March 17, 1953 A. JULLIEN 2,631,899

HYDRAULIC SYSTEM FOR THE DELIVERY OF PULVERULENT MATERIALS

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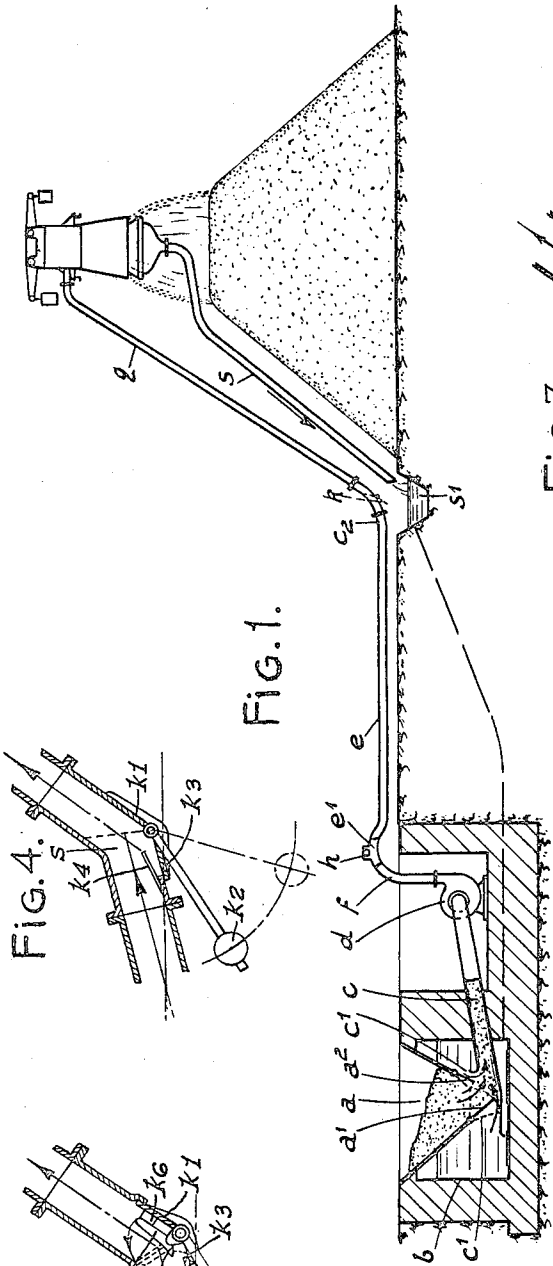


Fig. 1.

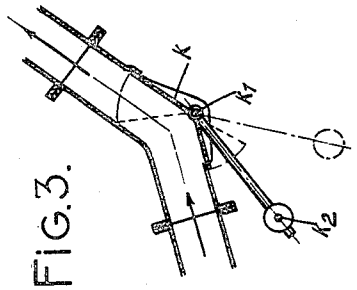


Fig. 3.

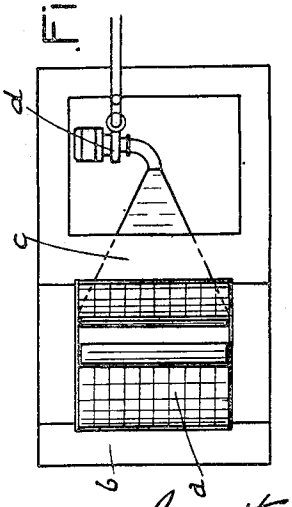


Fig. 2.

Fig. 4.

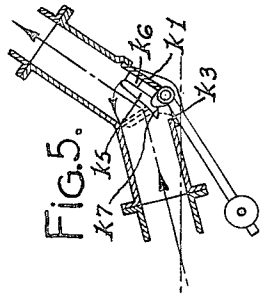


Fig. 5.

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6 Claims. (Cl. 302—14)

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This invention relates to hydraulic systems for delivering and dumping pulverulent materials. It is particularly though not exclusively applicable to the handling of salt in salt-works.

It is an object of the invention to provide a method and means for delivering and dumping a pulverulent solid material which comprises pumping means, a source of conveying fluid, means for feeding into the intake of said pump said pulverulent material together with said fluid in predetermined proportions, delivery conduit means extending from the outlet of said pump to a point above a dumping location, separator means at the delivery end of said conduit and means for dumping said material and draining off the fluid separated therefrom.

It is another object to provide a method and means of the character described in which the delivery system will not be subject to the danger of clogging or obstruction upon the flow of fluid therethrough being cut off.

It is a further object to provide such method and means particularly useful in salt works for conveying salt to a dump, wherein such salt is adapted to be effectively washed or leached during the conveying operation.

Another important object of the invention is the provision of improved automatically-operable valve means for draining the rising sections of the delivery conduit upon the flow of fluid through the system being cut off.

Still other objects and features of the invention will appear from the ensuing description.

My invention essentially comprises a device in which pulverulent material is adapted to be discharged continuously or intermittently, said device being connected with the intake of a lift-and-force pump, said intake also connecting with a source of handling or conveying fluid. The connection of the pump with the delivery or handling fluid is adjusted so as to enable the liquid-to-solid ratio delivered through the pump to be varied. The delivery conduit of the pump leads to a separator means wherein the handling fluid is adapted to be separated from the pulverulent material and the separated pulverulent material issuing from said separator is adapted to be directly dumped with the natural slope angle of said material, while said fluid may be recycled into the intake circuit of said pump to be used in the transportation of fresh amounts of pulverulent material.

Where the system is used in the handling of salt, the fluid used is salt-saturated water or brine. Such brine may be derived from the liquid

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used in watering the last basins of the salt-works or "tables saunantes" preferably however the brine used for delivering the salt according to my invention is obtained from fresh water saturated with salt tapped from the salt which is to be transported.

As a result of the turbulent condition prevailing during the delivery, a thorough washing or leaching effect is obtained effective to remove the magnesia and lime salts remaining entrapped between the salt crystals deposited on said last salting basins, and also any mechanically-entrained clay.

After the separating step the water is discharged into settling tanks in which the impurities stripped from the salt are adapted to settle. From the settling tanks the clarified water is recycled into the circuit.

The ensuing description will provide a clear understanding of the invention and the various objects, features and advantages thereof. The invention will be described merely by way of illustration and not of limitation in connection with an installation for conveying, washing and dumping salt in a salt-works.

In the accompanying drawings:

Fig. 1 is a general elevational view, somewhat diagrammatical in character, of an installation according to the invention.

Fig. 2 is a plan view of the left-hand portion of Fig. 1.

Fig. 3 is a detail view showing a knee-section provided with a drain-valve means according to the invention, arranged in the delivery conduit of the pump.

Fig. 4 shows one form of embodiment of a drain-valve usable when it is desired that there should be no back-flow through the pump when the pump is in idle condition (e. g. in case of a piston pump).

Fig. 5 shows a type of drain valve usable in the case of a pump adapted to allow the reverse flow of fluid therethrough when idle, while opposing a more or less high retarding action thereto (e. g. a centrifugal pump).

As shown in the drawings, the pulverulent material which will be termed "solids" hereinafter is discharged, for instance from tip-wagons, into a hopper *a* partially immersed in a body of the conveying or delivery or handling fluid supplied to a tank *b*. The intake pipe *c* of the pump *d* connecting as shown with the mouth of the hopper comprises two separate branch connections c^1 so arranged that the sheet of solids issuing from the mouth of the hopper will be drawn

in or aspirated between two sheets of liquid. The mixture then flows through a converging duct constituting the intake pipe c of the pump d.

While the pump is adapted to operate both under load and under a slight vacuum, operation under load is however preferable as priming is thereby facilitated and the risk of accidental unpriming in operation is avoided. The sloping sides of the hopper terminate at their lower ends in hinged vanes or flaps a^1 and a^2 which make it possible to modify the respective flow sections for the solids and the liquid and thus adjust the liquid-to-solid ratio in the mixture. The rate of flow of the mixture through the conduit should be such that the solids will be entirely suspended in the liquid. Where the solids are salt for instance necessary rate of flow is in the order of about 8 or 9 ft./sec.

In order to avoid the danger of obstruction or clogging when the flow is stopped, the conduit should be arranged with horizontally-extending elements or sections e connecting with vertical elements f or steeply inclined elements such as g forming with a horizontal plane an angle substantially greater than the natural slope angle of the solids to be delivered.

As clearly shown in Fig. 1 the horizontal elements e terminate in short slightly upraised portions such as e^1, c^2 so that they should at all times be in a filled condition. The connecting knees or bends between the various elements of the conduit should be provided with a siphoning preventing means device (as at h in Fig. 1) wherever, in the direction of flow, a rising section connects with a horizontal section of the conduit, and with a special automatically-openable drain or check-valve means (as at k in Fig. 1) wherever a horizontal section merges into a rising section.

As shown in Fig. 3 said drain-valve is pivoted on a pivot k^1 and is balanced for the static load in the conduit. The valve is adapted under the effect of the dynamic load set up by the flowing sludge, to automatically assume a sealed condition thus preventing outflow of the sludge. Should the rate of flow drop below a predetermined critical value (that under which the solids would tend to settle) a counterweight k^2 is operative to open the valve, this effectively draining the rising pipe section. The counterweight k^2 is adjustable in position so as to enable adjustment of the operational characteristics of the device.

As a result to the foregoing arrangements, in normal operation the sludge is adapted to circulate at a rate above its critical rate of flow, whereby the solids are maintained in suspension in the liquid and there is no danger of clogging. In the event of accidental stoppage in the circulation, the automatic valves will open and the vertical or sloping sections will be thoroughly drained off, while the horizontal sections remain filled. The solids settle off from the liquid and so only occupy a portion of the total flow section through the conduit, the remaining area of the section being occupied by the liquid. Upon the system being re-started the liquid will then resume its motion with a uniform acceleration throughout the entire length of the conduit, thus gradually and little by little carrying off the solids with it. There is practically no danger of clogging "plugs" forming during such a re-starting operation. As soon as the rate of flow has exceeded the critical value the automatic valves will swing to sealed position and the operative conditions return to normal.

The valve device shown in Fig. 4 is similar to that in Fig. 3 and is adapted to operate under similar conditions with the difference that the part k^3 upstream of the valve in the direction of flow has arranged thereover a deflector or baffle member k^4 secured to the inside wall of the conduit. This baffle is operative to render operation of the valve more rapid both on closure and opening thereof. Its action may be explained as follows. At the time the liquid starts circulating its rate of flow is higher in the section s of the bend; it follows that the part k^1 of the valve is subjected to greater stress than the part k^3 thereof which is located in a zone of relative vacuum. Both these causes combine their effects to accelerate the closure of the valve member. Also, as the flow of fluid is stopped through the conduit, the fluid tends to drop back and will exert within the acute angle defined between the baffle member and the valve member k^3 a pressure which facilitates the swinging movement thereof in the direction of the arrow under action of the counterweight k^2.

In the embodiment shown in Fig. 5 the valve member portion k^3 is substantially smaller than in the previously described devices.

The main valve or two-armed flap k^1 is adapted in normal operation to be applied against its seating, thus obturating an opening formed in the under part of the bend or knee. An auxiliary valve k^5 is pivoted on a pivot supported by k^1.

The valve k^5 is of such length that when it has swung about its pivot, it will seal the conduit substantially completely without its end however engaging the opposite wall of the knee. It comprises a shank portion k^7 which is adapted to abuttingly engage the rear part of k^1 when it occupies the position thereof at which it seals the conduit.

When the pump is delivering fluid, the valve k^5 assumes a position in which it is in abutment against a pair of small abutment ribs k^6 carried by k^1, so proportioned that the angle formed between the two valves k^1 and k^5 is very small.

The fluid stream flowing in the direction of normal flow actuates the valve k^5 which in turn actuates the portion k^1 of the valve in closing direction. Upon the flow being cut off there is a tendency for the flow of fluid to reverse. It then tends to rock the valve member k^5 in the direction of the arrow until the shank member k^7 thereof engages k^3. At that time the auxiliary valve member k^5 is effective to almost completely seal the conduit (as shown in dotted lines in Fig. 7). As a result a very high dynamic load is applied to the valve member k^5 which actuates the main valve member which latter is almost exclusively subjected to the static load. The main valve then opens and the conduit is emptied out through its downstream rising portion.

The separating of the solids and the dumping of the solids into a naturally sloping heap may be effected through the use of a separator connected to the upper end of the delivery conduit g.

It will of course be understood that while some preferred forms of embodiment of devices forming part of my invention have been described and illustrated, the invention itself is in no way restricted thereto but only as defined in the ensuing claims.

What I claim is:

1. In an installation for conveying solid pul-

verulent materials with a stream of liquid, a source of liquid, a feeding hopper for the pulverulent solids, pumping means for the entrainment of said solids in suspension in said liquid, delivery conduit means from said pump to a point of delivery of said solid, and the provision, in said conduit means, of substantially horizontal parts and rising parts, the inclination angle of the rising parts being substantially greater than the slope of the naturally formed heap of said pulverulent solid, each of said horizontal parts of the delivery conduit means being arranged at a slightly depressed level with respect to the level of both ends of the horizontal parts, each connection between a rising part and a horizontal part following it in the directtion of the flow, comprises syphon-preventing means.

2. An installation for conveying solid pulverulent materials as in claim 1, in which each connection between a horizontal part and a rising part of the delivery conduit means following it in the direction of the flow, is provided with an automatically operable valve means adapted above a predetermined value of the dynamic load created by the flow of said liquid and said solids through said conduit, to remain in a position sealing the walls of said conduit and automatically operable in response to a drop in said dynamic load below said value to move to an open position allowing said liquid and said solids to drain out of the rising part of the delivery conduit means.

3. An installation for conveying solid pulverulent materials as in claim 2, in which said valve means comprises rockable flaps swingable to and from positions sealing the bottom side wall of said conduit at the base of said rising parts and counterweight means to balance said flaps for said predetermined dynamic load.

4. An installation for conveying solid pulverulent materials as in claim 2 in which said valve means comprises a two-armed flap member pivoted at the connection of said arms thereof in the bottom side-wall of said conduit at the base of said rising part and adapted in a sealing position to seal a wall portion of said horizontal part with one of said arms and a wall portion of said rising section with the other of said arms, counterweight means for normally pivoting said flap-member to open position, said counterweight being adjustable to be made operative when the rate of flow of said suspension drops beneath a predetermined value.

5. An installation for conveying solid pulverulent materials as in claim 2 in which said valve means comprises a first two-armed flap-member pivoted at the junction of said arms

in the bottom side-wall of said conduit at the junction between said horizontal and said rising parts and adapted in a sealing position to seal a wall-portion of said horizontal part with one arm and a wall portion of said rising part with the other arm, adjustable counterweight means normally pivoting said flap member to open position and a deflector member in said horizontal conduit section defining an acute angle between it and said horizontal flap-arm, said angle opening towards said rising section.

6. An installation for conveying solid pulverulent materials as in claim 2 in which said valve means comprises a first two-armed flap member pivoted in the bottom side wall of said conduit at the junction between said horizontal and rising parts and adapted in a sealing position to seal the walls of said parts with the respective arms thereof, adjustable counterweight means for normally pivoting said first flap-member to open position and an auxiliary flap member pivoted on said first flap member within said conduit, said auxiliary member being pivotable between a conduit opening position wherein it lies alongside the rising arm of said first flap member so as to define therewith an acute angle opening upwardly, and movable to a conduit sealing position in which it extends across the bottom end of said rising part to prevent back-flow therethrough, said auxiliary member being moved to said conduit sealing position by the back-flow of said suspension down said rising part exerting pressure within said acute angle, whereby after said auxiliary member has been moved to said conduit sealing position it is operative to cause said main flap-member to be moved to its opened position under static load.

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