This invention relates to railroad cars for handling of dry bulk commodities and more particularly to a novel method and apparatus for use with a sparger type covered hopper railroad car for the expedient removal of all of the bulk commodity from the hoppers of the cars.

Therefore, the usual practice of transporting and unloading dry bulk commodities from railroad cars (such as, for example only, potassium chloride), consists in shipping the commodity in box cars to the destination where the commodity is removed from the cars by mechanical equipment. Such practices normally require the use of manned equipment, such as power unloader for transferring the commodity from the car to a hopper conveying system, or transferring it directly to a saturator, which operation is costly, time consuming and usually requires approximately ten hours to unload one hundred (100) ton of such a commodity. Moreover, such prior practices result in substantial waste or loss of the commodity in handling it, and always presents the problem of possible contamination of the load by reason of the box car containing a quantity of some other material from a prior load in the car. Furthermore, in handling of certain dry bulk commodities, such material, while in transit, cakes and forms large solid bodies of material which must be broken up for convenient handling, thus requiring additional expenditure of labor. All of the foregoing conditions and disadvantages add substantial costs to the processors and users of such commodities.

It is also well known that sparger type railroad cars, due to their design, are capable of handling approximately twice the tonnage of a conventional box car, and have for large quantity shipments, involving the use of several cars, demurrage charges are reduced or eliminated, as compared to using box cars, and the necessity for movement of the cars from a siding to a desired unloading position is likewise reduced or eliminated. By using sparger type railroad cars, great savings is additionally effected by reason of the elimination of any need for pay loader type equipment and the operator thereof, and there also results total elimination of waste of material due to handling such as exists in connection with unloading conventional type box cars.

While there have been some attempts to utilize sparger type railroad cars for handling of dry bulk commodities, such use, in the main, has not been found acceptable or satisfactory for many reasons. The main disadvantage is that they necessitate the use of substantial manual labor to effect and complete the unloading of the commodity from the cars and in the cleansing of the hopper portions of the cars after the unloading and the time required to complete unloading of cars has been found to be quite substantial.

One of the objects of this invention is to provide a novel method and apparatus for efficiently unloading dry bulk commodity from sparger type covered hopper railroad cars.

Another object is to provide a novel method and apparatus for unloading dry bulk commodities from sparger type railroad cars in a manner which requires approximately one-fifth the time normally required for complete unloading of a similar quantity of such material from box cars.

A further object is to provide a novel method and apparatus for use in connection with a sparger type covered hopper railroad car which insures relatively complete removal of all commodity from the hopper of the car as a part of the unloading operation, so as to eliminate possible contamination of the next load of commodity that is placed in the hopper of the car.

It is also an object of this invention to provide a novel method and apparatus for unloading dry bulk commodities from sparger type covered hopper railroad cars by virtue of which great economies and savings are effected as compared to other currently used methods and apparatus.

Another object is to provide a novel method and apparatus for unloading dry bulk commodities from a sparger type railroad car wherein a suitable liquid is introduced into the hopper of the car, into contact with the commodity, in a manner to produce a highly agitated, turbulent, swirling admixture of the liquid and commodity, to create a slurry of all of the commodity in the hopper which is completely and rapidly discharged from the hopper in the car.

A still further object of this invention is to provide a novel method and apparatus for unloading dry bulk commodity from a sparger type car which effects a thorough cleansing of the entire interior surfaces of the hopper in the car incident to complete discharge of the commodity from the car.

Other objects and advantages of this invention will be apparent from the following description, taken in connection with the accompanying drawings in which:

FIG. 1 is a side elevational view of a sparger type covered hopper railroad car embodying the present invention.

FIG. 2 is a plan view of the car with the hopper arrangement shown in dot and dash outline, and the sparger apparatus being shown in full lines.

FIG. 3 is an enlarged fragmentary, elevational view of the railroad car, a portion being shown in section and a portion being shown in elevation, with respect to two adjacent hoppers of the car.

FIG. 4 is a transverse, vertical sectional view, taken substantially as indicated at line 4—4 on FIG. 3.

FIG. 5 is a horizontal sectional view through the lower portion of one of the hoppers, taken substantially as indicated at line 5—5 on FIG. 4.

FIG. 6 is a fragmentary sectional view showing a portion of the sparger apparatus for one of the hoppers, taken substantially as indicated at line 6—6 on FIG. 3.

FIG. 7 is an enlarged view in side elevation of the novel nozzle embodying the present invention shown mounted in a fragmentary portion of side wall of the hopper.

FIG. 8 is an end view of the nozzle taken substantially as indicated at line 8—8 on FIG. 7.

FIG. 9 is a fragmentary plan view of the discharge end of the nozzle shown in FIGS. 7 and 8.

FIG. 10 is a sectional view through the nozzle taken as indicated in line 10—10 on FIG. 9.

FIG. 11 is an enlarged vertical section through the sump portion and discharge outlet of the hopper taken as indicated at line 11—11 on FIG. 9.

Referring now in detail to the drawings, the railroad car to which the present invention is directed which is indicated generally at A is of the sparger, covered hopper type, and as shown includes three separate, connected hoppers B, and such cars are usually formed on metal. Each of the hoppers are of generally inverted pear shape design in vertical cross section, as may be seen in FIG. 4 of the drawings, and each of the hoppers is provided with two normally closed hatches as indicated at C, for
loading of the hopper with bulk commodity. As may be seen in FIG. 4, the hopper lateral walls 10 are in the main, curved, with the upper portion being substantially semicircular in contour, and the lower portions thereof, as indicated at 12, being curved in an inwardly and downwardly converging direction. The hopper’s transverse walls each comprise a downwardly inclined wall portion 14, and an upright wall 16 which is a common wall with respect to two adjacent compartments or hoppers B.

For convenience I will now describe a single hopper unit and the sparger arrangement therefor. As may be seen in FIGS. 1 and 2 the sparger apparatus is identical for each hopper, except that for the right hand end hopper it is located in an opposite relation to that for the hopper at the left end of the car.

Surrounding the lower marginal edge portions of the curved side walls 12 and the inclined end walls 14 is a frame member 17 which is welded to said wall portions. Said frame member includes a horizontally disposed flange 18 to which is secured by bolts 20, a lower hopper section 22, having a horizontal flange 24, registering with the flange 18, at the lower end of the main hopper body, as seen in FIG. 11 of the drawings. The lower hopper section includes a bottom 28, formed to provide two oppositely inclined portions extending generally in the direction of the end walls 14 of the hopper as seen in FIG. 3. The inclined portions of the bottom are connected by a curved section to form a sump or trough. Welded to the ends of the bottom 28, of the lower hopper section, are end walls 30 to complete the closure for the lower hopper section. The end plates 30 are each formed with a large circular discharge opening 32 adjacent to the lower edges thereof, with the marginal edge of opening 32 coinciding with the curved section of the bottom 28, as seen in FIGS. 3 and 11 of the drawings. Preferably the openings 32 are of a diameter, in the range of 4” to 8”, to correspond in size to a discharge conduit which is to be associated therewith as hereinafter described. Welded to the exterior of each of the end plates 30, in registration with the openings 32, are coupling adapters 36, the external surface of which is formed with a suitable annular groove 38 and a pair of recesses 40 for cooperative engagement with locking elements of a quick-connect-disconnect type of closure unit 42, for effecting a sealed closure for the end of the adapter 36, as seen in FIG. 11 of the drawings. The closure unit includes a cap member 44 with a gasket 46 within the cap member, positioned to abut against the end of the adapter and a pair of engaging arms 48 pivotally connected at 50 to the cap member, said arms having locking members 51 for engaging the notches 49, formed in the outer wall of the adapter. Normally when the car is in transit and the hopper is loaded, the ring elements 52 at the outer ends of the arms 48, are interconnected by a suitable, conventional wire seal, not shown. It will be noted that the discharge openings 32 and their adapters 36, with their closure 42, at opposite ends of the bottom section of the hopper, are located at opposite sides of the car, as seen in FIG. 4 of the drawings, for purposes of selective unloading of the commodity from the hopper at either side of the car. Each of the hoppers of the car are provided with a sparger arrangement and while they are herein shown as separate arrangements, they may if desired, be interconnected into a common system. Each of the sparger arrangements include a pair of nozzles 60, of novel design, which are mounted in the lower curved, opposite portions of the hopper, as may be seen in the drawings. The pair of nozzles 60, are mounted with their discharge orifices facing in an upwardly direction in the hopper, above and adjacent the sump of the hopper, in staggered offset relation to the geometric center of the hopper, as clearly seen in FIG. 5 of the drawings. The orifices of the nozzles is formed with a circular guide flange 61, fitted in a correspondingly shaped opening 62, in the lower portion 12 of the side wall, with an immediately adjacent flange 63, abutting against and welded to the exterior of the plate of the lower wall portion 12 of the hopper, as seen in FIG. 7. The nozzle includes a generally tubular body 64, terminating at its forward end, outwardly of the flange 61, in a flattened tapered portion 66 which is flared generally, in fan shape, as shown in FIG. 9. The extreme end of the tapered portion 66 is formed with an elongated discharge orifice 67 which, as may be seen in FIGS. 7 and 8 of the drawings, opens in an upwardly direction and is disposed in a substantially horizontal plane. Extending downwardly from the outer wall of the tapered portion 66 at an immediate adjacent to the orifice 67, is formed the charge opening, approximately one-half of the height of said orifice, are a pair of spaced apart, arcuate diverters 68. The underside of the flattened portion 66, of the nozzle is provided with a pair of discharge openings 69, and formed as an integral part and positioned at the opposite end of the body 64, is a circular mounting flange 70 for connection, as by bolts to a pipe coupling, as hereinafter described.

Connected to the flanges 70, of each of the nozzles, at opposite sides of the car, are downwardly inclined branch conduits 72 and 74 which are interconnected by T-fittings 76, to a transversely extending main supply conduit 78, by virtue of which liquid is conveyed to be supplied through the nozzles 60 to the interior of the hopper. The opposite ends of the main conduit 78 are provided with coupling adapters 80 which are normally closed by a conventional quick connect-disconnect closure unit 81 (as seen in FIG. 4), substantially identical, except for size, to the closure unit 42 as applied to the outlet of the sump for the hopper as shown in FIG. 11 of the drawings. The main conduits 78 are supported in connected relation to the nozzles by a pair of U-bolts 82, to the intermediate flanges 12a, constituting extensions of the side wall portion 12 of the hopper, intermediate adjacent hoppers, as seen in the drawings. The conduits 72, 74 and 78 for convenience in the nature of pipes and to facilitate assembly and mounting of the nozzles in proper position, suitable pipe couplers 84, are interposed in the piping constituting the conduits and for connection to flanges 70 of the respective nozzles 60.

It may be understood that the adapters and piping for liquid supply for the spargers system may be of any suitable size and preferably when utilizing a 4” diameter discharge opening 32 in the sump portion of the hopper said piping and adapters for supplying liquid to the discharge opening 32, would be of a size and number of nozzles, as may be understood that when liquid is to be introduced into the hopper the quick connect-disconnect closure 81, at the end of the main conduit 78 at the side of the car where convenient to a source of liquid for the hopper is available, is removed and a suitable conduit provided with a quick connect-disconnect coupler, of conventional design, is then connected to the adapter 80 by virtue of which liquid is then supplied to both nozzles in the hopper.

For clarity of illustration of the invention in the drawings the quick connect-disconnect closures 42 and 81, which are a commercially available item, are only shown in the enlarged FIGS. 4 and 11 of the drawings. To unload the commodity from one of the hoppers of the car the hopper is positioned adjacent a liquid supply line and a slurry receiving conduit, and the quick-disconnect closure 81, is removed from the adjacent end of the main sparger conduit 78, and the liquid supply line, indicated at D, which is provided with a quick connect coupler E at its end, is then connected to the coupler adapter 80 for supplying liquid under pressure, to the two nozzles at opposite sides of the hopper. The quick connect-disconnect closure 42, associated with the coupler adapter 36 of discharge outlet of the sump of the hopper is removed, and a slurry discharge conduit, if provided at its end with a quick connect-disconnect coupler G, is then connected to the adapter 36, associated with the discharge outlet opening 32 of the sump, as seen.
in FIG. 4. Either one or both of the hatches C of the hopper are then opened to insure venting of the hopper to atmosphere. The pump for the liquid supply line D is started and liquid is discharged through the nozzles 60 into the hopper, into contact with the commodity therein. Depending on the character of the commodity to be unloaded, the liquid introduced into the hopper is permitted to saturate the commodity to insure softening to ensure that it will be converted into a slurry. After the commodity is properly conditioned by the admixture with liquid for a predetermined period of time the pump for the slurry liquid supply conduit F and the pump for slurry discharge conduit F are placed in operation for effecting a complete removal of the commodity from the hopper. After the commodity is totally removed from the hopper and the interior thereof is thoroughly cleansed by the liquid to remove substantially all material or commodity therefrom, the pumps are stopped and the couplers of the liquid supply and slurry discharge conduits are removed and the corresponding closures 81 and 82 are then replaced and the hatches are then closed.

By virtue of the arrangements of the nozzles and their novel form, the liquid introduced into the hopper through the nozzles is directed upwardly, laterally and downwardly as seen in FIGS. 4 and 5 of the drawings. The liquid is introduced in the hopper under substantial pressure in the range of 40 p.s.i. or greater, and is caused to penetrate through the body of the commodity in the hopper to create an admixture of liquid and commodity and form a slurry. Downwardly, projecting streams of liquid from the apertures 69 of the nozzles are directed in the general area of the sump portion of the lower hopper section so as to insure prompt creation of a slurry in the zone where the slurry is to be discharged. As the liquid continues to be forcibly discharged into the body of the commodity, it creates a continuously agitated, turbulent swirling admixture, and as the slurry in the sump portion of the hopper is discharged, the body of the commodity within the hopper tends to cavitate and finally the remaining portion of the load, which would normally tend to adhere to the sides walls of the hopper, falls down and into the zone of the streams of liquid, its slurry formation and is then discharged. When substantially all of the material or commodity is discharged from the hopper the streams or jets of liquid then impinge directly upon or flow over the entire inner surfaces of the hopper in a manner so as to effect substantially complete removal of all commodity from the hopper and thus insure against possible contamination of next load of commodity placed in the hopper.

It has been found that by virtue of my novel method and apparatus it is possible to totally unload thirty-three (33) tons of commodity from one hopper in approximately thirty-five (35) minutes and to remove the loads of commodity in all three hoppers of the car in approximately two hours. Thus, it will be apparent that to unload approximately one-hundred (100) tons of commodity will require approximately 1/2 of the time required to unload the same quantity of commodity from box cars containing the same quantity of commodity as is the general current practice.

The character of the liquid utilized in creating a slurry with the commodity will depend upon the nature of the commodity itself. In some instances water is utilized, in other instances a brine solution is utilized, and for other commodities suitable liquids containing chemicals are utilized. For some purposes it may be desired to cause the commodity to go into complete solution in the liquid introduced into the hopper, depending upon its character and the intended use of the commodity.

The branch conduits 74 of the sparger apparatus are preferably disposed at an inclined angle to vertical as seen in FIGS. 1 and 3, so that when the load is totally removed from the hopper there will be no residual liquid in the conduits which might impair or contaminate the next load of commodity introduced into the hopper, and which might occur if such a subsequent load of commodity is of hydroscopic character, such as potassium chloride, which liquid would cause hardening of portions of the commodity prior to its discharge from the hopper and which would also present an obstruction to the free admission of liquid into the hopper for the creation of a slurry to effect rapid discharge of the load of commodity. Due to the novel form and design of the nozzle 60, the liquid discharged therethrough is caused to direct streams in an upwardly laterally and downwardly directed to rapidly and efficiently create a slurry. If desired, separate nozzles could be utilized to direct streams or jets of liquid in a downwardly direction in the zone of the sump portion of the hopper. The design of the nozzles is such as to be substantially clog proof and this factor is of substantial importance because frequently foreign objects are contained in the liquid supply stream, such as wood chips in a brine solution. Even if such chips do move through the supply conduit and become lodged in the nozzle, it is not believed that such a condition could ever result in clogging of the nozzle to an extent greater than 50% of its discharge capacity.

Although I have herein shown and described a preferred embodiment of my invention, manifestly it is capable of modification and rearrangement of parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as I may be so limited by the appended claims.

I claim:

1. The method of unloading dry bulk commodity from a sparger type railroad car having a hopper which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing from points within the lower portion of the hopper and adjacent to opposite sides thereof streams of liquid into the hopper in upward and lateral directions at opposite sides of the geometric center of the hopper, into direct contact with the commodity, for creating within the hopper an agitated, turbulent swirling admixture of the liquid and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

2. The method of unloading dry bulk commodity from a sparger type railroad car having a hopper which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing from points within the lower portion of the hopper and adjacent to opposite sides thereof streams of liquid into the hopper in upward, downward and lateral directions at opposite sides of the geometric center of the hopper, into direct contact with the commodity, for creating within the hopper an agitated, turbulent swirling admixture of the liquid and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

3. The method of unloading dry bulk commodity from a sparger type railroad car having a hopper which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing two main streams of liquid into the hopper in upward direction from points within the lower part of the hopper at opposite sides and directing the hopper with one of the streams originating in offset relation to the geometric center of the hopper, into direct contact with the commodity for creating within the hopper an agitated, turbulent swirling admixture of the liquid
and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

4. The method of unloading dry bulk commodity from a sump having a hopper having which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing two main streams of liquid into the hopper in upward directions, from opposite sides of the hopper with one of the streams originating in offset relation to the geometric center of the hopper, adjacent the sump portion of the hopper and located in a zone within the lower one third of the vertical height of the hopper, said streams being introduced under a pressure greater than 30 p.s.i., with direct contact with the commodity for creating within the hopper an agitated, turbulent swirling admixture of the liquid and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

5. The method of unloading dry bulk commodity from a sump having a hopper having which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing from points within the lower part of the hopper two main sets of streams of liquid into the hopper in upward, downward and lateral directions, from opposite sides of the hopper with one of the streams originating in offset relation to the geometric center of the hopper, into direct contact with the commodity for creating within the hopper an agitated, turbulent swirling admixture of the liquid and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

6. The method of unloading dry bulk commodity from a sump having a hopper having which is substantially inverted pear-shaped in transverse vertical section comprising the step of introducing from points within the lower part of the hopper two main streams of liquid into the hopper in upward directions, from opposite sides of the hopper with one of the streams originating in offset relation to the geometric center of the hopper, with the origin of the streams being adjacent the sump portion of the hopper and located in a zone within the lower one third of the vertical height of the hopper, said streams being introduced under a pressure greater than 30 p.s.i., with direct contact with the commodity for creating within the hopper an agitated, turbulent swirling admixture of the liquid and commodity to form a slurry, and the step of withdrawing the slurry from the bottom of the hopper, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

7. In combination with a railroad car having a hopper for receiving dry bulk commodity, said hopper being formed with downwardly and inwardly converging lower side wall portions, sump means at the lower end of the hopper, outlet means associated with said sump means, a nozzle carried on one wall portion of the hopper and having a discharge end portion extending into the hopper, and a conduit connected to the other end of the nozzle for supplying liquid to the nozzle, said discharge end of the nozzle having a horizontally extending elongated discharge orifice, said nozzle being positioned to cause the liquid to contact the hopper, offset in relation to the geometric center of the hopper, into contact with the commodity, for creating within the hopper an agitated, turbulent swirling admixture of liquid and commodity to form a slurry, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

8. In combination with a railroad car having a hopper for receiving dry bulk commodity, said hopper being formed with downwardly and inwardly converging lower wall portions, sump means at the lower end of the hopper, outlet means associated with the said sump means, a pair of nozzles carried on opposite wall portions of the hopper and each having a discharge end portion extending into the hopper, and conduits connected to the other ends of said nozzles for supplying liquid thereto, said discharge end of each of said nozzles having a horizontally extending, elongated discharge orifice, said nozzle being positioned to cause discharge streams of liquid in an upward direction, from opposite sides of the hopper, to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

9. In combination with a railroad car having a hopper for receiving dry bulk commodity, said hopper being formed with downwardly and inwardly converging lower wall portions, sump means at the lower end of the hopper, outlet means associated with the said sump means, a pair of nozzles carried on opposite wall portions of the hopper and each having a discharge end portion extending into the hopper, and conduits connected to the other ends of said nozzles for supplying liquid thereto, said discharge end of each of said nozzles having a horizontally extending, elongated discharge orifice, said nozzle being positioned to cause discharge streams of liquid in an upward direction, from opposite sides of the hopper, to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.
said nozzles being positioned adjacent the sump means in a zone within the lower one third of the vertical height of the hopper to discharge streams of liquid in an upward direction, from opposite sides of the hopper with one of the streams originating in offset relation to the geometric center of the hopper, into contact with the commodity, for creating an agitated, turbulent swirling admixture of liquid and commodity to form a slurry, said streams being directed in paths to cause the liquid to contact the entire interior surface of the hopper, after removal of substantially all commodity in the form of a slurry from the hopper, to insure complete removal of all commodity from and thoroughly cleanse the entire interior surface of the hopper.

11. In combination with a railroad car having a hopper for receiving dry bulk commodity, said hopper being formed with downwardly and inwardly converging lower wall portions, sump means at the lower end of the hopper, outlet means associated with the sump means, a pair of nozzles carried on opposite walls of the hopper and each having a discharge end extending into the hopper, and conduits connected to the other ends of the nozzles for supplying liquid thereto, said nozzles each having a flattened end portion and a horizontally extending, elongated discharge orifice, diverter means within the flattened end portion, said nozzles being positioned to discharge streams of liquid in upward and lateral directions from opposite sides of the hopper, with one of the streams originating in offset relation to the geometric center of the hopper, into contact with the commodity for creating an agitated, turbulent swirling admixture of liquid and commodity to form a slurry.

12. In combination with a railroad car having a hopper for receiving dry bulk commodity, said hopper being formed with downwardly and inwardly converging lower wall portions, sump means at the lower end of the hopper, outlet means associated with the sump means, a pair of nozzles carried on opposite walls of the hopper and each having a discharge end extending into the hopper, and conduits connected to the other ends of the nozzles for supplying liquid thereto, said nozzles each having a flattened end portion and a horizontally extending, elongated discharge orifice, diverter means within the flattened end portion, and a downwardly directed opening positioned rearwardly of said elongated orifice, said nozzles being positioned to discharge streams of liquid in upward, downward and lateral directions from opposite sides of the hopper with one of the streams originating in offset relation to the geometric center of the hopper, into contact with the commodity for creating an agitated, turbulent swirling admixture of liquid and commodity to form a slurry.

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