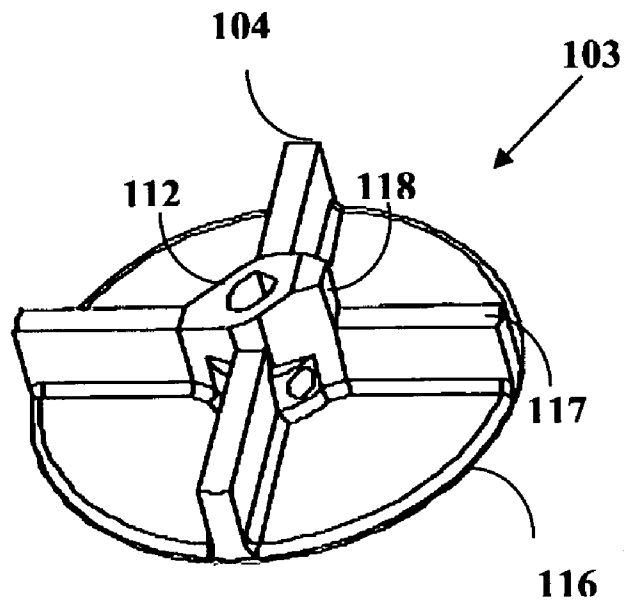
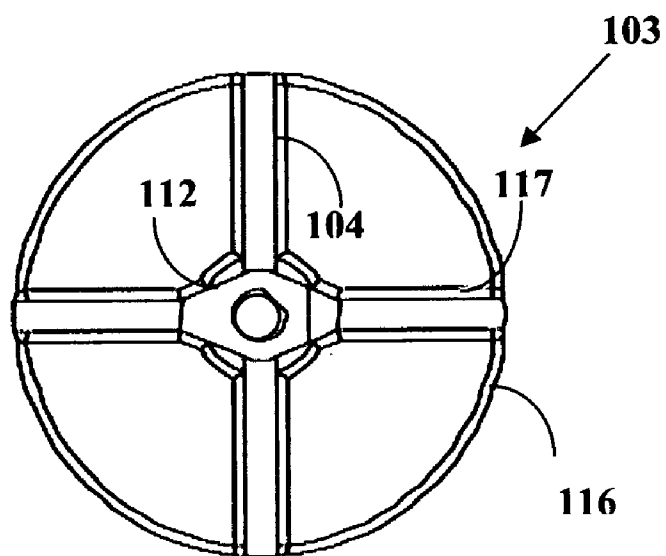


FIGURE 1A



**FIGURE 1B**



**FIGURE 1C**

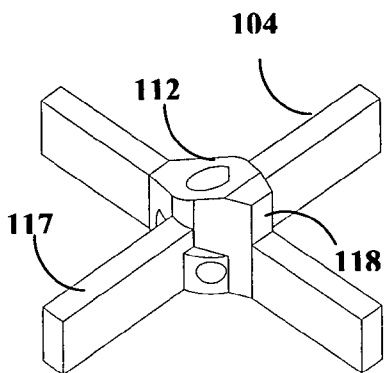


FIGURE 1D

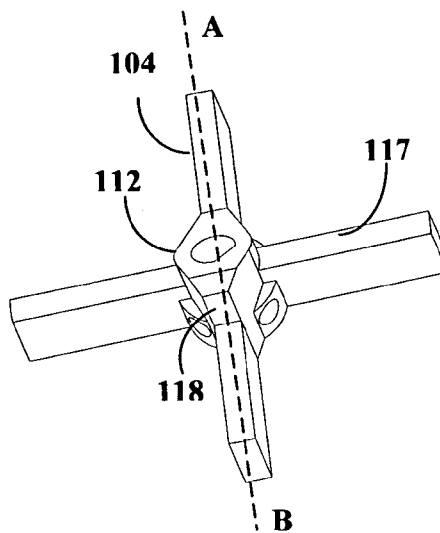


FIGURE 1E

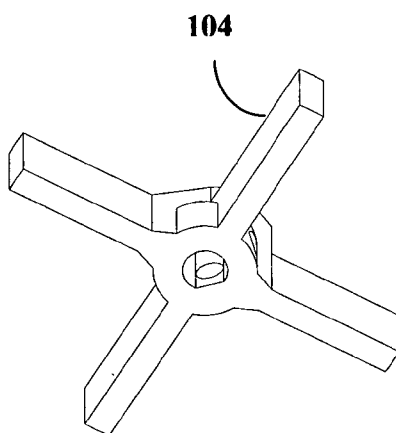


FIGURE 1F

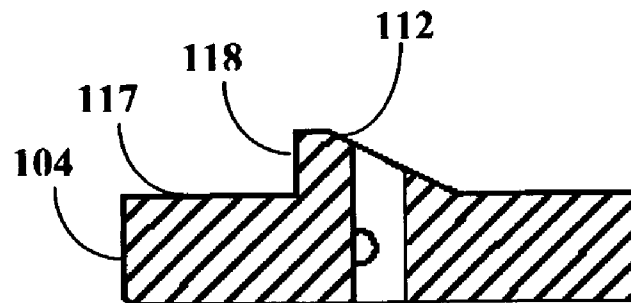


FIGURE 1G

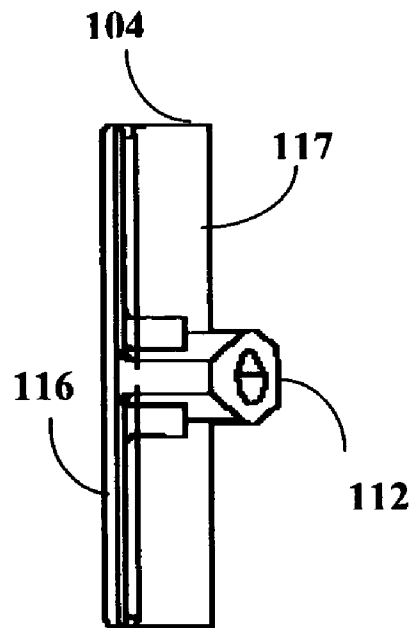


FIGURE 1H

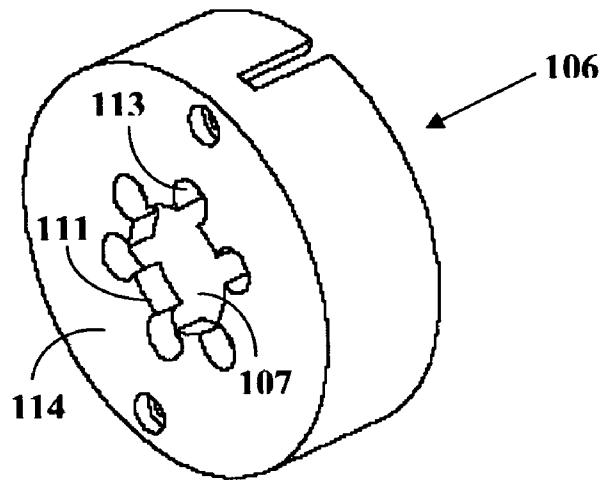


FIGURE 1I

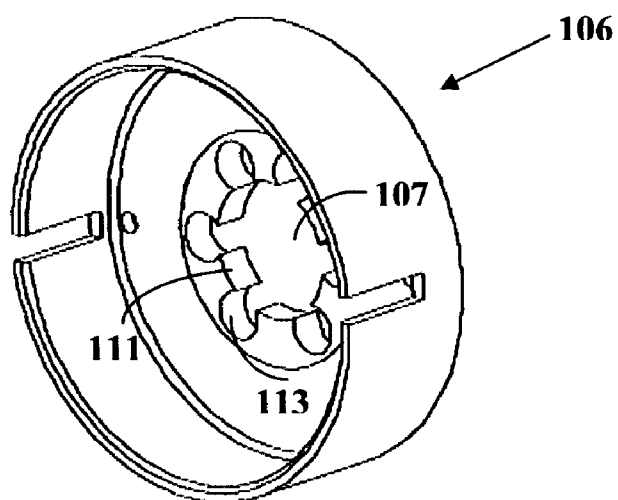


FIGURE 1J

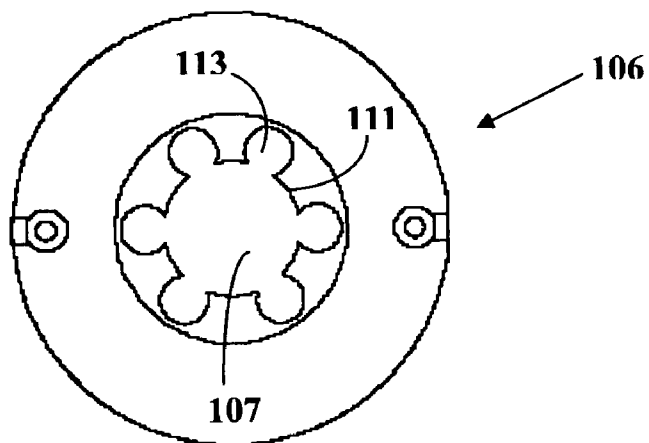


FIGURE 1K

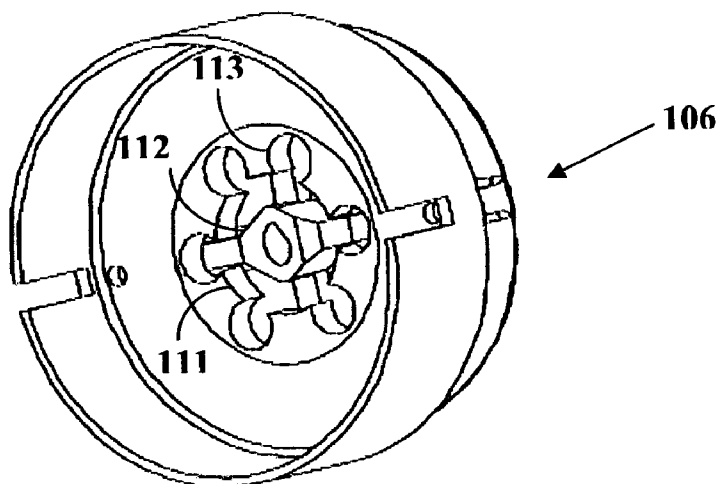
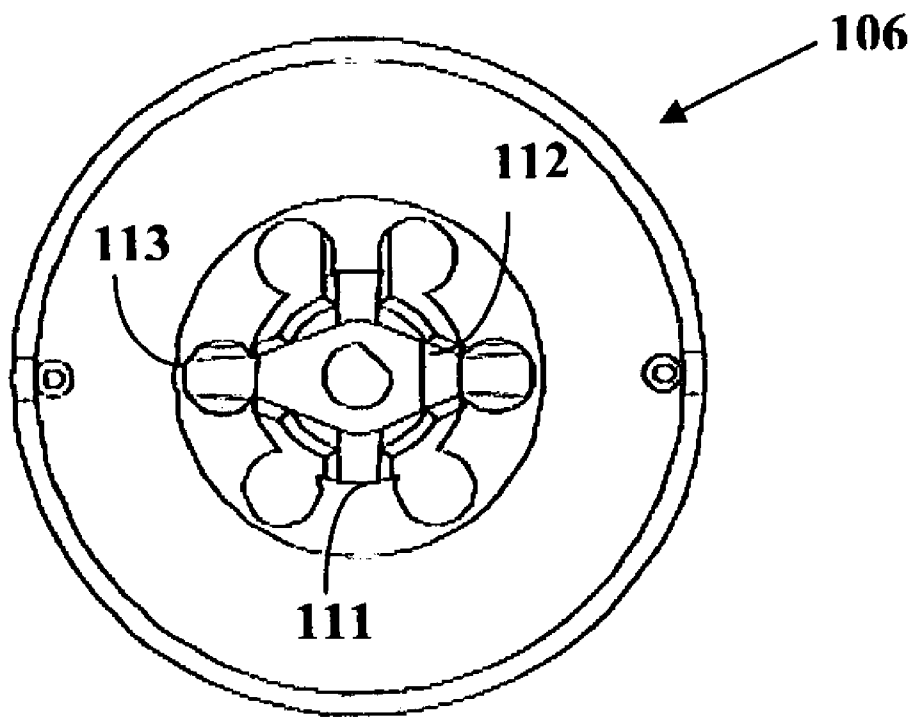
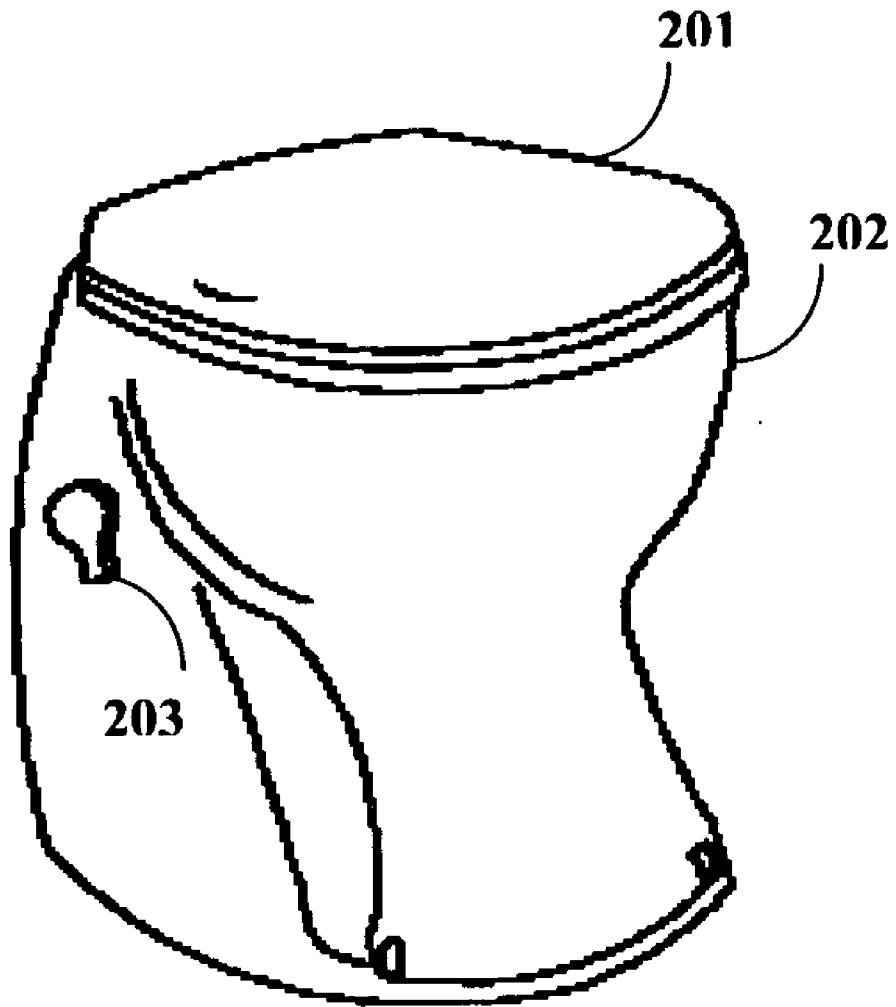


FIGURE 1L



**FIGURE 1M**



**FIGURE 2A**

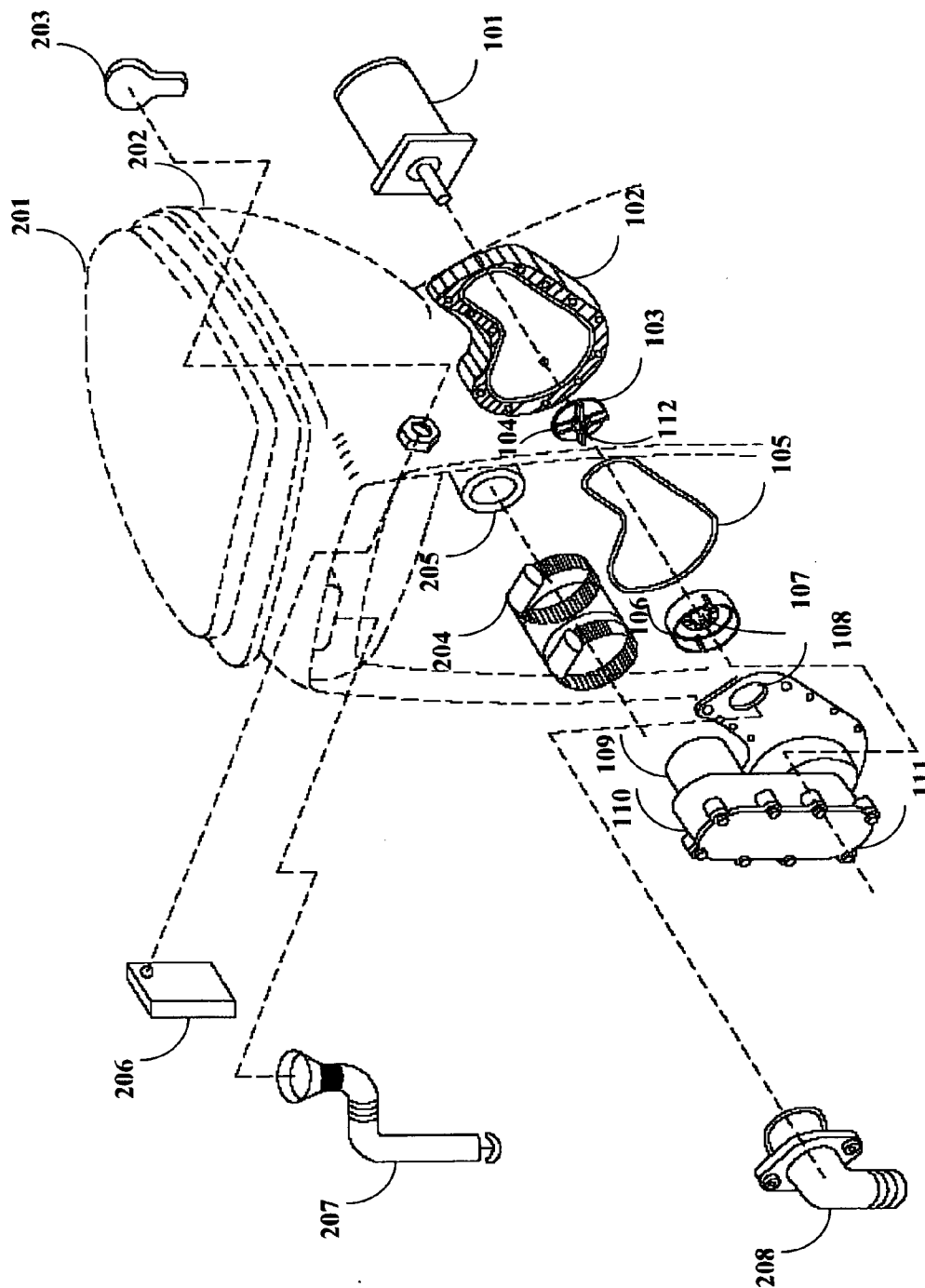


FIGURE 2B

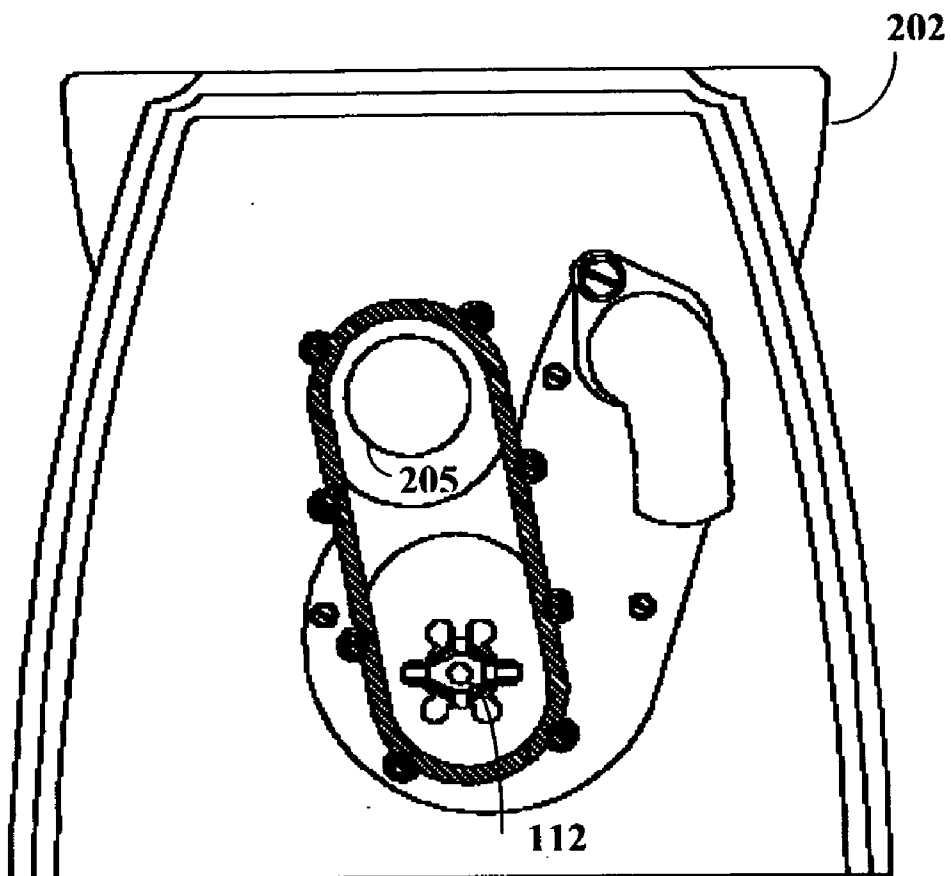


FIGURE 2C

**NON-CLOG SHREDDER**

## BACKGROUND OF THE INVENTION

[0001] The present invention, in general, relates to a shredder for shredding semi-solid or particulate matter entrained in a non-homogenous liquid-solid flow. The shredder disclosed herein finds an application in process industries, for example in the ore, paper, pulp, food and fiber industries for macerating particulate or solid material in an incoming liquid-solid feed.

[0002] An example of the application of the shredder disclosed herein is in marine and recreational vehicle toilets. These toilets are designed to accept waste, such as human waste and toilet paper which can be easily flushed down the toilet. But if products such as feminine hygiene and diapers are discarded in the toilet, the toilet often clogs. Repeated attempts to flush such products down the toilet may eventually be successful but it results in excessive usage of fresh water. In one embodiment of the invention disclosed herein, the shredder is located downstream of the toilet bowl discharge line of a marine or recreational vehicle toilet to prevent clogging of toilets, especially when products such as feminine hygiene products and baby diapers are discarded in the toilet bowl.

[0003] In general, there is an unsatisfied market need for shredding solid matter in an incoming liquid-solid feed without clogging the line transporting such flow.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1A illustrates the exploded view of the shredder.

[0005] FIG. 1B illustrates the impeller assembly.

[0006] FIG. 1C illustrates the plan view of the impeller assembly.

[0007] FIG. 1D, FIG. 1E and FIG. 1F illustrate different isometric views of another embodiment of the impeller.

[0008] FIG. 1G illustrates the sectional view of the impeller taken along section line A-B of FIG. 1E.

[0009] FIG. 1H illustrates the side elevation view of the impeller assembly.

[0010] FIG. 1I illustrates the isometric view of the cup.

[0011] FIG. 1J illustrates another isometric view of the cup.

[0012] FIG. 1K illustrates the plan view of the cup.

[0013] FIG. 1L illustrates the side elevation view of the cup.

[0014] FIG. 1M illustrates an isometric view of the impeller assembly abutting the cup with the cutting blade projecting through the circular opening in the cup.

[0015] FIG. 2A illustrates the perspective view of the self-contained toilet system.

[0016] FIG. 2B illustrates the exploded view of the self-contained toilet system with the built-in shredder.

[0017] FIG. 2C is a cross-sectional rear view of the self-contained toilet system with built-in shredder.

## DETAILED DESCRIPTION OF THE INVENTION

[0018] The method and apparatus of this invention, including all its embodiments are herein referred to as a shredder.

[0019] FIG. 1A illustrates the exploded view of the shredder 100. The shredder 100 housing comprises an inlet line 109 through which the liquid-solid feed enters the reservoir 116 located in the front section of the shredder housing 110, a generally cylindrical cup 106 that is open at the upstream end with respect to the incoming liquid-solid flow and capped at the other end by a circular end-cap 114 with an axial opening 107 through which the cutting blade 112 projects into the cup 106, an impeller assembly 103 mounted on a shaft 115, and a motor 101 that drives the shaft 115. The cup 106 including the end-cap 114 is stationary and does not rotate.

[0020] An O-ring 105 on the discharge side of the shredder 100 provides a seal between the front section of the housing 110 and the rear section of the housing 102.

[0021] FIG. 1B illustrates one embodiment of the impeller assembly 103. The impeller assembly 103 consists of impellers 104 rigidly affixed to the impeller plate 116 and extending radially from the center of the impeller plate 116 towards the circumference of the impeller plate 116 and perpendicular to the upstream face of the impeller plate 116 with the cutting blade 112 located at the center of the impeller 104. In one embodiment of the invention shown in FIG. 1B, the impeller assembly 103 consists of two impellers 104 positioned at right angle to each other with an integrally machined or cast cutting blade 112. In another embodiment of the invention, the cutting blade 112 may be cast separately from the impeller 104 and thereafter rigidly affixed to the impeller 104. In the assembled position, the impeller assembly 103 is positioned with the impeller 104 adjacent to and abutting the downstream surface of the end-cap 114 with the cutting blade 112 projecting through and upstream of the axial opening 107 in the end-cap 106. With the shredder in operation, the cutting surface 118 of the cutting blade 112 shreds solid matter in the liquid-solid feed as the feed approaches the opening 107 in cup 106. The surface 117 of the impeller 104 rotates adjacent to and immediately downstream of the end-cap 114. The relative motion of the surface 117 of impeller 104 over the downstream surface of the end-cap 114 shreds the solid matter in the liquid-solid feed at the downstream surface of the opening 107, and in one embodiment of the invention where the opening has a plurality of recesses 113, also at the downstream surface of the recesses 113. The impeller assembly 103 is located in the housing 110 of the shredder 100. The shaft 115 is connected at one end to the center of the impeller plate 116 and to the variable speed motor 101 at the other end. In one embodiment of the invention, impellers 104 shown in FIG. 1D through 1F are axially mounted at one end of the shaft 115, with the other end of the shaft 115 connected to the motor 101. In one embodiment of the invention, the speed of the motor 101 is adjustable. For example, the motor 101 speed may be adjusted to provide a cutting blade 112 rotational speed of approximately 2600 revolutions per minute.

[0022] FIG. 1C illustrates the plan view of the impeller assembly 103 showing the impeller 104 and the cutting blade 112 at the center of the impellers 104.

[0023] FIG. 1D, FIG. 1E and FIG. 1F illustrates another embodiment of the invention where the impeller assembly comprises only the impeller 104 and the cutting blade 112.

[0024] FIG. 1G illustrates the sectional view of the impeller assembly 103 showing the impeller 104, cutting blade 112, cutting surface 118 and impeller surface 117 that abuts the downstream surface of opening 107 and recesses 113.

[0025] FIG. 1H illustrates the side elevation view of the impeller assembly 103, the impeller 104, cutting blade 112 and impeller plate 116 as shown in FIG. 1B.

[0026] FIG. 1I illustrates an isometric view of the generally cylindrical cup 106 that is open at one end and has a circular end-cap 114 at the other end. The end-cap 114 has an axial opening 107 opening that provides a conduit for transfer of the feed through the end-cap 114. In one embodiment of the shredder, cutting teeth 111 are located along the circumference of the opening 107. The axial opening 107 may be of any generally circular shape. In another embodiment of the invention, the opening 107 is in the shape of a circle with a plurality of recesses 113. In another embodiment of the invention, cutting teeth 111 are located on the periphery of the opening 107. In yet another embodiment of the invention, the cutting teeth 111 and recesses 113 are located alternately on the periphery of the opening. The relative motion of the section of the impeller blade 112 that projects through opening 107 with respect the stationary cutting teeth 111, shreds the solid material in the incoming liquid-solid feed as the feed moves through the opening 107. The recesses 113 also provide a conduit for transfer of the incoming feed through the end-cap 114.

[0027] FIG. 1J illustrates another isometric view of the cup 106 showing the axial opening 107, cutting teeth 111 and recesses 113 located along the periphery of the opening 107.

[0028] FIG. 1K illustrates the plan view of the cup 106 with the axial opening 107, and the recesses 113 and cutting teeth 111 located along the periphery of the axial opening 107.

[0029] FIG. 1L and FIG. 1M illustrates the impeller assembly 103 in the assembled position with the impeller assembly 103 adjacent to and abutting the end-cap 114 of cup 106 with the cutting blade 112 projecting through the opening 107 in cup 106.

[0030] FIG. 2A illustrates the perspective view of the self-contained toilet system, with the built-in shredder 100. The toilet consists of a seat cover 201, a hand lever 203 and a toilet bowl 202.

[0031] FIG. 2B illustrates an example of the exploded view of a self-contained toilet system with the built in shredder 100. A seat cover 201 is positioned above the toilet bowl 202. The shredder 100 is positioned below the toilet bowl 202. An inlet port 109 accepts the contents of the toilet bowl 202 when the flush is actuated. The shredded waste is discharged through the outlet 108 of the shredder 100. The flush can be either manually operated using a hand lever 203 control or electronically activated using an electronic timer control circuit 206 powered off a wall switch. A solenoid valve (not shown) regulates water consumption during each flush by controlling the inlet water pressure. The hand lever 203 operates a crank (not shown) that is connected to a crank

lever. Micro-switches are placed in various locations with respect to crank lever positions. Multi-functional operation of the crank lever is achieved using these micro switches. The hand lever 203 also activates the flush. The electronic timer control circuit 206 sequences the flush by first bringing water in through the intake hose 207, emptying the toilet bowl 202 and re-filling the water in the toilet bowl. A discharge connector 204 is connected to the inlet port 109 of the front section of the shredder housing 110. The outlet 205 of the toilet bowl 202 is connected to the discharge connector 204.

[0032] FIG. 2C is a cross-sectional rear view of the self-contained toilet system with a built-in shredder 100 showing the outlet of the toilet bowl 205, cutting edge 112, the semi-circular recesses 113, and the shredder outlet 108.

[0033] When the motor 101 is turned on, the rotation of the impeller over the downstream surface 114 of the cup 106 creates suction to effect the transfer of the incoming liquid-solid feed from the reservoir 100 located in the front section of the housing 110 through the opening 107. As the feed moves towards and through the opening 107, the solid material in the feed is shredded by the following: the cutting edge 118 of the rotating cutting blade 112, the cutting surface 117 of the rotating impeller 104 as the solid material in the feed moves to a point immediately downstream of the opening 107 and the recesses 113, and by the rotation of the impeller 104 with respect to the stationary cutting teeth 111 located on the periphery of the opening 107. The centrifugal action of the impeller 104 throws the shredded feed to the rear section of the housing 102 from where the shredded waste is discharged through outlet nozzle 108 located at the upper part of the rear section of the housing 102.

[0034] In one embodiment of this invention, the apparatus comprises a toilet bowl 202, a discharge opening at the bottom of said toilet bowl 205 and the shredder 100 positioned at the bottom of the toilet bowl 202. When a flush hand lever 203 is actuated, the waste from the toilet bowl feeds through the shredder inlet line 109 to the upstream reservoir 116 located in the front section of the housing 110. The outlet 108 of the shredder 100 is coupled to and in fluid communication with the exterior discharge opening of the toilet bowl 202.

[0035] When the flush hand lever 203 is actuated, motor 101 is turned on and waste from the toilet enters the shredder 100 through the inlet line 109. The cutting blade 112 rotates along the upstream surface of the stationary circular end-cap 114 to shred the incoming particulate matter in the liquid-solid feed. The feed containing the shredded particulate matter passes through the opening 107; and, in one embodiment of the invention, through the opening 107 and recesses 113 located on the periphery of the opening 107. The rotation of the impeller blades 104 creates suction to transfer the waste from the upstream reservoir 116 of the shredder to the outlet 108 of the shredder 100. The shredder 100 shreds solid wastes such as feminine hygiene and baby diaper products in addition to human sewage and toilet paper. The shredded feed is discharged through the discharge nozzle 208.

[0036] The following example illustrates the working of the shredder 100 in a toilet application. Ms. Jenny goes to a restroom to use the toilet facilities, and needs to dispose off a soiled sanitary napkin. She wraps the soiled sanitary

napkin and puts it into the waste basket. Even though quite simple and cost-effective, this conventional method poses a threat of infection to other toilet users through atmospheric dispersal of microbial germs and such disposal also emits an unpleasant odor. If the restroom is equipped with the shredder, Ms. Jenny need not dispose it off in the wastebasket. She can flush the soiled sanitary napkin down the toilet bowl **202**. When the flush hand lever **203** is activated, a shredder **100** mounted inside the toilet bowl **202** is also activated. The rotation of the cutting blade **112** and the impeller **104**, and the rotation of the impeller **104** with respect to the cutting teeth **111** on the opening **107** shreds the soiled sanitary napkin inside the toilet bowl **202**, and the shredded waste is flushed out without clogging the toilet system.

What is claimed is:

1. A shredder contained within a housing for shredding solid matter in an incoming liquid-solid feed comprising:

an inlet means in said housing for receiving the incoming feed,

a cup, said cup having a first end and a second end,

said first end of the cup being open and in communication with the inlet means to receive the incoming feed,

said second end of the cup having an end-cap with an axial opening, said opening providing a conduit for transfer of the feed through the end-cap,

an impeller assembly comprising:

a rotatable shaft coaxial with said opening in the end-cap,

a plurality of impellers extending radially from the axis of the rotatable shaft and abutting and disposed axially against the downstream surface of the second end of said cup, and

a cutting blade located on the upstream surface of the impeller and projecting axially through the opening in the end-cap, and

a motor connected to the shaft, wherein the rotation of the shaft rotates the impeller to effect the transfer of the in-coming feed in the cup to a point downstream of the impeller assembly and shreds the solid material in the feed by the cutting blade and the cooperative action of the impeller against the downstream surface of the end-cap.

2. A shredder contained within a housing for shredding solid matter in an incoming liquid-solid feed comprising:

an inlet means in said housing for receiving the incoming feed,

a cup, said cup having a first end and a second end,

said first end of the cup being open and in communication with the inlet means to receive the incoming feed,

said second end of the cup having an end-cap with an axial opening, said opening having a plurality of cutting teeth located on the periphery of the opening, said

opening providing a conduit for transfer of the feed through the end-cap,

an impeller assembly comprising:

a rotatable shaft coaxial with said opening in the end-cap,

a circular impeller plate mounted axially on the shaft, said impeller plate having an upstream face and a downstream face,

a plurality of impellers extending radially from the center of the impeller plate and abutting and disposed axially against the downstream surface of the second end of said cup, and

a cutting blade located on the upstream surface of the impeller and projecting axially through the opening in the end-cap,

a motor connected to the shaft, wherein the rotation of the shaft rotates the impeller to effect the transfer of the in-coming feed in the cup to a point downstream of the impeller assembly and shreds the solid material in the feed by the cutting blade, the cutting teeth and by the cooperative action of the impeller with respect to the cutting teeth and the downstream surface of the second surface of the end-cap.

3. The shredder of claim 1 wherein the opening in the end-cap has a plurality of cutting teeth located along the periphery of the opening.

4. The shredder of claim 1 wherein the opening in the end-cap has a plurality of recesses located on the periphery of the opening.

5. The opening of claim 4 wherein the recesses are semi-circular, elliptical, or rectangular in shape.

6. The shredder of claim 1 wherein the speed of the motor is variable.

7. A shredder to prevent the clogging of waste in a toilet system, comprising:

a toilet bowl,

a discharge opening at the bottom of said toilet bowl,

a line from the discharge opening to the inlet of the shredder,

a shredder positioned at the bottom of the toilet bowl, said shredder having a reservoir positioned to accept and collect said waste when a flush is actuated and a rear section coupled to and in fluid communication with the discharge opening of the toilet bowl, the shredder further comprising:

a cup, said cup having a first end and a second end,

said first end of the cup being open and in communication with the reservoir to receive the incoming feed,

said second end of the cup having an end-cap with an axial opening, said opening providing a conduit for transfer of the feed through the end-cap,

an impeller assembly comprising:

a rotatable shaft coaxial with said opening in the end-cap,

- a circular impeller plate mounted axially on the shaft, said impeller plate having an upstream face and a downstream face,
  - a plurality of impellers extending radially from the center of the impeller plate and abutting and disposed axially against the downstream surface of the second end of said cup, and
  - a cutting blade located on the upstream surface of the impeller and projecting axially through the opening in the end-cap,
- a motor connected to the shaft, wherein the rotation of the shaft rotates the impeller to effect the transfer of the in-coming feed in the cup to a point downstream of the impeller assembly and to shred the solid material in the feed by the cutting blade and the cooperative action of the impeller against the downstream surface of the end-cap.
- 8.** The shredder of claim 7 wherein the opening in the end-cap has a plurality of cutting teeth located along the periphery of the opening.
  - 9.** The shredder of claim 7 wherein the opening in the end-cap has a plurality of recesses, and the recesses and the cutting teeth are located alternately on the periphery of the opening.
  - 10.** The shredder of claim 7 wherein the recesses on the opening in the end-cap are semi-circular, elliptical, or rectangular in shape.
  - 11.** The shredder of claim 7 wherein the speed of the motor is variable.
- \* \* \* \* \*