

- [54] **CENTRIFUGAL SEPARATOR WITH INTERNAL SCRAPER BLADES**
- [75] Inventor: **Herbert R. Lincoln**, Detroit, Mich.
- [73] Assignee: **Star Cutter Company**, Farmington, Mich.
- [22] Filed: **Jan. 20, 1971**
- [21] Appl. No.: **108,031**
- [52] U.S. Cl. **233/7**
- [51] Int. Cl. **B04b 1/00**
- [58] Field of Search..... **233/7, 3, 46, 47 R, 233/1 R, 27, 23, 21, 28**

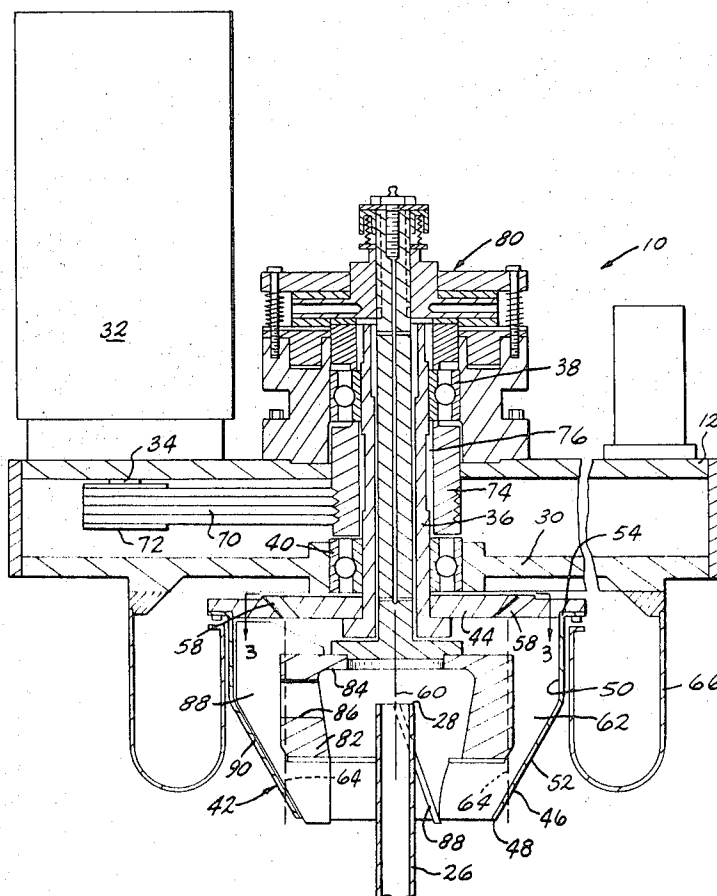
Primary Examiner—George H. Krizmanich
 Attorney—Olsen & Stephenson

[57] **ABSTRACT**

Apparatus for removing the solid particles from a liquid in which a bowl of generally inverted cup shape is rotated about a vertical axis concurrently with the supply of a liquid containing solid particles to the inner surface of the bowl so that the solid particles are centrifugally forced against the inner surface of the bowl and retained thereon. The bowl has fluid outlet openings in its top wall which extend radially outwardly from the axis of rotation of the bowl a distance greater than the spacing of the lower edge of the bowl from the axis of rotation so that fluid with the solid particles removed therefrom will flow out the outlet openings. Blades, positioned within the bowl so that they have scraping edges located adjacent the bowl inner surface, are mounted independently of the bowl for rotation about the same vertical axis on which the bowl is rotated and normally rotate with the bowl. When the blades are braked, the blades scrape the solid particles off the inner surface of the bowl so that the particles can fall out of the bowl through the lower open end.

- [56] **References Cited**
- UNITED STATES PATENTS**
- | | | | |
|-----------|---------|---------------------|---------|
| 3,403,848 | 10/1968 | Windsor et al. | 233/7 |
| 3,499,602 | 3/1970 | Nilson..... | 233/21 |
| 2,856,124 | 10/1958 | Cook et al. | 233/7 |
| 3,424,375 | 1/1969 | Maurer..... | 233/7 X |
| 560,630 | 5/1896 | Peck..... | 233/3 |
- FOREIGN PATENTS OR APPLICATIONS**
- | | | | |
|---------|---------|--------------------|-------|
| 362,652 | 7/1962 | Switzerland..... | 233/3 |
| 884,812 | 12/1961 | Great Britain..... | 233/3 |

4 Claims, 3 Drawing Figures



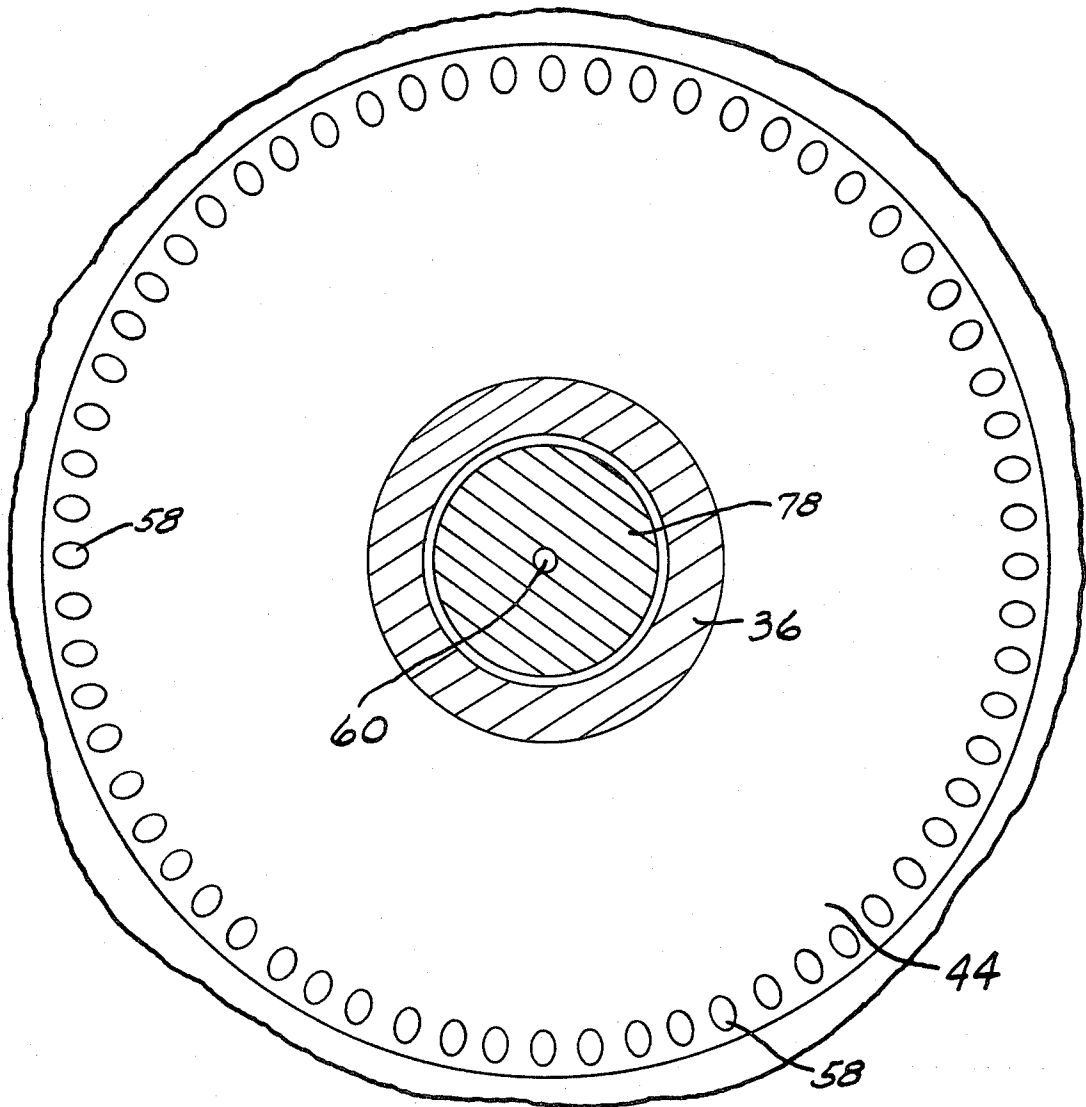


FIG. 3

INVENTOR
HERBERT R. LINCOLN

BY
OLSEN & STEPHENSON
ATTORNEYS

CENTRIFUGAL SEPARATOR WITH INTERNAL SCRAPER BLADES

BACKGROUND OF THE INVENTION

The apparatus of this invention is particularly useful in removing solid particles from the liquid coolant used in machine tools and is an improvement on the centrifugal separator apparatus shown in U.S. Pat. No. 3,403,848 owned by the assignee of this application. The apparatus shown in the aforementioned patent employs a rotary centrifuge bowl which is effective in removing the metal chips and pieces from the used coolant so that the coolant is clean and available for reuse. Internal blades which normally rotate with the bowl while used coolant is flowing through the bowl are periodically braked to obtain relative movement between the bowl and the blades so that the blades scrape the accumulated chips and pieces from the inner surface of the bowl. In the apparatus shown in the aforementioned patent, the cleaned coolant is removed from the bowl by flowing the coolant off the lower edge of the bowl and an annular manifold is provided adjacent the lower edge of the bowl for receiving the clean coolant. When the blades are braked to dislodge accumulated particles from the bowl and allow these particles to drop through the lower open end of the bowl, it is necessary to move a baffle or shield into a position between the bowl and the manifold to prevent dislodged particles from entering the manifold and contaminating the clean fluid therein. The necessity for the shield is an undesirable feature of the patented apparatus because it requires an additional moving part. In addition, the apparatus shown in the aforementioned patent employed an elongated drive shaft for the bowl thereby creating undesirable stress problems in connection with driving of the bowl. The principal object of the present invention, therefore, is to provide centrifugal separator apparatus of the type shown in the aforementioned patent which eliminates the shield and is an improvement on the patented apparatus.

SUMMARY OF THE INVENTION

In the apparatus of this invention, the inverted cup-shape bowl has its top wall positioned adjacent a supporting frame in which the drive shaft for the bowl is rotatably supported. The motor driven belts which drive the shaft are disposed adjacent the frame so as to reduce the length of the shaft between the drive therefor and the bowl. This arrangement is an improvement in that it reduces the stress problems otherwise involved in the shaft. Fluid to be cleaned is supplied to the bowl through an upwardly extending conduit which extends into a hollow chamber member secured to the lower end of the shaft which supports the blades. At least one opening in the chamber member directed toward the inner wall of the bowl functions to place the fluid to be cleaned on the inner surface of the bowl. The bowl has a downwardly and inwardly inclined side wall portion so that the lower edge of the bowl is spaced radially inwardly from the upper end of the bowl to provide an annular cavity for receiving the fluid to be cleaned. Discharge openings for the clean fluid are formed in the top wall of the bowl so that they communicate with this cavity. The fluid discharge openings are located radially outwardly relative to the lower edge of the bowl so that none of the clean fluid flows off the lower end of the bowl. Thus, in the apparatus of

this invention, the clean fluid is removed from the top of the bowl and the dislodged particles drop through the lower end of the bowl. This arrangement eliminates the necessity for the shield required in the apparatus shown in the aforementioned patent. This invention thus provides improved centrifugal separator apparatus capable of efficiently removing and disposing of solid particles in a fluid.

Further objects, features and advantages of this invention will become apparent from a consideration of the following description, the appended claims, and the accompanying drawing in which:

FIG. 1 is a side elevational view of the centrifugal separator apparatus of this invention with some parts broken away and other parts shown in section for the purpose of clarity;

FIG. 2 is a fragmentary sectional view of the separator bowl portion of the apparatus of this invention; and

FIG. 3 is an enlarged fragmentary sectional view of a portion of the apparatus of this invention as seen from substantially the line 3—3 in FIG. 2.

With reference to the drawing, the centrifugal separator apparatus of this invention, indicated generally at 10, is illustrated in FIG. 1 mounted on a main frame 12 disposed above a tank 14 which continuously receives liquid containing solid particles, such as machine tool coolant containing metal chips, particles, and pieces. The tank 14 is provided with a conventional conveyor 16 driven by a motor 18 and operable to remove solid material which has settled into the tank 14 and discharge this material through a tank outlet 20 disposed above the liquid level in the tank. A sump pump and motor unit 22 is operable to pump coolant to be cleaned from the tank 14 through a pipe 24 which terminates in an upwardly extending conduit 26 having a discharge end 28 (FIG. 2).

As shown in FIG. 2, the apparatus 10 includes a supporting frame portion 30 and a drive motor 32 disposed above the frame portion 30 and provided with a drive shaft 34. A tubular shaft 36, rotatably supported in vertically spaced bearings 38 and 40 carried by the main frame 12 and the frame portion 30, respectively, extends downwardly through the frame portion 30. At its lower end, the shaft 36 is secured to a bowl 42 which is of generally inverted cup shape having a top wall 44 disposed adjacent the frame portion 30 and a depending side wall 46 that terminates at its lower end in an annular edge 48 which defines the lower open end of the bowl 42. The bowl side wall 46 has an inner surface 50 and a downwardly and inwardly extending side wall portion 52 so that the lower edge 48 is disposed radially inwardly relative to the upper end 54 of the side wall 46.

The top wall 44 of the bowl 42 is provided with a plurality of fluid outlet openings 58 which are concentrically arranged, as shown in FIG. 3, about the axis 60 of rotation of the bowl 42. As shown in FIG. 2, each fluid outlet opening 58 is spaced radially inwardly from the upper end 54 of the bowl side wall 46 and extends radially outwardly from the axis 60 a distance greater than the spacing of the bowl edge 48 from the axis 60. This location of the outlet openings 58 provides for the formation in the rotating bowl 42 of an annular cavity 62 in which fluid is trapped by centrifugal force during rotation of the bowl 42. The radially inner side of the cavity 62 is indicated by the broken lines 64. Fluid can escape from the bowl through the openings 58 only when

the fluid accumulates on the bowl side wall 46 to a radial depth extending inwardly of the lines 64. At such time, this fluid can flow out of the bowl 42 through the openings 58 for impingement against the frame portion 30 and flow into an annular manifold 66 which is mounted on the frame portion 30 in a position surrounding the bowl 42.

A plurality of drive belts 70 extend between a drive pulley 72 mounted on the drive shaft 34 and a drive sleeve 74 which extends about the shaft 36 and is secured thereto by keys 76. Thus, on operation of the motor 32, the shaft 36 and the bowl 42 are rotated about the vertical axis 60. A shaft 78 is rotatably supported in the shaft 30 so that it is rotatable about an axis coincident with the axis 60. The shaft 78 has its upper end extended through a conventional air brake 80 which is operable to apply a braking force to the rotating shaft 78. The lower end of the shaft 78 is secured to a hollow chamber member 82 having an internal chamber 84 in which the discharge end 28 of the fluid supply conduit 26 is located. At least one discharge opening 86 is formed in the chamber member 82 so that it communicates with the chamber 84 and is directed toward the bowl side wall 46. A plurality of scraping blades 88 are mounted on the chamber member 82, each blade having a scraping edge 90 positioned in a closely spaced relation with the inner surface 50 of the bowl side wall 52. Thus, during rotation of the bowl 42, when the air brake 80 is actuated to brake the shaft 78, the bowl side wall 46 rotates relative to the blades 88 which thus function to scrape accumulated solid particles off the bowl inner surface 50.

In the operation of the apparatus 10, fluid containing solid particles is continually pumped by the unit 22 into the conduit 26 so that it is discharged into the chamber 84. The motor unit 32 operates to continuously rotate the bowl 42 about the axis 60. Fluid from the chamber 84 flows out of the chamber 84 through the passage 86 which directs the fluid against the bowl inner surface 50. The centrifugal force of the rotating bowl 42 causes the solid particles in the fluid to accumulate on the bowl inner surface 50. The fluid with the solid particles removed therefrom accumulates in the cavity 62 until it spills into the outlet openings 58 through which the cleaned fluid flows into the manifold 66 from which it is removed for use. Periodically, the brake 80 is actuated to provide for relative movement between the blade edges 90 and the bowl inner surface 50 causing the accumulated solid particles on the surface 50 to be dislodged and drop, under the action of gravity, downwardly through the lower open end of the bowl 42 into the tank 14 for removal by the conveyor 16. Thus, since the cleaned fluid is removed from the upper end of the bowl 42 through the openings 58 and the solid particles are removed from the bowl 42 through the lower open end, the possibility of contamination of the clean fluid by the dislodged particles is eliminated.

What is claimed is:

1. Centrifugal separator apparatus for separating solid particles from a fluid, said apparatus comprising a bowl of generally inverted cup shape having a top wall and a side wall having an inner surface, a frame disposed in a supporting relation with said bowl, said frame having a portion disposed above and in a closely spaced relation with said bowl top wall, said side wall having an upper end and an open lower end and a portion between said ends which extends radially inwardly and downwardly, blade members positioned within said bowl and having scraping edges disposed in close proximity to said side wall inner surface, a hollow shaft having a vertical axis and secured at the lower end thereof to said bowl, said shaft extending upwardly above said frame portion, motor means drivingly connected to said shaft at a position above and adjacent said frame portion for rotating said shaft about said axis, an upright shaft disposed within said hollow shaft and having the lower end thereof located below the lower end of said hollow shaft, means mounting said blades on the lower end of said upright shaft for rotation about an axis substantially coincident with said vertical axis, means spaced below said top wall for introducing a fluid containing solid particles onto said side wall inner surface so that upon rotation of said bowl about said vertical axis solid particles in said fluid are thrown by centrifugal force onto said bowl inner surface, means forming at least one fluid outlet opening in said top wall spaced radially inwardly from the upper end of said side wall and extending radially outwardly from said axis a distance greater than the spacing of the lower end of said side wall from said axis, and brake means engageable with said upright shaft so as to cause relative rotational movement of said blades and said bowl about said axis so as to move said blade edges along said bowl inner surface to dislodge accumulated particles thereon so that said dislodged particles can drop through the lower open end of said bowl.

2. Centrifugal separator apparatus according to claim 1 further including a hollow chamber member secured to the lower end of said upright shaft at a position within said bowl and in a spaced relation with said top wall of said bowl, said chamber member having passage means formed therein and directed toward said bowl inner surface for directing fluid containing solid particles to be separated toward said inner surface.

3. Centrifugal separator apparatus according to claim 2 wherein said chamber member is disposed in a supporting relation with said blade means.

4. Centrifugal separator apparatus according to claim 2 wherein said chamber member has a lower open end and further including conduit means extending upwardly through said lower open end of said chamber member for delivering fluid to said chamber member.

* * * * *