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Conley et al.

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[54] **GRAVEL WASHER AND TRASH SEPARATOR, PROCESS AND APPARATUS**

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[52] **U.S. Cl.** **209/17,** 209/158, 209/272

[51] **Int. Cl.** **B03b 7/00**

[58] **Field of Search**.....209/17, 157–160, 209/423–426, 428–430, 172.5, 173, 272

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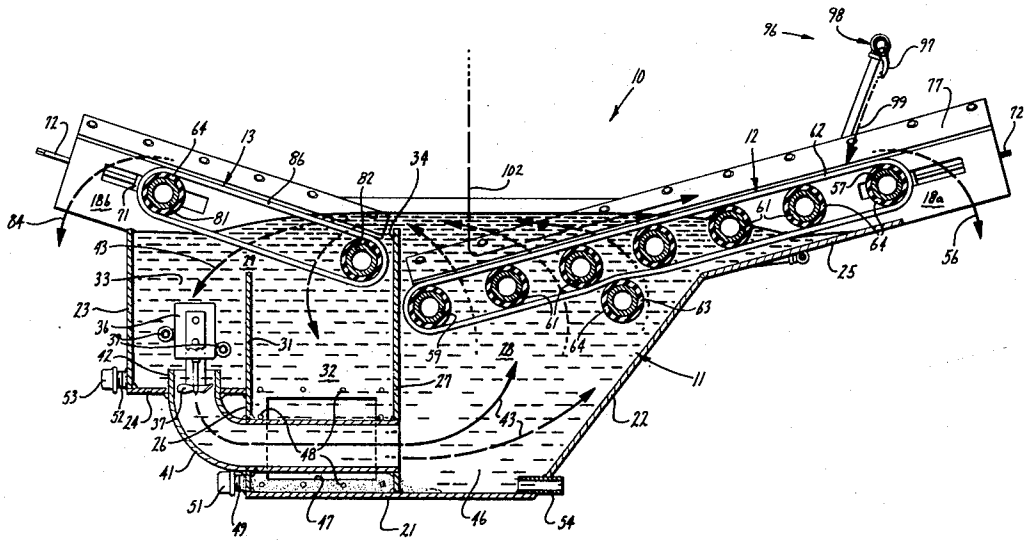
[57] **ABSTRACT**

The process of cleaning gravel of trash by depositing gravel in the upwardly moving portion of a circular current of water and supporting the gravel therein on an upwardly moving foraminous conveyor belt. Lighter trash materials are carried by current over a weir and by a downwardly moving current onto a second upwardly moving conveyor belt for discharge. Gravel is further washed by water spray on the first conveyor belt before discharge.

The gravel washer has an impeller mounted in a tank to direct a current horizontally against an inclined baffle and thence upwardly through the foraminous gravel conveyor. Impeller suction creates downward current through the foraminous trash conveyor belt.

7 Claims, 5 Drawing Figures



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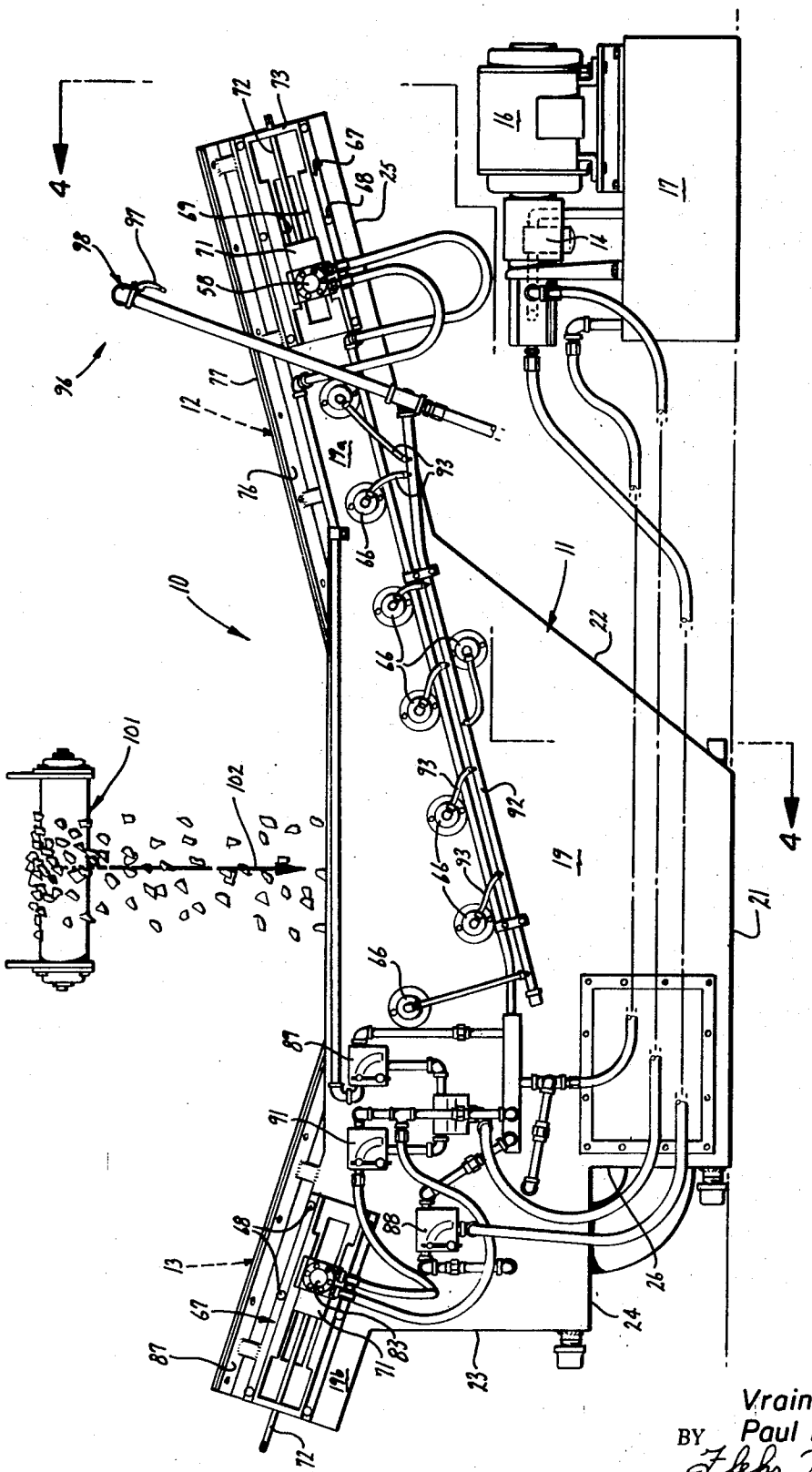

Fig. 1

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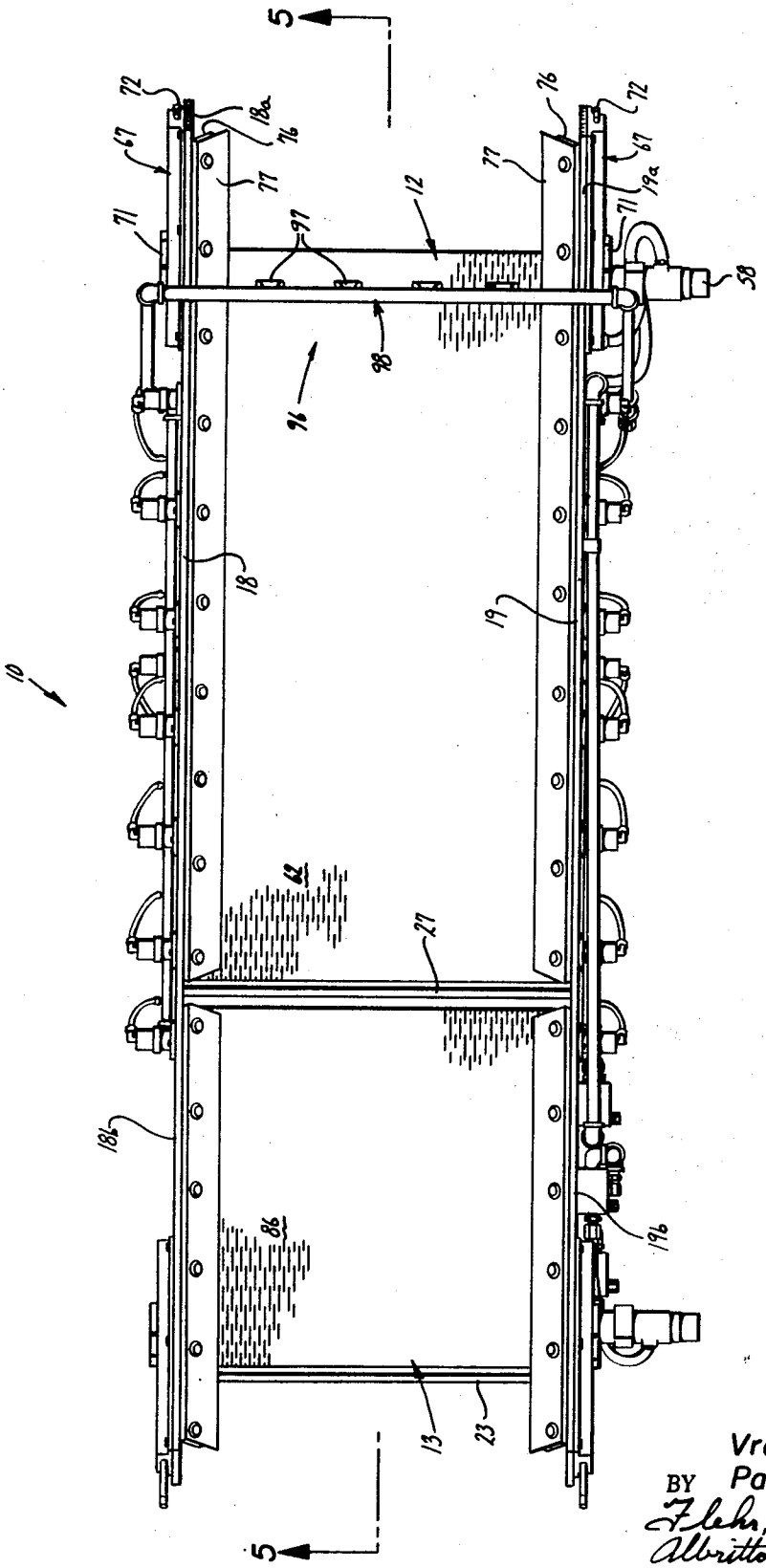

Fig. 2

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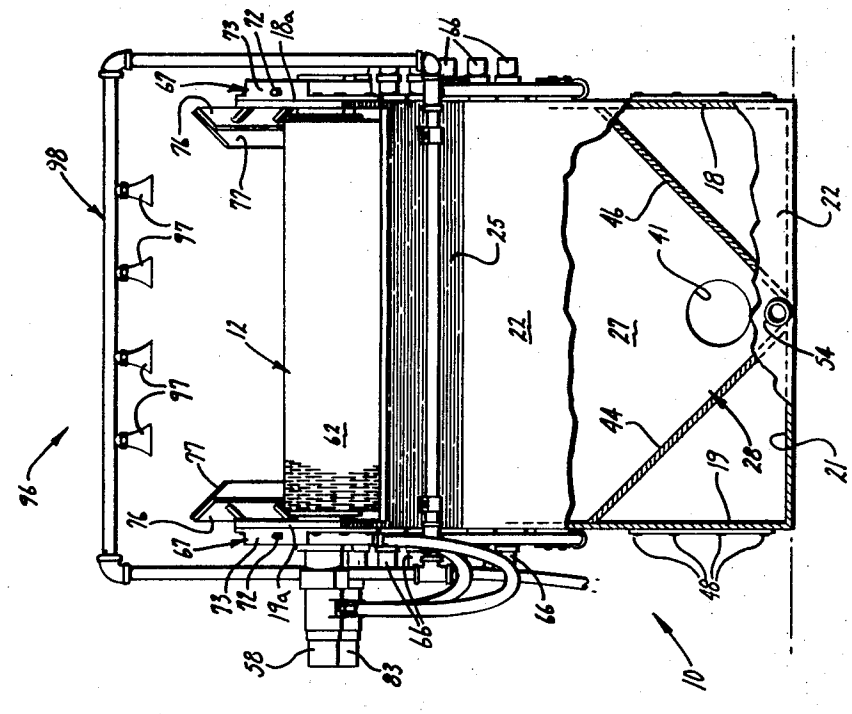

Fig. 4

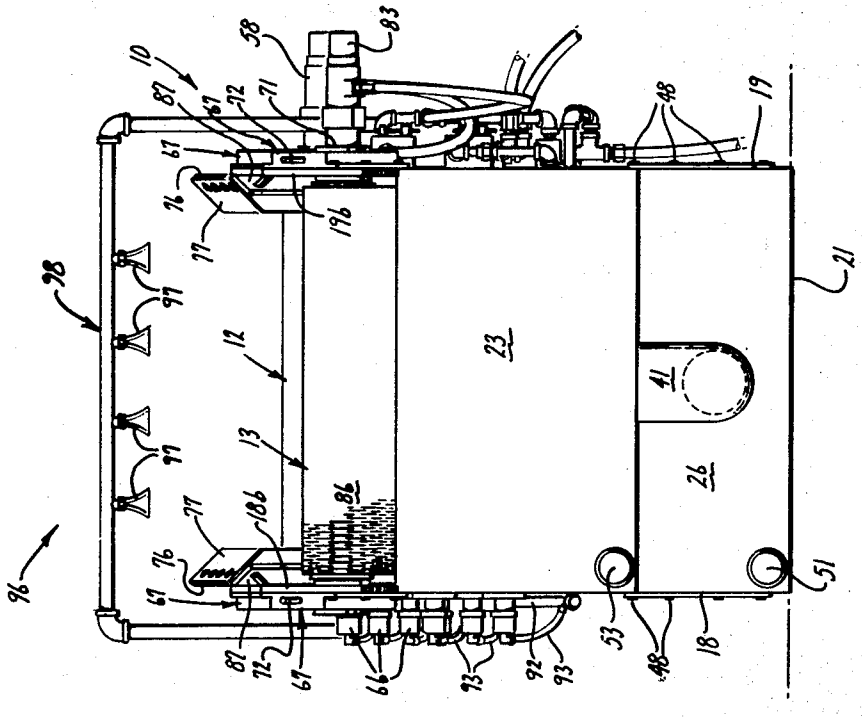

Fig. 3

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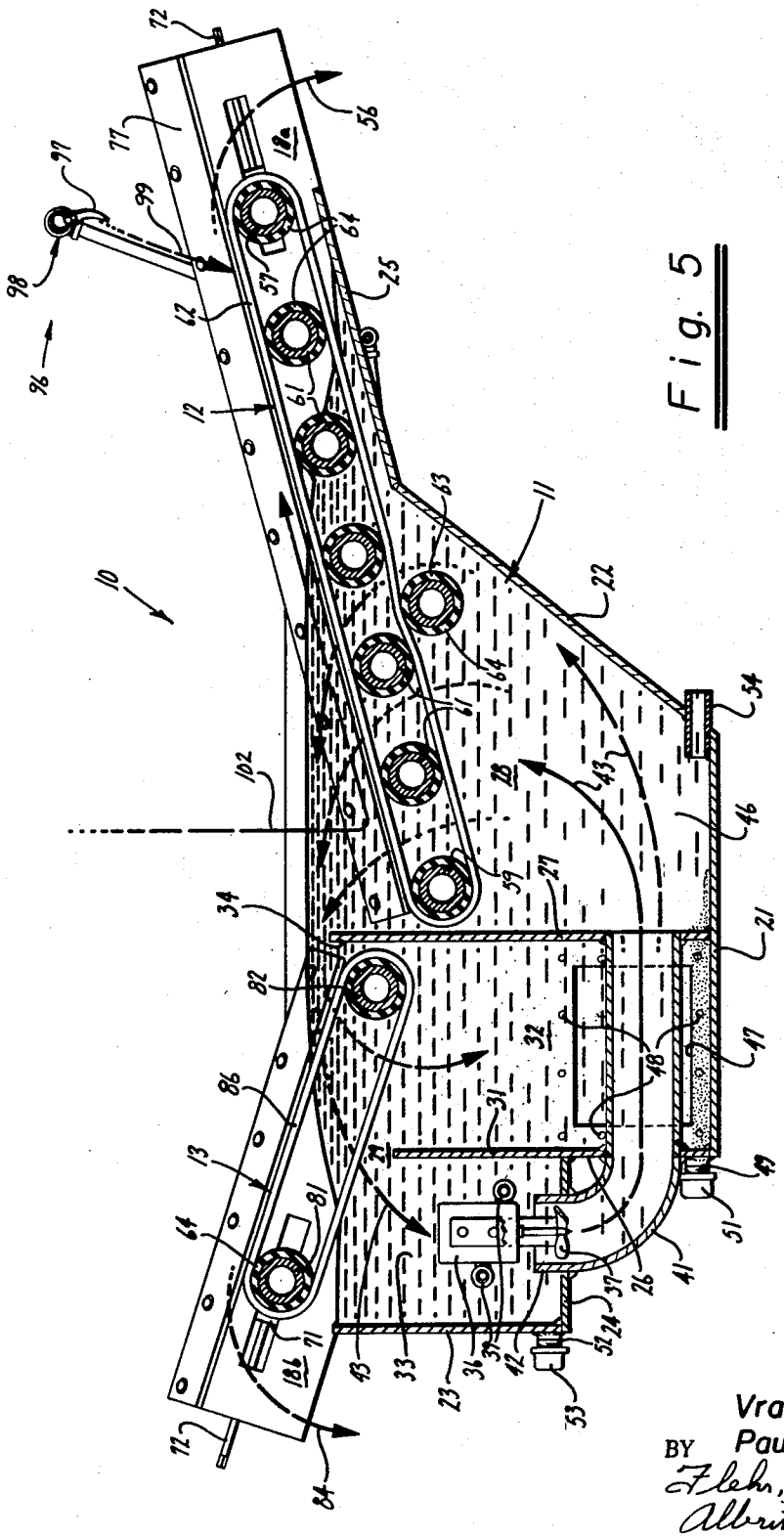

Fig. 5

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GRAVEL WASHER AND TRASH SEPARATOR, PROCESS AND APPARATUS

BACKGROUND OF THE INVENTION

This invention pertains to an improved gravel washer and trash separator and the process for separating light and sometimes floatable trash from gravel containing the same.

Deposits of gravel generally suitable for commercial purposes may be found in stream beds and frequently such gravel is intermixed with wood chips, leaves, sticks and the like which find their way into streams through natural and man made processes. The presence of wood chips in gravel reduces the value of the gravel for commercial uses, and consequently a higher price is received for the product after the trash material has been removed. This condition furnishes a strong commercial incentive to produce clean gravel; vis: gravel free from trash such as water soaked sticks, leaves, coal, etc.

Prior art gravel washers and trash separators frequently consumed considerable volumes of water to sluice the trash off from the washer unit unto a pile of waste. Certain prior art gravel washers operated on the principle of differential settling of materials in water wherein the heavier gravel fell to the bottom of the tank and was then removed from there by a bucket conveyor or the like. Such equipment was unnecessarily complex and elaborate to achieve the desired results.

Summary of the Invention and Objects

In summary, the present invention includes a vessel for containing a supply of water and having therein a bulkhead dividing the vessel into two compartments, with a liquid conduit extending between the compartments. An inclined conveyor having a foraminous belt is arranged in each compartment with the lower end of each conveyor submerged in the liquid and the upper end extending above the liquid level serving as a discharge end. A current generating impeller is mounted in one of the compartments for drawing a current of water through one of the conveyors to issue it through the conduit and into the other compartment where the current is deflected upwardly through the other conveyor belt and over the upper portion of the bulkhead which serves as a weir. A spray arrangement is mounted above one of the conveyors for directing jets of water at the material thereon.

The gravel washing and separating process includes depositing the combined trash and gravel into the body of liquid and then supporting the material there upon one of the foraminous conveyor belts through which liquid current is circulating upwardly. The current of water carries the lighter trash upwardly and over the weir and towards the other conveyor belt through which the liquid current moves downwardly. Liquid drains from the trash and gravel into the liquid body on the conveyor belts and it is sprayed with water prior to discharge from the respective conveyors.

It is a general object of the invention to remove trash from gravel with a current of water while the gravel is supported in a body of water.

Another object of the present invention is to provide an improved gravel washer and trash separator wherein fine particles of trash adhering to gravel after the same is lifted from the water is removed by a water spray.

Another object of the invention is to provide an improved gravel washer and trash separator of the type described wherein both the trash and gravel are removed from a body of water to a discharge point without sluicing.

Another object of the invention is to provide an improved trash separator and gravel washer wherein the water serving to separate the material is drained directly back into the body thereof.

Further objects of the invention will become apparent from the following description taken in conjunction with the drawings.

Brief Description of the Drawings

FIG. 1 is a side elevational view of a gravel washer and trash separator according to the present invention;

FIG. 2 is a plan view of the gravel wash and trash separator of FIG. 1;

FIG. 3 is a view of the left end of the apparatus shown in FIG. 1;

FIG. 4 is a view of the right end of the apparatus shown in FIG. 1; and

FIG. 5 is a vertical sectional view taken in the direction of the arrows 5—5 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1–4, a gravel washer and trash separator **10** of the present invention comprises a tank or vessel **11** having mounted thereon a gravel transport or conveyor **12** and a trash transport or conveyor **13**. An hydraulic pump **14** driven by a prime mover such as an electric motor **16** furnishes a source of hydraulic power for the gravel washer, such as to drive the conveyors, and it is mounted upon a base **17** which may also serve as a reservoir for hydraulic fluid serving the hydraulic system described below.

The tank or vessel **11** includes spaced apart, substantially flat, vertical side walls **18, 19** (FIGS. **3** and **4**), a bottom **21**, and upwardly inclined end wall **22** having an upper flaring panel **25** and an offset end wall **23** which includes a horizontal panel **24** and an intermediate vertical panel **26** (FIG. **5**). The side walls **18, 19** are provided with the respective extensions **18a, 19a** to accommodate the gravel conveyor **12** and the extensions **18b, 19b** to accommodate the trash conveyor **13**.

At about its mid-point, the vessel or tank **11** is divided laterally by a bulkhead **27** extending between the side walls **18, 19** to define two compartments: an up-current compartment **28** and a down-current compartment **29**. The down-current compartment **29** is sub-divided laterally by a bulkhead **31**, a continuation of the vertical wall panel **26**, into a sand trap compartment **32** and an impeller suction compartment **33**. The bulkhead **31** is shorter in height than either the end wall **23** or central bulkhead **27**. It should be noted here that the central bulkhead **27** includes an upper portion **34** which extends above the upper edge of the end wall **23**, the portion **34** functioning as a weir as will appear hereinafter. The vessel or tank **11** is preferably constructed from steel plate materials secured together preferably by welding so that the vessel **11** will serve as a satisfactory container for a body of liquid such as water.

Means for providing a current of liquid from compartment 33 to compartment 28 are provided comprising an hydraulic motor 36 having an impeller 37 mounted upon a shaft 38, the motor being operatively mounted within the impeller suction compartment 33 and operatively connected in an hydraulic circuit, including conduits 39, to the hydraulic pump 14. A tube 41 having a diameter slightly larger than the impeller diameter includes an upwardly extending collar 42 surrounding the impeller 37. The tube 41 is rigidly extended in a water tight manner through the wall portion 24 and continues in a 90° elbow portion through the wall panel 26, to continue through the compartment 32 in a straight section terminating at the central bulkhead 27. Thus the tube 41 with the impeller 37 at one end opens opposite from the inclined end wall 22. During operation of the motor 36 the impeller 37 generates and propels a current of liquid in the direction of the arrows 43, FIG. 5, creating a suction head within the compartment 33 and a pump head within the compartment 28. The current is directed from the tube 41 against the inclined end plate 22 which serves for the current as an upward directing baffle. Referring to FIG. 4, inclined plates 44 and 46 are arranged in compartment 28, one on each side of the opening of tube 41 so as to maintain the current issuing from the tube 41 within a confined volume at the bottom of the compartment 28 and serving to insure that the current remains substantially confluent in the direction of the inclined baffle 22. The plates 44 and 45 are secured as by welding to the respective side walls, 18, 19, and the bottom 21 of the vessel 11 and extend from the bulkhead 27 to the wall 22.

An access and clean-out door 47 is provided in each side wall 18, 19 opening into the fines and sand settling compartment 32, the clean-out door being normally secured as by fasteners 48 to the side wall plates and suitably sealed by a gasket (not shown). A pipe coupling 49 having a cap 51 suitably mounted thereon is fixedly secured in the wall 26 to facilitate the draining of compartment 32. A similar pipe coupling and cap 52, 53 is arranged in end wall 23 to facilitate draining of compartment 33. A discharge coupling 54, normally open, is arranged in the bottom portion of compartment 28, being suitably secure as by welding in the inclined wall 22. The discharge coupling 54 serves to provide a continuous flow of water with accompanying fines, such as sand and the like, from compartment 28. Fines may deposit in the bottom zone of compartment 28 and collect in the bottom zone of compartment 32.

The gravel conveyor 12 is arranged inclined from the horizontal with the lower end portion thereof disposed substantially below the weir portion of the central bulkhead 27 while the upper end of the conveyor extends above the liquid containing portion of the vessel 11 so that processed gravel may be discharged from the conveyor free of the apparatus as represented by the arrow 56, FIG. 5. Material discharged from the conveyor 12 should need no further treatment before sale and may be simply piled or fed to an associated conveyor (not shown) for remote piling. The gravel conveyor 12 includes a head roller 57 operatively associated with an hydraulic motor 58, a tail roller 59 and five carrier rollers 61. A continuous conveyor belt 62 formed from wire manufactured in a spiral weave configuration to provide an open foraminous construction is arranged about the rollers and a tensioning roller 63 is disposed on the lower run of a conveyor belt to avoid undue sagging of the conveyor belt. To provide smooth operation each of the rollers includes a rubber covering 64, rollers 59, 61, and 63 journaled at their ends in water lubricated bearing 66 arranged on the side walls of the vessel (FIGS. 1–2, 4). Means are provided to afford adjustment of the tension in the conveyor belt 62 and include brackets 67 (FIGS. 1–2, 4) secured by fasteners 68 to the extensions 18*a*, 19*a*, of the side walls. Each bracket 67 includes spaced parallel guides 69 between which a slidable member 71 is mounted and connected to a threaded shaft 72 having an outer portion received in an end plate 73 of the bracket. The belt tensioning apparatus is constructed so that rotation of the shaft 72 will move the sliding element 71 either towards or away from the end plate 73. On one of the sliding members 71 there is mounted the conveyor motor 58 and on the other member 71 there is mounted the bearing for the head roller. Thus movement of the members 71 moves the head roller 57 for belt adjustment purposes.

As shown in FIG. 4, side boards 76 including downwardly extending flexible members 77 are arranged laterally spaced apart on each side of the conveyor 12 to assure that gravel and like materials which are deposited on the conveyor do not creep between the side portions of the conveyor belt on the side walls of the vessel.

The trash conveyor 13 includes a head roller 81 arranged above the nominal liquid level of the vessel and a tail roller 82 arranged below the nominal liquid level of the vessel and disposed proximate to the central baffle 27 and above the tail roller 59 of the gravel conveyor, FIG. 5. Both the head roller and tail roller are equipped with a rubber convering or sleeve 64 and the tail roller is mounted with respect to the vessel side walls 18, 19 in water lubricated bearings 66. The ends of the head roller 81 are journaled in a sliding block 71 arranged in an adjustment bracket 67 having the components and functions described above for the gravel conveyor. An hydraulic motor 83 receiving a supply of fluid from the pump 14 drives the head roller 81 so as to convey material in the direction of the arrow 84, FIG. 5, for discharge into a point outside of the vessel. The presence of the adjustment bracket 67 on the trash conveyors serves to permit adjustment of the length of the conveyor to maintain the proper tension in a foraminous conveyor belt 86 which is formed similarly to the belt 62 of the gravel conveyor. Side boards 87 are provided on the trash conveyor, FIG. 3, and serve to maintain the material centered on the belt between the side boards until such is discharged as symbolized by the arrow 84.

The hydraulic circuit for driving the three hydraulic motors on the gravel washer and trash separator (motors 36, 58 and 83) may be of conventional arrangement and for each motor should include a speed regulation valve 88, 89, 91 arranged in the circuit in the conventional manner.

The water lubricated bearings are all fed off a common manifold 92 with connecting conduits 93 and the direction of water flow is through the bearing into the vessel.

An arrangement of water jet nozzles **96** for projecting a spray of water against the gravel conveyor belt and the material thereon is provided on the gravel washer and trash separator, as shown in the drawings. The spray arrangement may include four nozzles **97** arranged in a manifold **98** for projecting a stream of water as indicated by the arrow **99**, FIG. **5**, and remove residual particles from the gravel traveling on the conveyor belt **62**. The water from the spray nozzles and water from the bearings serves also as makeup water to that discharged through the open washout or discharge nozzle **54**.

OPERATION

The gravel washer and trash separator is prepared for operation by first filling the vessel or tank **11** with a liquid such as water to about the level of the end wall **23** and somewhat below the upper or weir portion **34** of the central bulkhead **27**. The prime mover electric motor **16** is placed in operation and drives the pump **14** developing hydraulic pressure in the system which includes the hydraulic motors **58, 83**, for the gravel and trash conveyors respectively and the hydraulic motor **36** which drives the impeller **37**. Water pressure is supplied to the water manifold **92** which furnishes water to the water lubricated bearing **66**. The jet water spray arrangement **96** is set in operation to direct a spray of water downwardly toward the upper run of the gravel conveyor **12**.

The effect of the impeller **37** rotating within the collar **42** of the tube **41** is to generate a strong current of water in the direction of the arrows **43** through the conduit **41** and outwardly therefrom through the V-shaped channel defined by the inclined baffles **44, 46**. The current is directed upwardly by the inclined end wall **22** and continues upwardly through the foraminous belt **62**, through both the upper and lower runs thereof. Being that the impeller is supplied with water from the suction compartment **33** a downward current is created therein extending through the trash conveyor **13**. The current effect in compartment **28** causes water to flow over and across the upper edge of the baffle (the weir portion **34**) and then downwardly through the foraminous belt **86** of trash conveyor **13**. The water passes through the foraminous belt **86** of the trash conveyor so that substantially no water is lost in sluicing material from the unit. Thus the current path is circular.

Gravel containing wood chips, twigs, leaves and the like material may be deposited in the gravel washer **10** from a conveyor unit **101** (FIG. **1**) positioned so that the material will drop as indicated by the arrow **102** (FIG. **5**). Thus the material for treatment will be dropped into the water and supported therein by the foraminous belt **62** of the gravel conveyor **12**. The up-current of water passing vigorously through the belt **62** will carry the lighter or floatable materials in the direction of the current over the weir portion **34** onto the trash conveyor **13** which is moving in an uphill direction as indicated by arrow **84**. The speed of the two conveyors **12, 13** may be regulated by the motor speed controls **89, 91** and thus adjustments can be made to achieve the most satisfactory cleaning conditions. As the gravel passes in the direction of the arrow and line **102** on the gravel conveyor **12**, the gravel encounters a water spray as indicated by arrow **99**. The water spray removes from the gravel any residual fines, sand, or trash particles adhering to the gravel. Particles removed by the jet stream are either driven downwardly into the turbulent current adjacent the weir or in the case of fine sand and the like passed downwardly through the belt into the bottom of the compartment **28** and are swept therefrom through the discharge nozzle **54**. Sands and the like entrained in the water current carried over the weir settle through the belt **86** into the settling compartment **32**. In this process a substantial amount of fines, sands and other corrosive particles are prevented from moving elements of the apparatus such as the impeller and bearing. Makeup water for that issuing from the discharge nozzle **54** is supplied both to the water lubricated bearings and the water jet arrangement **96**. Bearing life is enhanced by use of water lubrication which prevents sand and the like corrosive materials from entering the bearings.

We claim:

1. An improved gravel washer and trash separator comprising, a vessel serving to contain a liquid body and having therein first and second liquid compartments, conduit means in said vessel permitting a current of liquid to flow between said compartments, current creating and directing means cooperable with said conduit means serving to generate in said vessel a continuous current including an up-current in said first compartment and a down-current in said second compartment, means in said vessel defining a weir between said compartments, gravel transporting conveyor means arranged in said first compartment, trash transporting conveyor means arranged in said second compartment, each said conveyor means being arranged with respect to said liquid body in an inclined attitude with the lower end portions of the conveyors means submerged in the liquid body and with the lower end portions thereof being arranged adjacent to and below said weir means, the upper portions of said conveyor means extending above the level of said liquid body, each conveyor means including a conveyor belt of foraminous construction permitting liquid current to pass therethrough so that gravel and trash deposited in said liquid body on said gravel conveyor means are exposed to the liquid up-current serving to carry trash from the gravel over the weir, the current passing through the conveyor belt of said trash conveyor into the down-current stream, power means operably associated with said conveyor means for moving the upper run of said conveyor belts in the direction away from said weir.

2. The gravel washer and trash separator of claim **1** wherein said current creating and directing means includes impeller means mounted in said vessel adjacent one end of said conduit means, second power means for rotating said impeller means, and baffle means arranged in said vessel at the other end of said conduit means for directing the liquid current upwardly in said first compartment.

3. The gravel washer and trash separator of claim **1** wherein said vessel in said first compartment is provided with an open water discharge nozzle for conveying fines from said vessel.

4. The gravel washer and trash separator of claim 1 wherein a water spray apparatus is provided over said gravel transporting conveyor means and arranged to project a spray of water on the gravel after the same has emerged from said liquid body.

5. The gravel washer and trash separator of claim 4 wherein each said conveyor means is of a length with respect to said vessel permitting the conveyor belts to discharge materials outside of said vessel.

6. The gravel washer and trash operator of claim 1 wherein said current creating means includes motor means and an impeller arranged within said second compartment, and a bulkhead in said vessel dividing said second compartment into a fines settling chamber and an impeller suction chamber, precluding substantial ingestion of fines into the said impeller and motor means.

7. An improved gravel washer and trash separator comprising an upright vessel serving to contain a liquid body, bulkhead means extending between the side portions of said vessel to define therewith first and second compartments, liquid conduit means in said vessel communicating with said compartments to permit a current of liquid to flow therebetween, impeller means arranged in said second compartment adjacent to an end of said conduit means serving to generate in the liquid body a downward current in said second compartment and to circulate a current of liquid through said conduit to said first compartment, current directing means in said first compartment serving to direct the current of liquid upwardly therein, power means serving to drive said impeller means, the upper portions of said bulkhead means serving with the side portions of said vessel as a weir with respect to said liquid current, gravel conveyor means arranged on said vessel in an inclined attitude such that the lower end of said conveyor means is submerged in the liquid body, trash conveyor means arranged on said vessel such that the lower end thereof is submerged within said liquid body, the lower end portions of both said conveyor means being disposed adjacent to said weir, each conveyor being equipped with a conveyor belt of open, wire mesh construction permitting passage therethrough of the liquid current, second power means serving to drive each said conveyors such that the upper run of said conveyor belt moves upwardly out of the liquid body, and an array of water spray nozzles disposed above the gravel conveyor means to project a spray of water upon the gravel as the same is conveyed by the gravel conveyor means.

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