate in the same direction but at slightly different rates separates slurry fed into the interior of the rotor into solids and liquid. An auger flight on the outside surface of the rotor carries the solids along the annular channel between the outside of the rotor and the inside of the bowl. The slurry is fed into a chamber at one end of the rotor and through outlet holes in the sides of the rotor into the channel. An end plate of the chamber has a forwardly projecting domed central nose which extends into the flowing slurry. Transverse guide plates

(57) **Abrégé(suite)/Abstract(continued):**

of the rotor act to engage the slurry and accelerate it into rotation with the rotor before escaping through the holes. The guide plates are shaped with curved angularly projecting ribs on the downstream side in front of the hole over which the slurry flows in a smooth path before exiting the hole.

**ABSTRACT**

A centrifuge of the type having an outer bowl and an inner rotor both of which are generally cylindrical and rotate in the same direction but at slightly different rates separates slurry fed into the interior of the rotor into solids and liquid.

5 An auger flight on the outside surface of the rotor carries the solids along the annular channel between the outside of the rotor and the inside of the bowl. The slurry is fed into a chamber at one end of the rotor and through outlet holes in the sides of the rotor into the channel. An end plate of the chamber has a forwardly projecting domed central nose which extends into the flowing slurry. Transverse guide plates

10 of the rotor act to engage the slurry and accelerate it into rotation with the rotor before escaping through the holes. The guide plates are shaped with curved angularly projecting ribs on the downstream side in front of the hole over which the slurry flows in a smooth path before exiting the hole.

## **CENTRIFUGE WITH SHAPING OF FEED CHAMBER TO REDUCE WEAR**

This invention relates to a centrifuge.

### **BACKGROUND OF THE INVENTION**

Centrifuges have many different types and the present invention is  
5 concerned with the two phase centrifuge type which provides high speed horizontal  
decanting that separate solids from liquids. Centrifuges of this type have been  
manufactured by United Oilfield Inc., who are assignees of the present application  
for a number of years and each includes three primary parts which are the base or  
skid, the stainless steel case mounted on the skid and the rotating assembly  
10 consisting of the bowl, auger and gearbox which assembly is mounted in the  
stationary steel case on the skid. The auger is mounted in the bowl so that the bowl  
surrounds the auger and both are mounted for coaxial rotation about a longitudinal  
axis. The auger comprises generally a cylindrical body coaxial to the cylindrical bowl  
with an auger flight on its outer surface which has an edge close to the inside  
15 surface of the cylindrical bowl.

To create the desired effect, the bowl with the auger inside rotates  
about the axis at slightly different speeds in the same direction. The bowl speed is  
variable depending upon the application and operating conditions.

During operation, feed slurry is fed from an axially extending stationary  
20 feed pipe at one end of the auger into a feed chamber at that end of the auger  
through an end wall of the bowl. The flowing slurry strikes an accelerator plate in the

auger at one end of the feed chamber and is forced from the feed chamber outwardly into the bowl.

Centrifugal force causes heavier solids to accumulate on the inside surface of the bowl. The auger, which is rotating with the bowl but at a slow speed relative to the bowl, acts to continuously drag them axially along the bowl. Each of the bowl and the auger includes a tapered end portion at the feed end which converges radially inwardly toward a discharge end of the bowl, which is at the same end as the feed end. The rotation of the bowl and its tapered end tends to move the heavier material axially away from the discharge end to the cylindrical section of greater diameter. Thus the auger drags the material along the tapered section toward the discharge end. The discharge end includes discharge ports surrounding the feed duct so that the heavier solid material when it reaches the discharge end is discharged outwardly by the centrifugal force into the case for collection.

Finer solids are retained in the liquid traveling through the bowl away from the feed end to the remote end but are deposited on the wall of the bowl and are continuously removed as they build-up inside the bowl by the action of the auger and out the solids discharge ports.

Clean fluids travel towards the remote fluid end of the bowl and exit through adjustable eccentric ports at the remote fluid discharge end of the bowl. The centrifuge is commonly but not exclusively used for mud systems in drilling where the mud is re-circulated through the drill string to extract drilling solids so that

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the solids can be extracted in the centrifuge and the clean fluid from the centrifuge can be recycled back into the mud system of the operation.

The greatest difficulty in achieving optimal performance in a centrifuge of this type is wear caused by the combined corrosive nature of flow pressure and the abrasive solids on the steel structure of the centrifuge.

#### SUMMARY OF THE INVENTION

It is one object of the invention to provide an improved centrifuge of this general type.

According to one aspect of the invention there is provided a centrifuge for separation of particulates from a slurry containing the particulates in a liquid comprising:

an outer bowl having a longitudinal axis and a peripheral wall surrounding the axis, the peripheral wall extending from a first end of the bowl to a second opposed end of the bowl;

a first discharge arrangement at the first end of the bowl for discharge of the particulates;

a second discharge arrangement at the second end of the bowl for discharge of the slurry with the particulates removed;

a support assembly mounting the outer bowl for rotation about the longitudinal axis such that the particulates in the slurry within the bowl tend to move radially outwardly of the axis toward an inner surface of the peripheral wall;

an inner rotor mounted coaxially within the outer bowl for rotation of an

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outer wall of the inner rotor about the longitudinal axis, the rotor extending along the bowl from a first end of the rotor adjacent the first end of the bowl to a second end of the rotor adjacent the second end of the bowl;

a drive system for driving rotation of the outer bowl and the inner rotor  
5 for common rotation in the same direction;

the drive system providing a differential in rotational speed between the outer wall of the inner rotor and the inner surface of the peripheral wall of the outer bowl such that the outer wall moves angularly relative to the inner surface of the peripheral wall;

10 the outer wall of the rotor being spaced radially inwardly of the inner surface of the bowl so as to define a space therebetween within which the slurry is separated;

a helical auger flight carried on the outer wall of the rotor having an outer edge of the auger flight which moves relative to the inner surface of the peripheral wall so as to tend to carry particulates collecting on the inner surface of the peripheral wall in a direction toward the first end of the bowl and the first discharge arrangement located at the first end;

the helical auger flight having openings therein allowing movement of the slurry in the space through the openings toward the second end of the bowl;

20 the bowl and the inner rotor each including a tapered portion such that the outer wall of the rotor and the inner surface of the bowl reduce in diameter toward the first end;

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the rotor having a slurry inlet opening at the first end of the rotor into a feed chamber within the rotor;

a slurry inlet duct for transporting the slurry through the first end of the bowl into the inlet opening in the first end of the rotor;

5 the rotor having at least one outlet opening in the outer wall to allow the slurry to exit through the outer wall from the feed chamber into the space;

the rotor having an end accelerator plate of the feed chamber mounted on the rotor for rotation therewith;

10 the end accelerator plate lying generally in a radial plane of the axis such that the slurry flowing generally axially into the feed chamber contacts the accelerator plate of the rotor and moves radially outwardly therefrom through the at least one outlet opening into the space;

wherein the end accelerator plate includes a raised projecting member thereon extending radially therefrom toward the slurry inlet opening.

15 Preferably the raised projecting member is dome shaped.

Preferably the raised projecting member is symmetrical about the axis and converges to an apex on the axis.

Preferably the raised projecting member extends to an outer edge thereof spaced inwardly of an edge of the end accelerator plate.

20 Preferably the at least one outlet opening is located in the tapered portion.

Preferably the rotor wall has a plurality of angularly spaced outlet

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openings each communicating with the feed chamber.

Preferably the rotor wall has a plurality of angularly spaced outlet openings each communicating with the feed chamber;

each outlet opening thus having a leading edge and a trailing edge  
5 when considered relative to the direction of rotation of the rotor;

there is provided within the feed chamber a plurality of discharge surfaces, each discharge surface extending between the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening so as to bridge a space therebetween;

10 each discharge surface being shaped, relative to an imaginary plane joining the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening, such that a portion of the discharge surface adjacent the leading edge of said next outlet defines a series of imaginary lines extending along the portion generally parallel to the axis and lying in the discharge  
15 surface, which imaginary lines are angularly retarded relative to corresponding imaginary lines lying in the imaginary plane, where each line and its corresponding line in the plane are equidistantly spaced from the axis.

Preferably the portion of the discharge surface is smoothly curved in cross-section taken in a radial plane of the axis.

20 Preferably the portion of the discharge surface has an apex which is at a maximum spacing from the imaginary plane where the apex is spaced from the leading edge and the surface tapers back toward the imaginary plane as it

approaches the leading edge.

Preferably the portion of the discharge surface where the surface is retarded has a width in the direction between the leading edge and the trailing edge which extends about half way across the imaginary plane.

5                    Preferably each discharge surface is shaped, relative to the imaginary plane, such that a portion of the discharge surface adjacent the trailing edge of said one of the outlets lies generally in the imaginary plane.

                  According to a second aspect of the invention there is provided a centrifuge for separation of particulates from a slurry containing the particulates in a  
10    liquid comprising:

                  an outer bowl having a longitudinal axis and a peripheral wall surrounding the axis, the peripheral wall extending from a first end of the bowl to a second opposed end of the bowl;

                  a first discharge arrangement at the first end of the bowl for discharge  
15    of the particulates;

                  a second discharge arrangement at the second end of the bowl for discharge of the slurry with the particulates removed;

                  a support assembly mounting the outer bowl for rotation about the longitudinal axis such that the particulates in the slurry within the bowl tend to move  
20    radially outwardly of the axis toward an inner surface of the peripheral wall;

                  an inner rotor mounted coaxially within the outer bowl for rotation of an outer wall of the inner rotor about the longitudinal axis, the rotor extending along the

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bowl from a first end of the rotor adjacent the first end of the bowl to a second end of the rotor adjacent the second end of the bowl;

a drive system for driving rotation of the outer bowl and the inner rotor for common rotation in the same direction;

5 the drive system providing a differential in rotational speed between the outer wall of the inner rotor and the inner surface of the peripheral wall of the outer bowl such that the outer wall moves angularly relative to the inner surface of the peripheral wall;

10 the outer wall of the rotor being spaced radially inwardly of the inner surface of the bowl so as to define a space therebetween within which the slurry is separated;

a helical auger flight carried on the outer wall of the rotor having an outer edge of the auger flight which moves relative to the inner surface of the peripheral wall so as to tend to carry particulates collecting on the inner surface of the peripheral wall in a direction toward the first end of the bowl and the first  
15 discharge arrangement located at the first end;

the helical auger flight having openings therein allowing movement of the slurry in the space through the openings toward the second end of the bowl;

the bowl and the inner rotor each including a tapered portion such that  
20 the outer wall of the rotor and the inner surface of the bowl reduce in diameter toward the first end;

the rotor having a slurry inlet opening at the first end of the rotor into a

feed chamber within the rotor;

a slurry inlet duct for transporting the slurry through the first end of the bowl into the inlet opening in the first end of the rotor;

the rotor having a plurality of angularly spaced outlet openings each communicating with the feed chamber to allow the slurry to exit through the outer wall from the feed chamber into the space;

the rotor having an end accelerator plate of the feed chamber mounted on the rotor for rotation therewith;

the end accelerator plate lying generally in a radial plane of the axis such that the slurry flowing generally axially into the feed chamber contacts the accelerator plate of the rotor and moves radially outwardly therefrom through the at least one outlet opening into the space;

each outlet opening having a leading edge and a trailing edge when considered relative to the direction of rotation of the rotor;

wherein there is provided within the feed chamber a plurality of discharge surfaces, each discharge surface extending between the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening so as to bridge a space therebetween;

each discharge surface being shaped, relative to an imaginary plane joining the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening, such that a portion of the discharge surface adjacent the leading edge of said next outlet defines a series of imaginary lines

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extending along the portion generally parallel to the axis and lying in the discharge surface, which imaginary lines are angularly retarded relative to corresponding imaginary lines lying in the imaginary plane, where each line and its corresponding line in the plane are equidistantly spaced from the axis.

5                    Preferably the portion of the discharge surface is smoothly curved in cross-section taken in a radial plane of the axis.

                    Preferably the portion of the discharge surface has an apex which is at a maximum spacing from the imaginary plane where the apex is spaced from the leading edge and the surface tapers back toward the imaginary plane as it  
10    approaches the leading edge.

                    Preferably the portion of the discharge surface where the surface is retarded has a width in the direction between the leading edge and the trailing edge which extends about half way across the imaginary plane.

                    Preferably each discharge surface is shaped, relative to the imaginary  
15    plane, such that a portion of the discharge surface adjacent the trailing edge of said one of the outlets lies generally in the imaginary plane. This forms a sharp edge at the junction with the wall of the rotor which can better engage the slurry within the rotor.

                    Thus the accelerator plate is dominated by a "striker nose" that  
20    protrudes into the feed chamber. This adaptation can operate to eliminate splash-back, positions the flow, increases optimal performance of the auger, and minimizes wear by forcing the solids to wear onto other solids and avoid wearing on steel.

In addition, the slurry passes over the base of the feed chamber which has been re-designed with a curved surface to facilitate easier movement of solids and to make the area more resistant to wear. This area has been accentuated to easier facilitate flow. By building up the height of the discharge edge or trailing of the feed chamber and giving it a slope, a path of least resistance is achieved.

After passing through the feed chamber, the slurry strikes an accelerator plate and is forced into the bowl. The accelerator plate has been designed to more readily force the materials into the bowl for separation.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

One embodiment of the invention will now be described in conjunction with the accompanying drawings in which:

Figure 1 is a partly schematic exploded view of a centrifuge according to the present invention.

Figure 2 is a partly schematic longitudinal cross sectional view of the centrifuge of Figure 1.

Figure 3 is a cross sectional view along the lines 3-3 of Figure 2.

Figure 4 is a cross sectional view along the lines 4-4 of Figure 3.

In the drawings like characters of reference indicate corresponding parts in the different figures.

#### **DETAILED DESCRIPTION**

In Figure 1 is shown schematically a centrifuge of the type with which the present invention is concerned. Centrifuges of this type have been

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manufactured for a number of years by the present assignee and details of the general construction of this centrifuge is well known to one skilled in the art.

The centrifuge generally comprises a base skid 10 on which is mounted on a fixed housing 11. The housing can be opened to access the interior of the housing and the elements therein. At one end of the housing is provided a motor and gear box arrangement schematically indicated at 12 which provides drive to the components inside the housing 11. At the other end of the housing is provided a feed duct 13 for supply of slurry from a source 14 through a duct 15.

Within the fixed housing 11 is provided an outer bowl 16 having a peripheral wall 17 with an inside surface 18. The bowl is mounted for rotation about a longitudinal axis 19 so that the inside surface of the peripheral wall rotates around the axis providing a centrifugal force against the inside surface. The bowl is elongate along the axis 19 so as to provide a first end 20 and a second end 21. The first end 20 is generally a feed end so that the slurry from the source 14 is fed in through the duct 13 which passes through an opening 22 in the end 20 for entry into the interior of the bowl. The second end 21 is a discharge end for the slurry and includes holes 24 through which the slurry can pass after separation of liquid from heavier particles so that the particles are generally collected within the bowl allowing the liquid component to escape through the holes 24 for collection within the housing 11.

Inside the outer bowl 16 is provided a rotor 25 which is shaped to follow generally the inside surface 18 of the bowl so that the rotor also has a first end

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26 adjacent the end 22 of that bowl and a second end 27 adjacent the end 21 of the bowl. The rotor also has an outer wall 28 which follows the general shape of the inside surface 18 but is spaced radially inwardly therefrom so as to define an annular space 30 along the length of the rotor and along the length of the bowl. The space  
5 30 defines a duct through which the slurry can pass while the centrifugal action separates the particles onto the inside surface of the bowl while the liquid component tends to move along the bowl toward the discharge end 21.

The motor and gear box 12 acts to drive the bowl through a first coupling 12A and acts to drive the rotor through a second coupling 12B. These are  
10 shown co-axial but this is merely schematic and suitable gear box arrangements are well known to one skilled in the art to provide this driving arrangement.

In particular the motor and drive arrangement 12 acts to drive the bowl and the rotor in a common rotation direction while providing a relatively small differential between the angular velocity of the bowl and the angular velocity of the  
15 rotor. This relatively small differential causes the outside surface of the wall 28 to move relatively slowly in comparison with the common angular velocity, relative to the inside surface 18 of the peripheral wall of the bowl.

The wall 17 of the bowl has a cylindrical portion 17A extending from the end 21 to a position 17B, from which the wall 17 tapers radially inwardly toward  
20 the end 20. This forms a conical section 17C which is tapered radially inwardly. It will be appreciated therefore that the rotation of the bowl provides a force on materials on the portions 17C of the wall of the bowl tending to cause those

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materials to move axially toward the end 21 and away from the end 20.

The wall 28 of the rotor also includes a cylindrical portion 28A extending to a position 28B and includes a tapered portion 28C matching the taper 17C of the bowl.

5           On the outside surface of the wall 28 is provided an auger flight 32 which is wrapped helically around the outer surface of the wall 28 from the end 21 through to the end 20 including along the tapered section 28C. The flight is helically arranged at an angle such that the differential in angular rotation of the wall 28 relative to the bowl causes the auger flight to sweep material collecting on the inside  
10   surface 18 of the wall 16 along the wall 16 to the discharge end 20 where it can be discharged from the bowl as collected solids. It will be appreciated that the heavy solids collect on the inside surface 18 substantially immediately after the discharge into the space 30. Lighter solids flow along the space 30 through openings 33 in the flight 32 toward the discharge end 24 but continue to accumulate on the inside  
15   surface due to the centrifugal action on the particles. Such particles whenever they collect on the inside surface are then carried by the outside edge or ribbon of the flight along the wall to the end 20 of the bowl where they are discharged into the housing for collection in a suitable launder (not shown).

          The duct 13 extends into the open end of the rotor at the end 26. Thus  
20   the slurry enters into the hollow interior of the rotor and flows along the interior up to a closure plate 35 which bridges across the interior of the rotor and halts the further forward flow of the slurry. Two radially opposed holes 36A and 36B are provided in

the outside wall of the rotor in the tapered section 28C for discharge of the slurry radially outwardly into the space 30.

Centrifuges of the above type are previously manufactured by the present assignee and the centrifuge of this type is modified in the area of the feed chamber 37 within the hollow interior between the end 26 and the acceleration plate 35. The feed chamber 37, the holes 36A and 36B and the acceleration plate 35 are shown on an enlarged scale and in more detail in Figures 3 and 4 which show the improvements of the present invention. Thus in Figure 3 the wall 28C is shown which has two opposed discharge holes 36A and 36B which are diametrically opposed relative to a center 19A on the axis 19. The hole 36A has a leading edge 38A and a trailing edge 38B relative to a direction of rotation R around the axis 19. The opening 36B has a leading edge 39A and a trailing edge 39B again relative to the direction of rotation. The holes 36A and 36B are generally rectangular so that the leading and trailing edges are generally parallel and extend along the tapered section 28C. While the holes 36A and 36B are shown rectangular, they may indeed be tapered in view of the taper in the wall 28C so that the leading and trailing edges are not exactly parallel but converge together toward the end 26. An imaginary plane is indicated at P1 which interconnects the leading edge 38A with the trailing edge 39B. Symmetrically a plane P2 which again is imaginary interconnects the leading edge 39A with the trailing edge 38B. These planes are defined merely for convenience of explanation of the shape and construction of a surface 40 which extends from the leading edge 38A through to the trailing edge 39B. A symmetrical

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surface 41 extends from the leading edge 39A to the trailing edge 38B. These surfaces engage the material within the feed chamber 37. It will be appreciated that the surfaces 40 and 41 are rotating with the rotor at relatively high velocity while the slurry entering through the duct 13 is moving only in the axial direction. Thus the  
5 surfaces 40 and 41 together with the acceleration plate 35 act to engage the fluid within the feed chamber 37 so as to accelerate the fluid in its rotation around the axis 19 thus causing the fluid to move outwardly through the discharge holes 36A and 36B.

The plate 35 is generally flat and circular in plan so as to fill the interior  
10 of the rotor and define the end face of the feed chamber. The acceleration plate 35 is modified by the addition of a nose 42 which extends forwardly from the plate to an apex 43 spaced forwardly of the plate toward the end 26. The nose 42 is mounted on the axis 19 so as to be symmetrical about the axis. The nose has a circular edge 44 at the plate surrounding the axis 19. The nose is dome shaped so that it  
15 converges smoothly to the apex 43 with curved walls. The nose forms a wear member which projects into the flow of the fluid from the mouth 13A of the duct 13 so that the fluid tends to engage the nose at the apex and to spread around the surface 45 of the nose onto the plate 35 and its front surface 35A facing the fluid. The plate 35 is located at a downstream end 46 of each of the holes 36 with the  
20 holes extending with the parallel upper and lower edges to an upstream end 47 just beyond the mouth of the duct 13. Thus the material flowing onto the accelerator plate 35 and its nose 42 is halted at that location thus causing the material to flow

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outwardly through the holes 36A and 36B. As the material begins to flow outwardly, it is engaged by the surfaces 40 and 41 as best shown in Figure 3. The surfaces are symmetrical so that only one of the surfaces will be described. Thus the surface 40 includes an end 40A commencing at the trailing edge 39B and from that end 40A it is flat extending to approximately a mid-point 40C. From that mid point it is curved rearwardly toward a rearward most point 40B. From that point 40B, the surface 40 curves forwardly to a point 40D after which it reaches the plane P1. Thus it will be noted that each of a series of lines 40D, 40E, 40F are angularly retarded relative to points P3, P4, P5 lying in the plane P2. It will be appreciated that all of these points or lines are purely imaginary and are used merely for explanation of the shape of the surface. Thus the point P3 lies at a common radial distance from the center 19A with the point 40D with each of the further points corresponding in radial distance. It will be noted that in the whole of the area between the edge 40A and the point 40C, the lines in the surface are angularly retarded relative to corresponding lines within the plane P1. From the point 40C to the end 40A, the surface 40 is flat indicated at 40G. This provides on the surface 40 a rib 40H which is raised relative to the imaginary plane P1.

This shape is formed by providing a part cylindrical wall 50 with one edge 51 at the edge 40K and a second edge 52 attached to the wall 28C at a position behind the section 41G. Between the surface 40G and the point 52, the surface 41 is made up from a filler material indicated at 53. The filler material can be weld or other materials which are resistant to the highly abrasive action of the

particles within the fluid in the chamber 37.

The shaping of the surface 40 such that it is domed in an retarded direction at the trailing end 40K assists in sweeping the material out of the opening 36B so that it flows more smoothly over the surface and out of the opening. In addition the curvature of the surface and the smooth flowing action of the materials over the surface reduces the wear on the surface 40. As set forth above, the surface 41 is exactly symmetrical so that it cooperates with the surface 40 as just described.

Thus the portion 40G of the surface 40 is a leading portion and rotates into the stationary or only slowly rotating slurry and acts to engage this slurry and accelerate the slurry. The slurry then moves over the surface 40 toward its end 40K at the opening 36B. The first part of the surface in advance of the mid point 40C is flat and thus the slurry slides imply across this surface portion. However the second part of the surface 40 between the mid point 40C and the end 40K is domed as the slurry begins to accelerate and move rapidly across this portion of the surface. This domed shape which is retarded relative to the plane P1 surprisingly allows smoother flow of the slurry with less wear on the surface caused by the highly abrasive slurry. At the end 40K the surface curves forwardly toward the plane P1 so that at the edge 38A of the opening 36B the slurry can simply slide off the surface 40 through the leading edge 38A of the opening 36B. It will be noted that the junction of the end 40A of the surface 40 with the wall 28C at the trailing edge 39B of the opening 36A provides a sharpened edge or nose 60 which can bite into the slurry and cause it to

move away from this edge toward the end 40K of the surface 40.

Since various modifications can be made in my invention as herein  
above described, and many apparently widely different embodiments of same made  
within the spirit and scope of the claims without department from such spirit and  
5 scope, it is intended that all matter contained in the accompanying specification shall  
be interpreted as illustrative only and not in a limiting sense.

**CLAIMS:**

1. A centrifuge for separation of particulates from a slurry containing the particulates in a liquid comprising:

an outer bowl having a longitudinal axis and a peripheral wall surrounding the axis, the peripheral wall extending from a first end of the bowl to a second opposed end of the bowl;

a first discharge arrangement at the first end of the bowl for discharge of the particulates;

a second discharge arrangement at the second end of the bowl for discharge of the slurry with the particulates removed;

a support assembly mounting the outer bowl for rotation about the longitudinal axis such that the particulates in the slurry within the bowl tend to move radially outwardly of the axis toward an inner surface of the peripheral wall;

an inner rotor mounted coaxially within the outer bowl for rotation of an outer wall of the inner rotor about the longitudinal axis, the rotor extending along the bowl from a first end of the rotor adjacent the first end of the bowl to a second end of the rotor adjacent the second end of the bowl;

a drive system for driving rotation of the outer bowl and the inner rotor for common rotation in the same direction;

the drive system providing a differential in rotational speed between the outer wall of the inner rotor and the inner surface of the peripheral wall of the outer bowl such that the outer wall moves angularly relative to the inner surface of

the peripheral wall;

the outer wall of the rotor being spaced radially inwardly of the inner surface of the bowl so as to define a space therebetween within which the slurry is separated;

5 a helical auger flight carried on the outer wall of the rotor having an outer edge of the auger flight which moves relative to the inner surface of the peripheral wall so as to tend to carry particulates collecting on the inner surface of the peripheral wall in a direction toward the first end of the bowl and the first discharge arrangement located at the first end;

10 the helical auger flight having openings therein allowing movement of the slurry in the space through the openings toward the second end of the bowl;

the bowl and the inner rotor each including a tapered portion such that the outer wall of the rotor and the inner surface of the bowl reduce in diameter toward the first end;

15 the rotor having a slurry inlet opening at the first end of the rotor into a feed chamber within the rotor;

a slurry inlet duct for transporting the slurry through the first end of the bowl into the inlet opening in the first end of the rotor;

20 the rotor having at least one outlet opening in the outer wall to allow the slurry to exit through the outer wall from the feed chamber into the space;

the rotor having an end accelerator plate of the feed chamber mounted on the rotor for rotation therewith;

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the end accelerator plate lying generally in a radial plane of the axis such that the slurry flowing generally axially into the feed chamber contacts the accelerator plate of the rotor and moves radially outwardly therefrom through the at least one outlet opening into the space;

5                wherein the end accelerator plate includes a raised projecting member thereon extending radially therefrom toward the slurry inlet opening.

2.        The centrifuge according to Claim 1 wherein the raised projecting member is dome shaped.

3.        The centrifuge according to Claim 1 wherein the raised  
10        projecting member is symmetrical about the axis and converges to an apex on the axis.

4.        The centrifuge according to Claim 1 wherein the raised projecting member extends to an outer edge thereof spaced inwardly of an edge of the end accelerator plate.

15                5.        The centrifuge according to Claim 1 wherein the at least one outlet opening is located in the tapered portion.

6.        The centrifuge according to Claim 1 wherein the rotor wall has a plurality of angularly spaced outlet openings each communicating with the feed chamber.

20                7.        The centrifuge according to Claim 1 wherein  
the rotor wall has a plurality of angularly spaced outlet openings each communicating with the feed chamber;

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each outlet opening thus having a leading edge and a trailing edge  
when considered relative to the direction of rotation of the rotor;

there is provided within the feed chamber a plurality of discharge  
surfaces, each discharge surface extending between the trailing edge of a  
5 respective one of the outlet openings and a leading edge of the next outlet opening  
so as to bridge a space therebetween;

each discharge surface being shaped, relative to an imaginary plane  
joining the trailing edge of a respective one of the outlet openings and a leading  
edge of the next outlet opening, such that a portion of the discharge surface  
10 adjacent the leading edge of said next outlet defines a series of imaginary lines  
extending along the portion generally parallel to the axis and lying in the discharge  
surface, which imaginary lines are angularly retarded relative to corresponding  
imaginary lines lying in the imaginary plane, where each line and its corresponding  
line in the plane are equidistantly spaced from the axis.

15 8. The centrifuge according to Claim 7 wherein the portion of the  
discharge surface is smoothly curved in cross-section taken in a radial plane of the  
axis.

9. The centrifuge according to Claim 7 wherein the portion of the  
discharge surface has an apex which is at a maximum spacing from the imaginary  
20 plane where the apex is spaced from the leading edge and the surface tapers back  
toward the imaginary plane as it approaches the leading edge.

10. The centrifuge according to Claim 7 wherein the portion of the

discharge surface where the surface is retarded has a width in the direction between the leading edge and the trailing edge which extends about half way across the imaginary plane.

11. The centrifuge according to Claim 7 wherein each discharge  
5 surface is shaped, relative to the imaginary plane, such that a portion of the discharge surface adjacent the trailing edge of said one of the outlets lies generally in the imaginary plane.

12. A centrifuge for separation of particulates from a slurry containing the particulates in a liquid comprising:

10 an outer bowl having a longitudinal axis and a peripheral wall surrounding the axis, the peripheral wall extending from a first end of the bowl to a second opposed end of the bowl;

a first discharge arrangement at the first end of the bowl for discharge of the particulates;

15 a second discharge arrangement at the second end of the bowl for discharge of the slurry with the particulates removed;

a support assembly mounting the outer bowl for rotation about the longitudinal axis such that the particulates in the slurry within the bowl tend to move radially outwardly of the axis toward an inner surface of the peripheral wall;

20 an inner rotor mounted coaxially within the outer bowl for rotation of an outer wall of the inner rotor about the longitudinal axis, the rotor extending along the bowl from a first end of the rotor adjacent the first end of the bowl to a second end of

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the rotor adjacent the second end of the bowl;

a drive system for driving rotation of the outer bowl and the inner rotor for common rotation in the same direction;

the drive system providing a differential in rotational speed between  
5 the outer wall of the inner rotor and the inner surface of the peripheral wall of the outer bowl such that the outer wall moves angularly relative to the inner surface of the peripheral wall;

the outer wall of the rotor being spaced radially inwardly of the inner surface of the bowl so as to define a space therebetween within which the slurry is  
10 separated;

a helical auger flight carried on the outer wall of the rotor having an outer edge of the auger flight which moves relative to the inner surface of the peripheral wall so as to tend to carry particulates collecting on the inner surface of the peripheral wall in a direction toward the first end of the bowl and the first  
15 discharge arrangement located at the first end;

the helical auger flight having openings therein allowing movement of the slurry in the space through the openings toward the second end of the bowl;

the bowl and the inner rotor each including a tapered portion such that the outer wall of the rotor and the inner surface of the bowl reduce in diameter  
20 toward the first end;

the rotor having a slurry inlet opening at the first end of the rotor into a feed chamber within the rotor;

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a slurry inlet duct for transporting the slurry through the first end of the bowl into the inlet opening in the first end of the rotor;

the rotor having a plurality of angularly spaced outlet openings each communicating with the feed chamber to allow the slurry to exit through the outer wall from the feed chamber into the space;

the rotor having an end accelerator plate of the feed chamber mounted on the rotor for rotation therewith;

the end accelerator plate lying generally in a radial plane of the axis such that the slurry flowing generally axially into the feed chamber contacts the accelerator plate of the rotor and moves radially outwardly therefrom through the at least one outlet opening into the space;

each outlet opening having a leading edge and a trailing edge when considered relative to the direction of rotation of the rotor;

wherein there is provided within the feed chamber a plurality of discharge surfaces, each discharge surface extending between the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening so as to bridge a space therebetween;

each discharge surface being shaped, relative to an imaginary plane joining the trailing edge of a respective one of the outlet openings and a leading edge of the next outlet opening, such that a portion of the discharge surface adjacent the leading edge of said next outlet defines a series of imaginary lines extending along the portion generally parallel to the axis and lying in the discharge

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surface, which imaginary lines are angularly retarded relative to corresponding imaginary lines lying in the imaginary plane, where each line and its corresponding line in the plane are equidistantly spaced from the axis.

13. The centrifuge according to Claim 12 wherein the portion of the  
5 discharge surface is smoothly curved in cross-section taken in a radial plane of the axis.

14. The centrifuge according to Claim 12 wherein the portion of the  
discharge surface has an apex which is at a maximum spacing from the imaginary  
plane where the apex is spaced from the leading edge and the surface tapers back  
10 toward the imaginary plane as it approaches the leading edge.

15. The centrifuge according to Claim 12 wherein the portion of the  
discharge surface where the surface is retarded has a width in the direction between  
the leading edge and the trailing edge which extends about half way across the  
imaginary plane.

15 16. The centrifuge according to Claim 12 wherein each discharge  
surface is shaped, relative to the imaginary plane, such that a portion of the  
discharge surface adjacent the trailing edge of said one of the outlets lies generally  
in the imaginary plane.

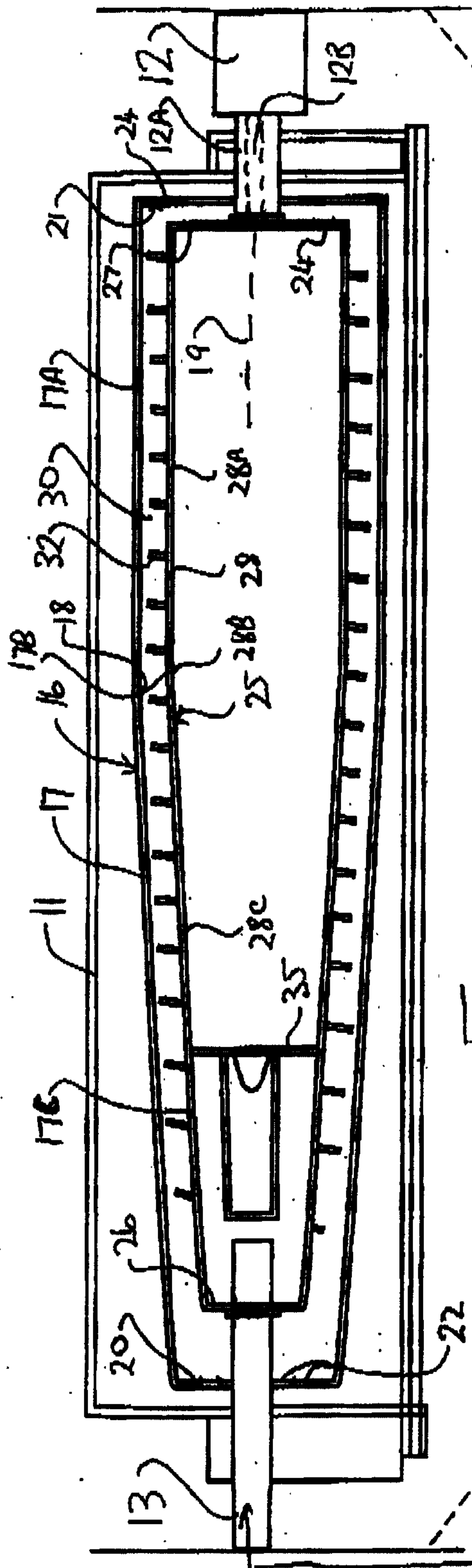


FIG. 2

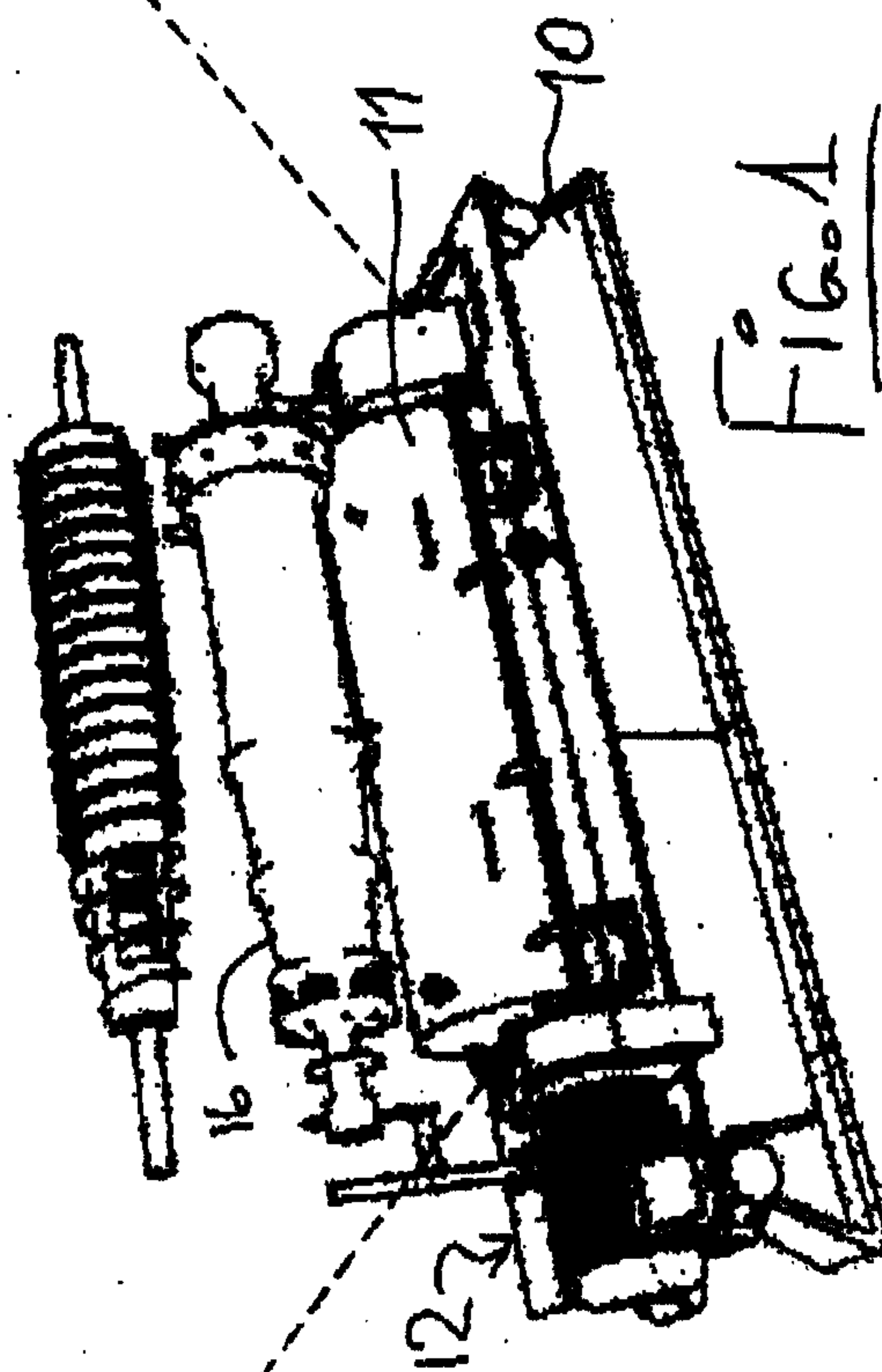


FIG. 1

SOURCE

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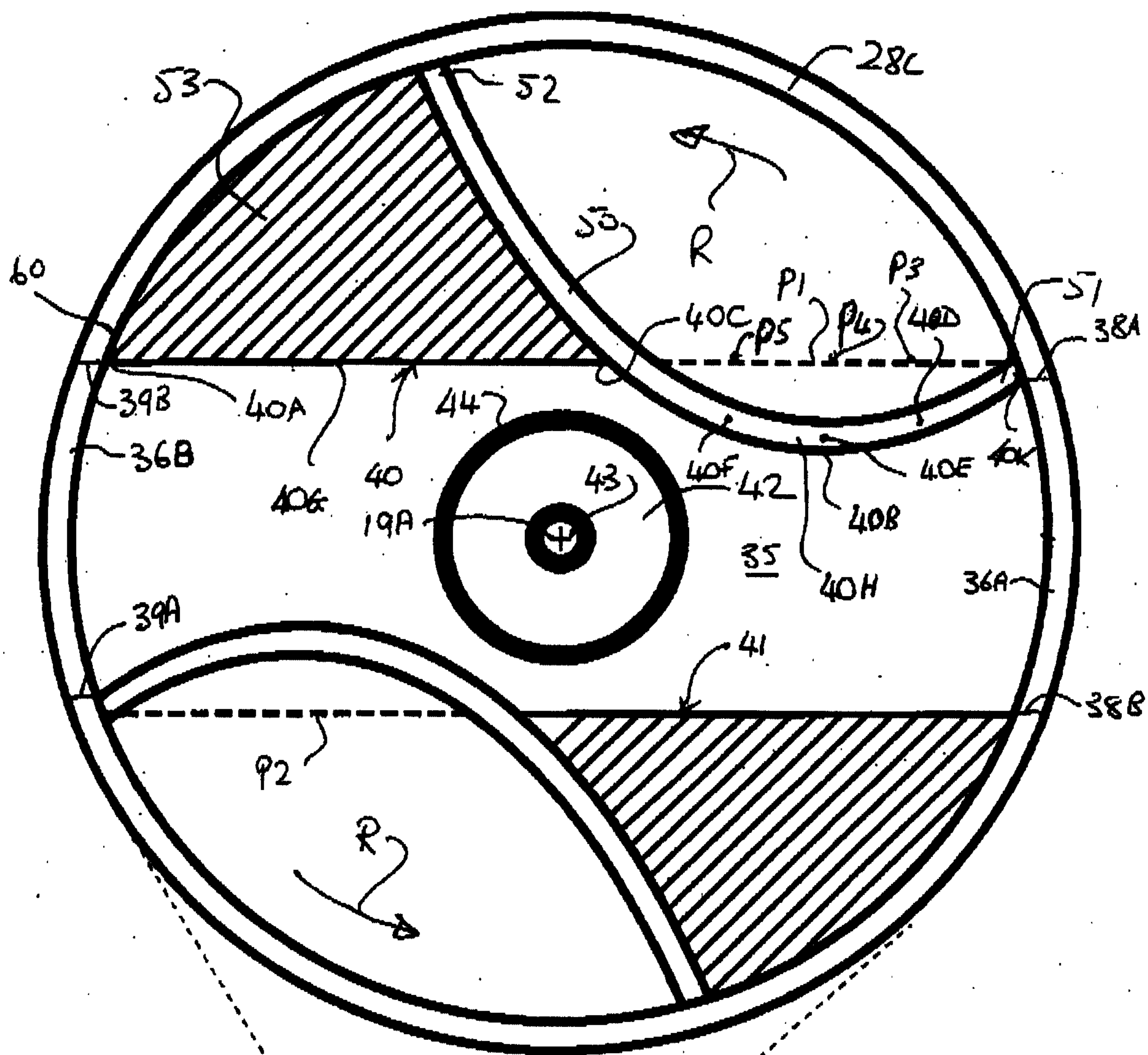


FIG. 3



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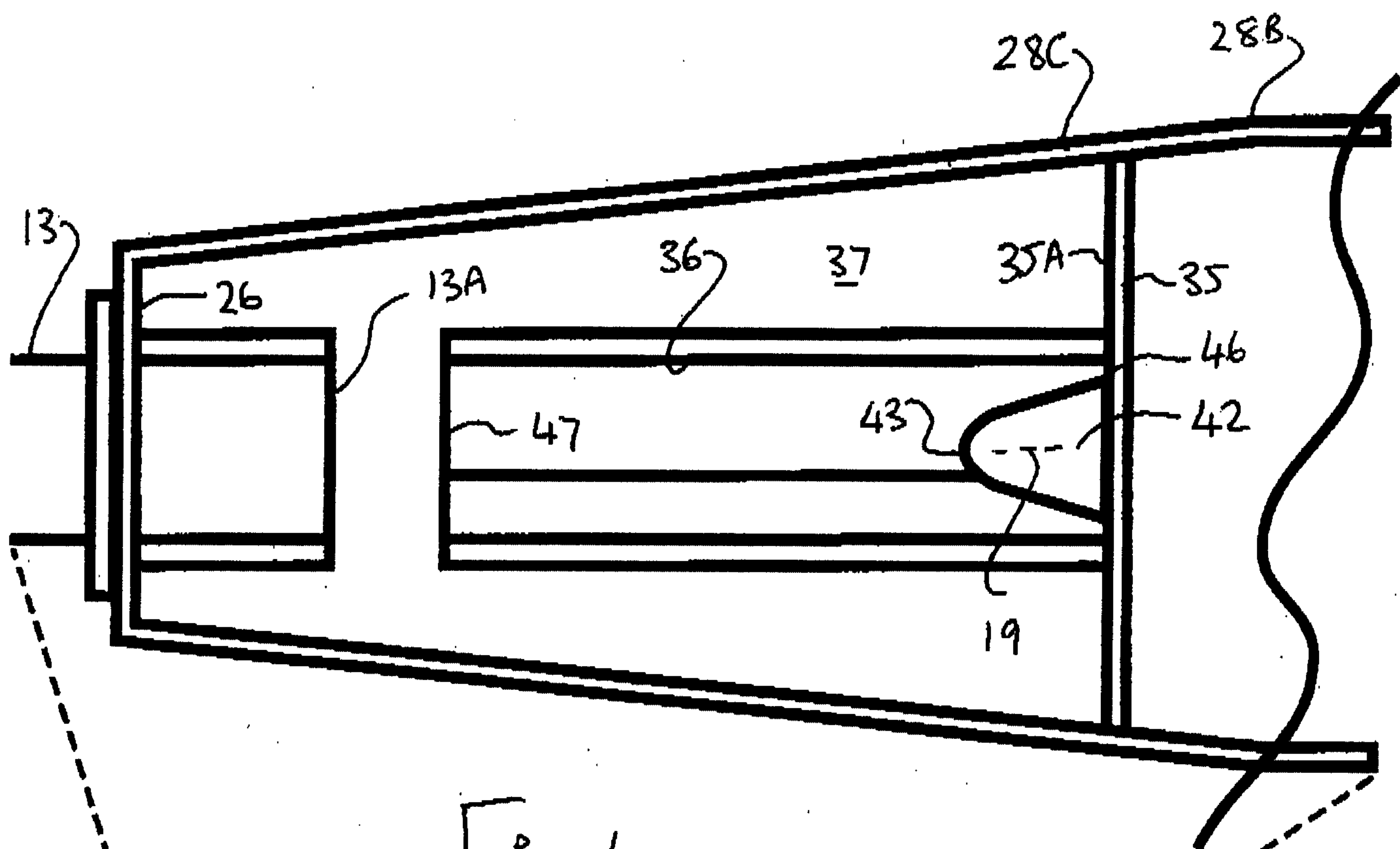


FIG 4



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