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Bilton

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[54] SCOOP-TRIMMED FLUID COUPLINGS

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[58] Field of Search.....60/54

[56]

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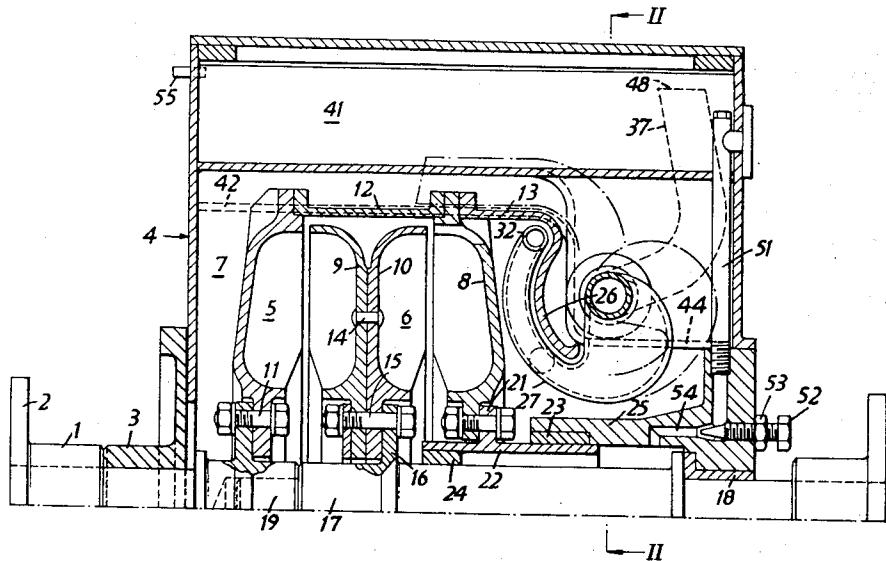
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[57]

ABSTRACT

The trimming scoop of a scoop-trimmed fluid coupling is interconnected with a movable weir tube in an overhead reservoir to effect complementary changes in the volumes of liquid in the reservoir and the working circuit or circuits of the coupling on movement of the weir tube and scoop tube in either direction. A cooling flow path may extend from the reservoir to the working circuit or circuits.

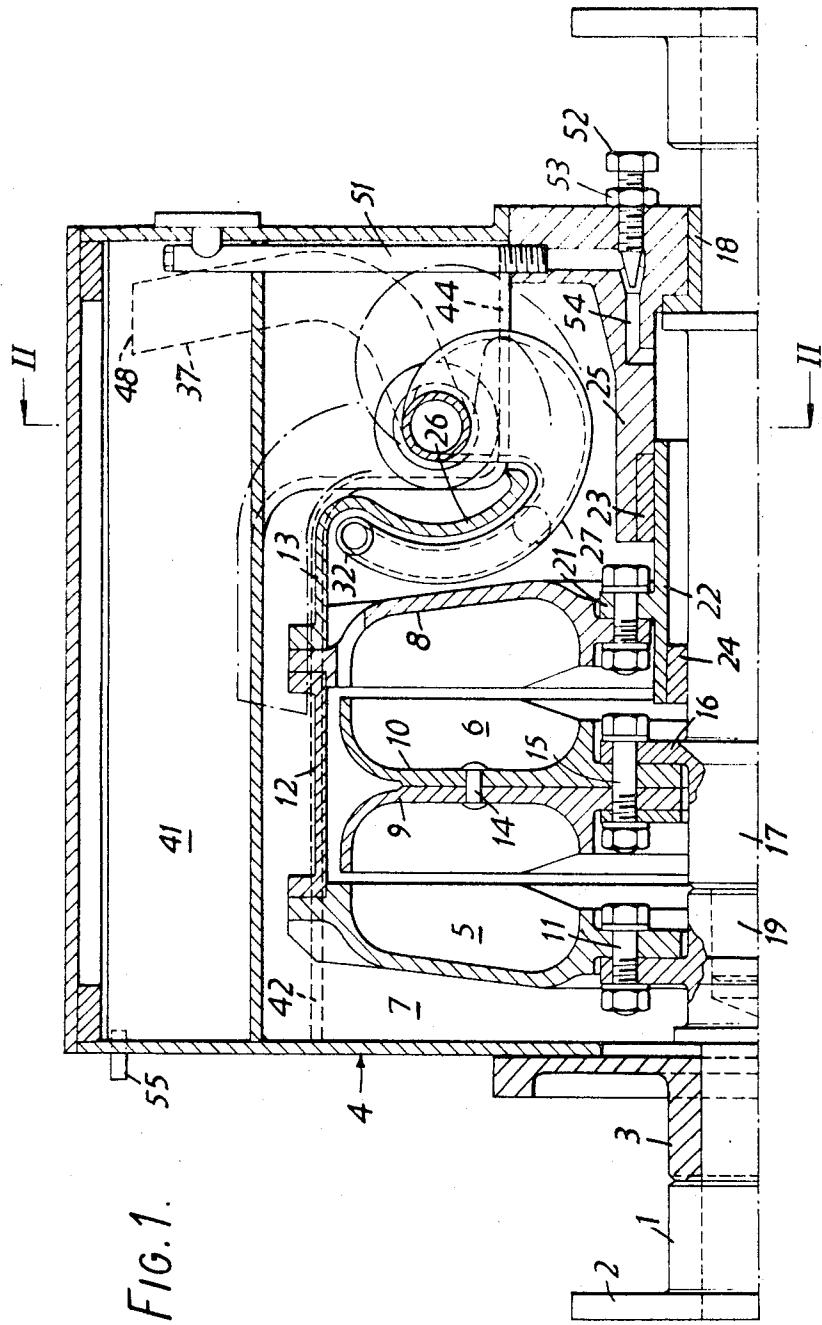
7 Claims, 5 Drawing Figures



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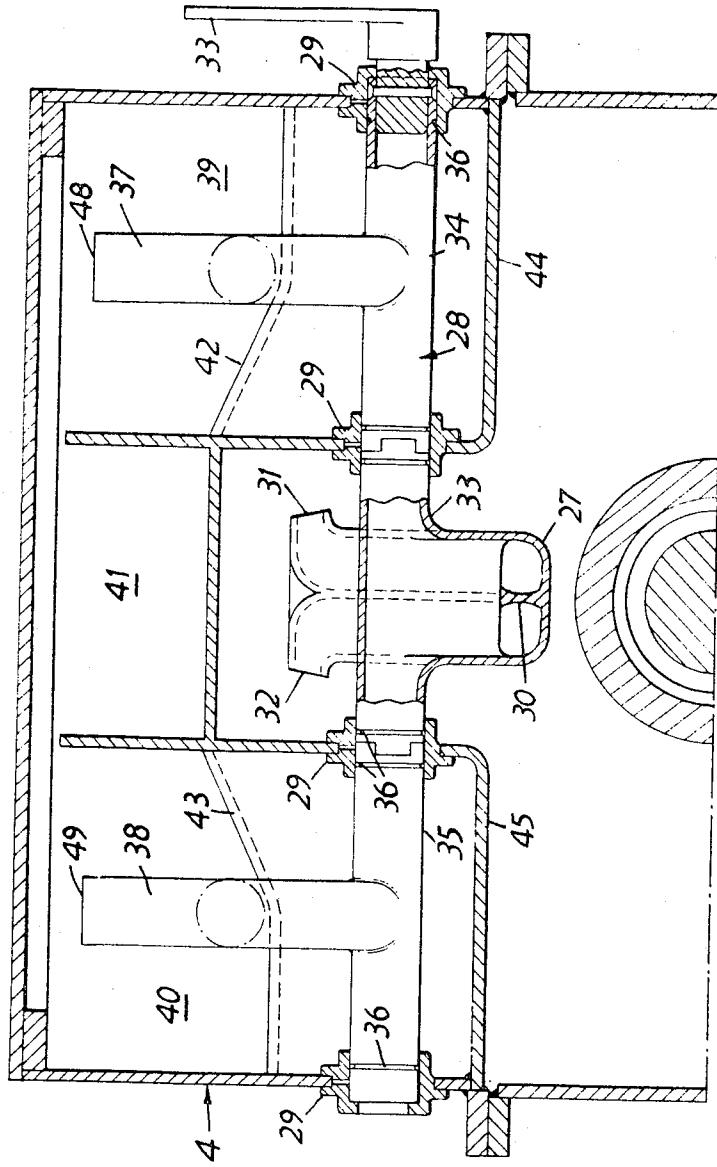


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FIG. 2.



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FIG. 3.

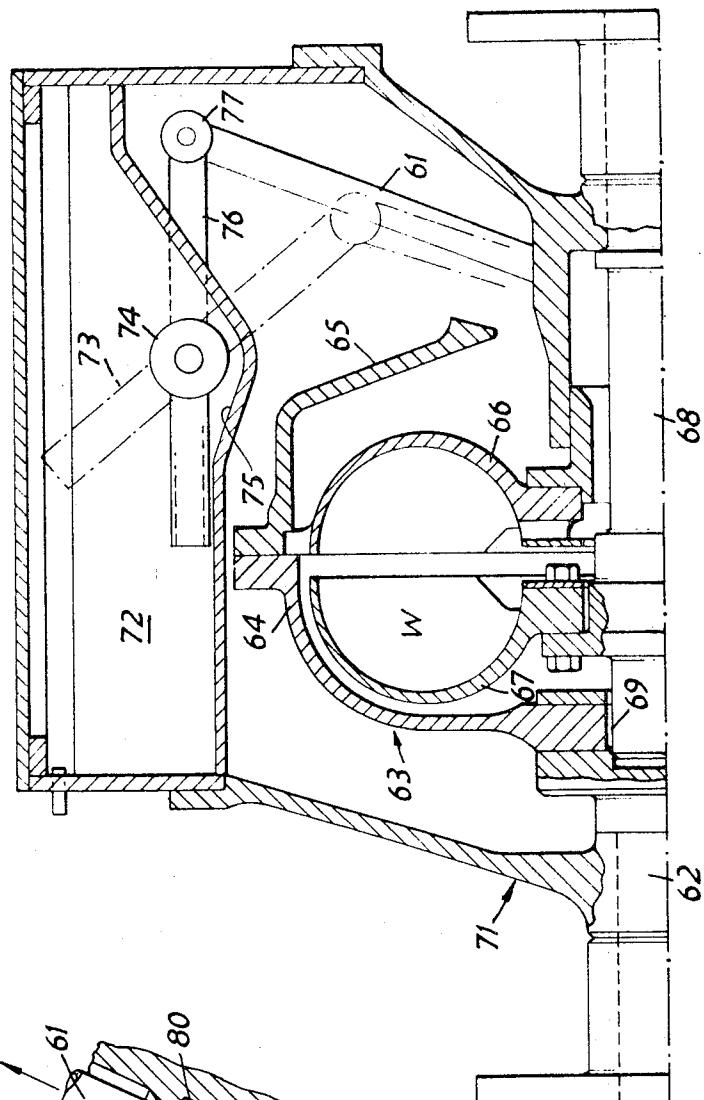


FIG. 4.

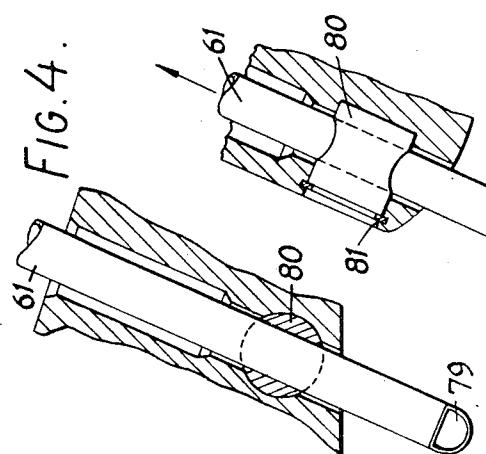


FIG. 5.

SCOOP-TRIMMED FLUID COUPLINGS

This invention relates to scoop trimmed fluid couplings, that is to say fluid couplings in which a casing rotates with one of the two vaned elements which together define a toroidal working circuit for liquid and an adjustable trimming scoop extends into a scoop chamber formed within the casing to trim off liquid from this chamber and thereby control the quantity of liquid within the working circuit.

In operation, working liquid is supplied continuously to the working circuit at a constant rate, typically by a filling pump. In the steady state corresponding to any particular position of the trimming scoop, working liquid is removed by the scoop at the same rate as it is supplied by the pump.

While this arrangement enables a cooling circulation to be maintained through the coupling, the need for a continuously running pump increases the initial cost and the mechanical complexity. Further, the maximum filling flow rate available is limited to the delivery rate of the pump. Thus, to increase the filling rate a larger pump has to be used thereby increasing the initial cost and absorbing more power in maintaining a larger-than-necessary flow through the coupling.

In U.S. Pat. No. 3,521,451, the working liquid is water and the pump is omitted. Instead, a continuous flow (corresponding to the pump delivery) is passed through the coupling from a mains supply to a drain. While the initial cost is reduced, this arrangement is not suitable for many applications, such as underground conveyor belt drives in mines. Moreover, the higher the filling rate required, the higher is the continuous flow from mains to drain during normal running.

It has been proposed in British Pat. No. 328,028 to use a reservoir connected to deliver working liquid under a pressure head, for example a gravitational head, to the working circuit. The degree of filling of the working circuit is controlled by adjusting the outlet flow from the reservoir to the coupling, the scoop being fixed with its scoop orifice permanently at the "circuit empty" position, that is at the same radial distance from the coupling axis as the radially outermost portion of the working circuit. While this arrangement enables the required flow rate to the working circuit to be obtained the scooping orifice must necessarily be in the position where it exerts the maximum drag torque on the coupling under all conditions. Further, to obtain an acceptable emptying time for discontinuing drive through the coupling, the scoop must continuously withdraw liquid from the working circuit at the empty rate even under normal driving conditions. This again results in a higher circulation rate than may be required for cooling and a consequent waste of power.

According to the present invention there is provided a scoop trimmed fluid coupling assembly characterized in that it includes a stationary reservoir arranged to deliver working liquid under a filling pressure head to the working circuit and means for controlling the delivery rate from the reservoir to the working circuit and in that the control means is interconnected for movement with the scoop tube in such a manner as to deliver a larger flow rate to the working circuit when the scooping orifice of the scoop tube moves out of the scoop chamber to fill the working circuit than during the steady state.

Conveniently, the reservoir extends above the level of the working circuit and a movable weir tube communicating with the scoop tube has a movable weir orifice within the reservoir and is interconnected for movement with the scoop tube in such a manner that as the scooping orifice of the scoop tube moves into the scoop chamber to empty the working circuit, the weir orifice rises within the reservoir and the liquid trimmed off from the scoop chamber is discharged through the weir orifice into the reservoir whereas when the trimming scoop orifice is withdrawn to its 'circuit full' position, the weir orifice moves below the level of liquid in the reservoir and liquid flows back through the weir orifice from the reservoir into the scoop chamber to refill the working circuit. If desired a continual flow of cooling liquid can be maintained through the working circuit of the coupling by providing a flow path from the reservoir to a point near the axis of the coupling from which liquid can enter the radially inner part of the working circuit, the resultant excess of liquid in the working circuit being trimmed off by the scoop and being returned through the weir tube and weir orifice to the reservoir.

Particularly where it is desired that the coupling should be suitable for either direction of rotation, the scoop tube may be a double scoop tube having separate orifices facing in opposite directions and each orifice may be connected to its own weir tube working in a common reservoir. With this arrangement, the cooling flow may also be obtained by direct collection of liquid by a scooping orifice facing in the forward direction, the liquid thus collected flowing into the reservoir by the weir tube connected to the forwardly facing scoop orifice and thereafter returning to the working circuit through the other weir tube which communicates with the rearwardly facing scoop orifice.

The scoop tube may be of the arcuate form shown in German Pat. No. 820,660 mounted for pivotal movement about a horizontal axis transverse to the coupling axis and displaced therefrom. With such an arrangement, the scoop tube may be carried by a hollow shaft which also carries the weir tube or tubes. The scoop tube, hollow shaft and weir tube or tubes then move as a single unit about the transverse axis, the interior of the scoop tube being connected with the weir tube through the interior of the hollow shaft.

In an alternative arrangement, the scoop tube is of the well-known sliding type and the weir tube is pivotally mounted and has an extension beyond its pivotal mounting, the extension being articulated to the scoop tube. A connection for flow of liquid from the scoop tube to the weir tube is provided. This may conveniently be effected through the articulation joint between the scoop tube and the weir tube.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which :

FIG. 1 shows in axial section the upper half of a scoop trimmed coupling incorporating the invention,

FIG. 2 is a section on the line IIII-II of FIG. 1,

FIG. 3 is an axial sectional view of the upper half of another embodiment of the invention in the form of a single circuit coupling, and

FIGS. 4 and 5 are sectional views showing the pivoted trunnion support for the scoop tube of FIG. 3.

The coupling shown in FIG. 1 has an input shaft 1, which in use is driven by a motor (not shown) through a driving flange 2 secured to the shaft 1 which is

mounted in bearings 3 in a housing 4 for the coupling.

Twin working circuits 5 and 6 are defined by vaned impeller elements 7 and 8 and runner elements 9 and 10. The impeller element 7 is bolted at 11 to a flange on the input shaft 1 and a cylindrical casing portion 12 interconnects the outer peripheries of the two impeller elements 7 and 8. A scoop chamber casing portion 13 is also secured to the outer periphery of the impeller 8.

The two runner elements 9 and 10 are secured together back-to-back by rivets 14 and are bolted at 15 to a flange 16 and an output shaft 17 mounted in a bearing 18 in the housing 4. The output shaft 17 may have a spigot 19 received in a bearing within the end of the input shaft 1.

The hub of the impeller 8 is bolted to a flange 21 of 15 a sleeve 22 which is journalled at 23 in a bearing carried by an inwardly extending cylindrical portion 25 of the housing. Thus, input stub shaft 1, impeller 7, casing 12, impeller 8 and sleeve 22 comprise a rigid rotating bridge. This bridge is supported between journal bearing 3 and sleeve bearing 24. In place of the spigot 19, the output shaft 17 may be supported by a split bearing bush 24 carried by the sleeve 22 which would then be formed with feed holes if working liquid is to be supplied to the working circuit from within the sleeve 22.

The scoop chamber portion 13 of the rotating casing of the coupling has its end wall 26 shaped to conform to the movement of an arcuate scoop tube 27 mounted on a hollow shaft 28 supported in bearings 29 (FIG. 2) in the housing 4. The scoop tube 27 has two orifices 31 and 32 opening within the scoop chamber formed by the casing member 13. The angular position of the shaft 28 and thus the radial position of the scoop tube orifices 31 and 32 may be adjusted by any appropriate means such as the lever 33 shown in FIG. 2 or a servo-control device (not shown).

In the construction shown in FIG. 2, the hollow shaft is in the form of three separate portions: a central portion 33 integral with the scoop tube 27 and two outer portions 34 and 35. The center portion 33 is divided internally by a wall 30 and its ends are shaped to interfit with the adjacent ends of the two outer portions 34 and 35 so as to provide a rotational driving engagement while permitting slight angular misalignment between the portions of the hollow shaft 28. The orifice 31 communicates with the outer portion 34 and the orifice 32 with the outer portion 35. O-ring seals 36 prevent leakage of working liquid through the support bearings 29.

Each of the outer portions 34 and 35 of the hollow shaft 28 carries an elbowed weir tube 37 and 38 respectively. Each weir tube 37, 38 extends into a side pocket portion 39, 40 of a reservoir tank 41 defined in the upper part of the housing 4. The floor 42, 43 of the side pocket portions 39 and 40 at the input end of the housing 4 is higher than the floor portions 44, 45 nearer the output end of the housing 4 in order to provide clearance for the rotating coupling casing at the input end of the coupling and extends beneath the hollow shaft 28 adjacent the output end of the coupling.

Each of the weir tubes 37 and 38 terminates in a weir orifice 48, 49 which define the liquid level in the reservoir tank 41. If the lever 33 is moved to lower the orifices 48, 49 below the liquid level in the reservoir tank 41, liquid will tend to flow under gravity through the weir tubes 37 and 38 into the hollow shaft 28 and from thence through the arcuate scoop tube 27 and whichever of the orifices 31 and 32 is facing in the direction

of movement of the scoop chamber casing 13 as the latter rotates. In this way, the filling of the coupling is increased.

If however the lever 33 is moved in the direction to raise the orifices 48, 49 above the level of liquid in the reservoir tank 41, the scooping orifices 31 and 32 will be plunged into the ring of liquid in the scoop chamber and accordingly liquid will be trimmed off by whichever of the scoop orifices 31, 32 is facing in the opposite direction to the direction of movement of the casing member 13 and liquid will be forced into the scoop tube 27 and thence through the hollow shaft and the appropriate weir tube 37 or 38 into the reservoir tank 41.

In this way, it can be seen that no circulation pump is necessary for replenishing or filling the working circuit.

The coupling shown in FIGS. 1 and 2 could be designed for use with water or a water and oil emulsion as working liquid in which case the various bearing bushes for supporting the shafts (e.g. the bushes 18, 23 and 24) could be of polytetrafluoroethylene. The double circuit arrangement avoids the need for any substantial axial thrust bearing.

If a flow of liquid for cooling the working circuits is required, the coupling may include a pipe 51 to which the cooling liquid is supplied, the flow of which is controlled by a bleed screw 52 with a lock nut 53. The working liquid passing the tapered head of the bleed screw 52 flows through a passage 54 in the cylindrical housing portion 25, into the working circuit 6 and thence into the interior of the casing 12, 13, the tank having an overflow outlet 55 for any accretion of liquid not lost by leakage through the normal labyrinth seals.

In an alternative arrangement, the cooling flow may be taken from the bottom of the tank 41, passed through an external cooler (not shown) and then fed into the pipe 51 at a level lower than that of the overflow pipe 55. A shut-off valve would then be ganged with the lever 33 to close pipe 51 in the 'circuit empty' position to prevent the tank being drained.

The coupling shown in FIG. 3 differs from that described in FIGS. 1 and 2 in that the coupling has a single working circuit W and the scoop tube 61 is of the conventional sliding type which is here supported for sliding movement in a trunnion 80 mounted for angular movement in a cross bore in which it is retained by a circlip 81.

The input shaft 62 carries a casing 63 comprising a bell-shaped housing 64 to which is secured a scoop chamber casing 65 and the impeller 66 which together with a runner 67 defines the working circuit W. The runner 67 is secured to an output shaft 68. One end of the output shaft 68 is supported in a bearing 69 in the hub of the casing 63. The input shaft 62 and output shaft 68 are both supported in bearings where they pass through the walls of a stationary housing 71 for the coupling. A reservoir tank 72 is formed in the upper part of the housing 71.

A weir tube 73 is carried by a horizontal hollow shaft 74 which passes out through a side wall of a pocket 75 of the reservoir tank 72 and carries an extension 76 which is articulated to the scoop tube 61 by means of a joint 77 which permits flow of the working liquid therethrough.

I claim:

1. A scoop-trimmed fluid coupling assembly comprising a fluid coupling in which a casing rotates with one of the two vaned elements which together define a toroidal working circuit for liquid and an adjustable trimming scoop extends into a scoop chamber formed within the casing to trim off liquid from this chamber and thereby control the quantity of liquid within the working circuit, wherein the assembly includes a stationary reservoir arranged to deliver working liquid under a filling pressure head to the working circuit and means for controlling the delivery rate from the reservoir to the working circuit and wherein the controlling means is interconnected for movement with the scoop tube in such a manner as to deliver a larger flow rate to the working circuit when the scooping orifice of the scoop tube moves out of the scoop chamber to fill the working circuit than during the steady state.

2. A coupling assembly according to claim 1, wherein the reservoir extends above the level of the working circuit and a movable weir tube has a movable weir orifice within the reservoir and is interconnected for movement with the scoop tube in such a manner that corresponding movements of the scoop tube and weir orifice

cause complementary changes in volume of working liquid in the coupling and the reservoir.

3. A coupling assembly according to claim 2, wherein the scoop tube is arcuate and is provided about an axis, and the weir tube is fixed to the scoop tube by a hollow shaft which provides liquid communication between, and forms the pivotal axis for, the weir tube and scoop tube.

4. A coupling assembly according to claim 2, wherein the scoop tube is slidale and the outer end of the scoop tube is articulated to the weir tube.

5. A coupling assembly according to claim 4, wherein the articulation between the scoop tube and weir tube is hollow and provides liquid communication between the scoop tube and weir tube.

6. A coupling assembly according to claim 5, wherein the scoop tube is slidale in a pivot.

7. A coupling assembly according to claim 1, including means defining a restricted flow path for cooling liquid from the reservoir to the coupling working circuit.

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