

[54] JET EJECTOR DEVICE

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Related U.S. Application Data

[63] Continuation of Ser. No. 125,608, March 18, 1971, abandoned.

[52] U.S. Cl. **417/182, 417/196**

[51] Int. Cl. **F04f 5/48, F04f 5/44**

[58] Field of Search 417/151, 182, 170, 171, 417/198, 176, 174, 196; 239/127.3, 255.17

[56] **References Cited**

UNITED STATES PATENTS

3,071,081 1/1963 Mullick 417/182

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[57]

ABSTRACT

A device for removing oil field waste material from storage tanks is presented. The storage tanks are equipped with a gravity discharge drain, and may have internal sprayers to flush the waste material from the tank. The discharge drain is connected to a mixing chamber interior to a jet ejector pump. Water under high pressure enters the pump chamber through a converging nozzle, and exits the chamber through a conical constriction at the discharge port. The passage of the water through the chamber creates a partial vacuum therein which draws air through a vent and the waste materials from the tank, into the chamber, which materials are then entrained in the water stream. The waste materials carried by the water stream then jet from the chamber through a pipe connected to the discharge port to a disposal site.

3 Claims, 4 Drawing Figures

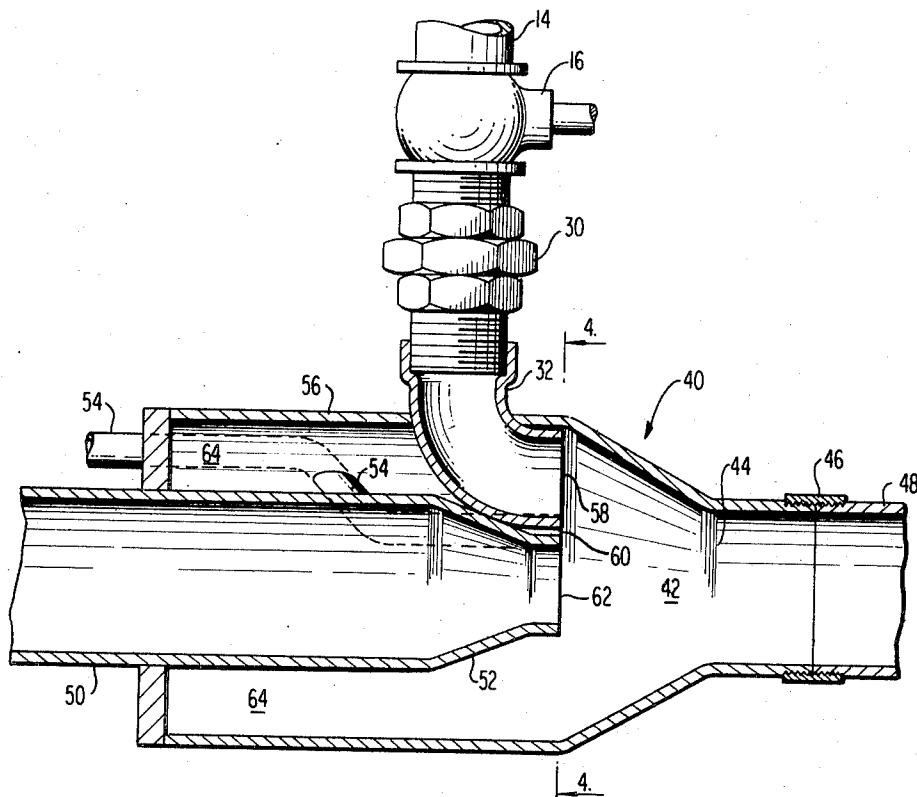


FIG 1

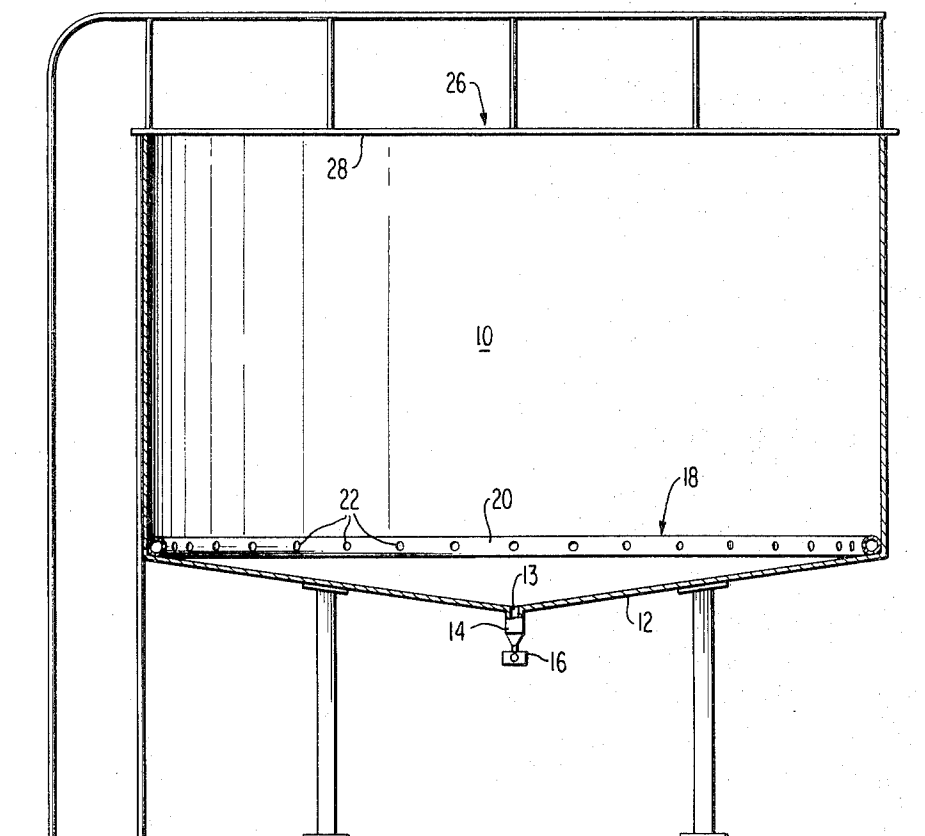
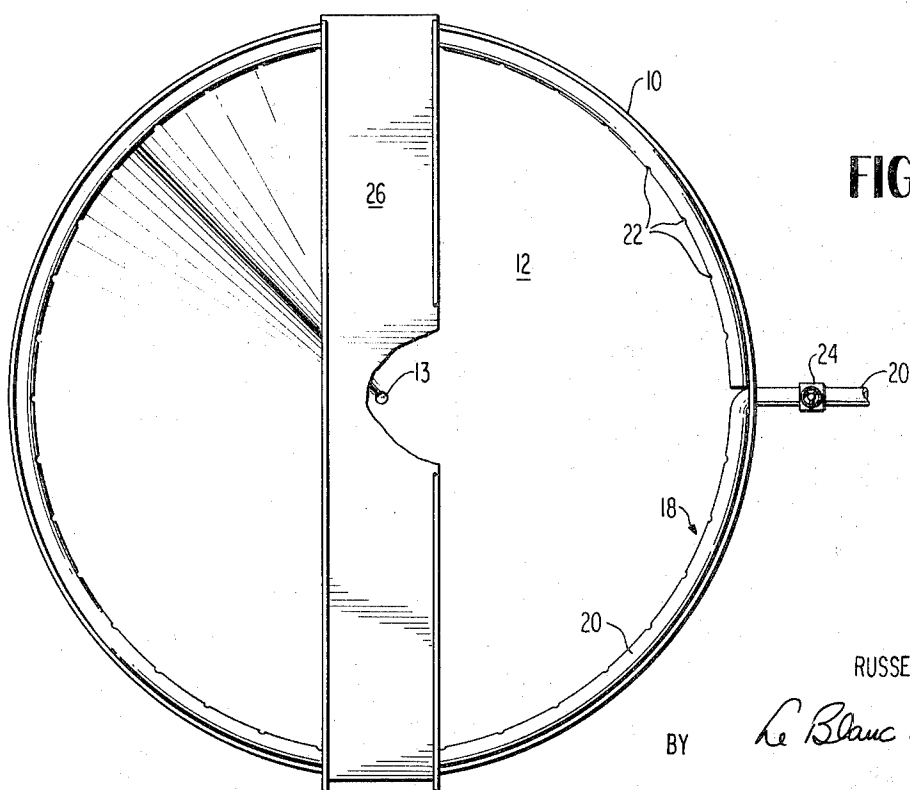


FIG 2



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FIG 4

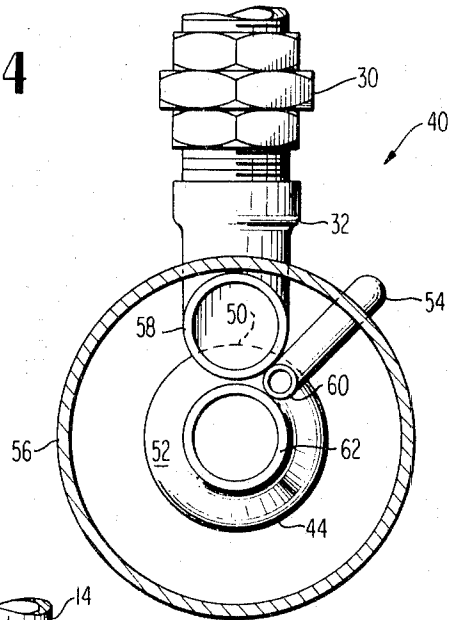
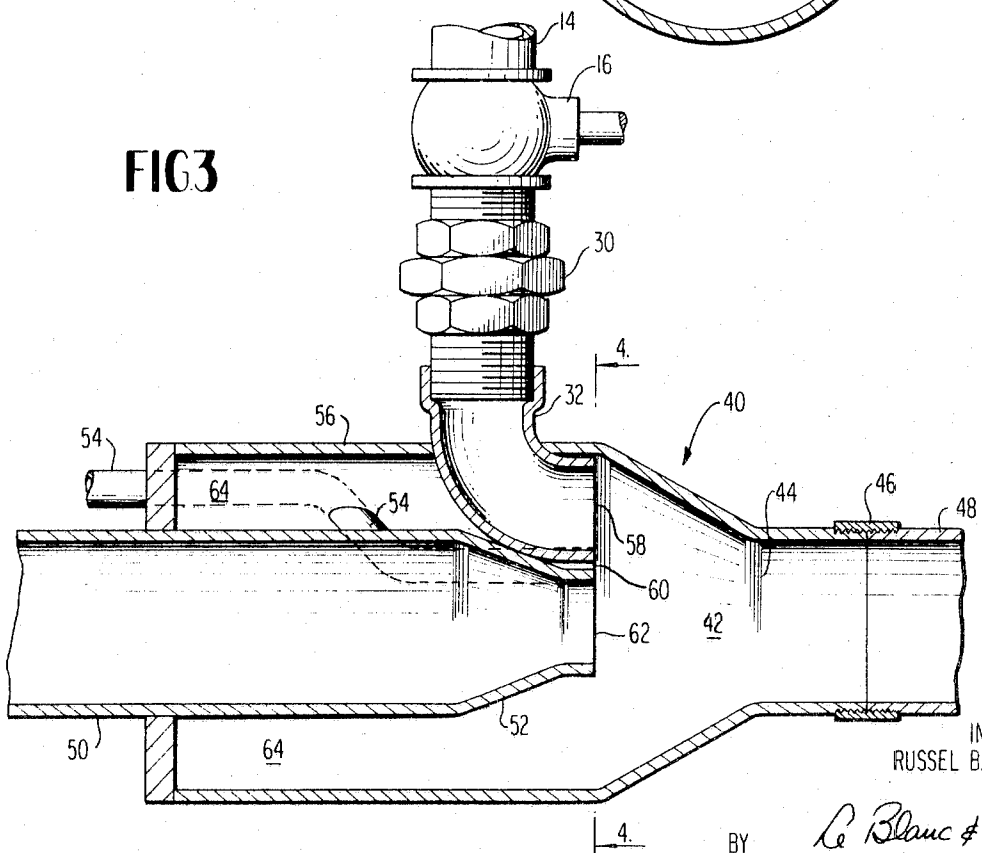


FIG 3



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JET EJECTOR DEVICE

This is a continuation of application Ser. No. 125,608 filed 18 Mar., 1971, now abandoned.

This invention relates to a device useful to remove heavy viscous waste materials; sand, silt and lignite accumulated at an oil well site from storage tanks. The invention in particular is a unique jet ejector pump which acts to draw the waste materials from the storage tank to be entrained in a high pressure stream of water and ejected into a conduit connecting the pump and a disposal site.

The rotary method of drilling oil wells requires the circulation of a drilling fluid or mud. Mud circulation functions to clean the bottom of the hole, to cool and lubricate the tools, and to maintain the walls of the well. This medium may be water, mud, oil, air, gas, or mixtures thereof, but water or water-based mud is the circulating medium used in approximately 98 percent of all wells drilled by the rotary method.

Water-based mud is generally composed, in addition to water, of 5%-10% diesel fuel oil, dissolved chemicals, dispersed clay particles, and finely ground solids.

The main components of a fluid circulating system for rotary drilling are the pump, hose and swivel, drill string, bit, return annulus, and pits. The main functions of the pits are to accumulate mud circulated from the hole and to supply fluid to the suction of the pump. A pit will also slow the mud stream down, thus allowing settlement of cuttings transported by the fluid from the hole, and affording storage so that there will always be enough fluid to fill the well.

Reserve pits, constructed of earth or another material, such as steel, are also employed as part of the circulating system in an oil field. Reserve pits are used for collecting waste fluid, contaminated mud, cuttings, and even trash which accumulates as a well is drilled. Reserve pits are not usually provided for rigs operating on water locations, and if waste mud and cuttings do not contaminate the water, they are dumped directly into it.

However, for the most part the waste materials include oil, oil-water emulsions, and chemicals removed from the tanks, heaters and treaters from the permanent structures and gathering systems in the oil field. Unfortunately, these materials are pollutants and should not be disposed of merely by dumping directly into the ocean.

A nonpolluting method of disposing of these waste materials involves the use of storage tanks on barges. The tanks accumulate the materials until the barge is fully loaded. The barge is then towed to a site adjacent an earthen pit location and the materials are conveyed from the tanks to the pit. However, because the waste materials are viscous and contain solids, the mechanics of the unloading process are complicated, and prior unloading processes have been expensive and time-consuming.

For example, a typical barge carries six open-top tanks. The tanks are interconnected with equalizing lines approximately eighteen inches below the top thereof to maintain an equal level of waste material in the tanks, and to minimize an overflow problem during loading. The tanks are also equipped with gravity discharge drainage systems and a system of water sprayers

may be used to agitate and dilute the waste materials during unloading.

A barge carrying six tanks is about 120 feet long by 24 feet wide, with a depth of 10 feet, 3 inches. Accordingly, a single barge is capable of transporting a large volume of waste material.

An obvious prior method for unloading the barge and transporting the material to the earthen site involves utilizing a heavy-duty pump similar to the power pump utilized to circulate mud at the well site. However, this type of pump is expensive and cumbersome, and the use thereof for this purpose is economically undesirable.

Prior to this invention, no rapid, efficient, and inexpensive method was known for unloading the oil field wastes from storage tanks even though this problem has existed for many years.

However, there has now been discovered a unique type of jet ejector pump wherein the motive force, a high pressure stream of water, is utilized as a conveying jet to entrain and convey the waste material from a tank to an earthen site. The water passes through a converging nozzle into a mixing chamber to form decreased pressure within the chamber. The chamber is in communication with the waste material in the tank and the decreased pressure draws the material into the chamber. When the pump is regulated by an atmospheric air supply, a jet of water and waste material is formed which conveys the waste material from the tank. This jet, formed by the pump of this invention, is capable of propelling the waste material and water through a conduit from the barge to an adjacent earthen site.

By using the unique jet ejector pump of this invention, water flowing at 80 to 100 pounds per square inch pressure will empty the barge tanks and will convey the material through a 3 inch conduit to a site at least 80-100 feet from the barge.

Essential to the operation of the device of this invention is the provision for an air supply within the mixing chamber through a vent to the atmosphere. The decreased pressure and turbulence in the mixing chamber as the stream of water exits a converging nozzle therein causes air from the vent and waste material from the gravity discharge drain of the storage tank to be drawn into the chamber, mixed with the water and entrained therein for passage through a conical constriction, a discharge port, and a discharge pipe, as a jet, to the earthen site.

The water preferably is pumped by a high pressure centrifugal water pump through the jet ejector pump of this invention and thereafter through the discharge pipe.

In a preferred embodiment, the storage tanks are equipped with a plurality of internal water sprayers. The sprayers may be utilized to dilute the waste material if necessary and to flush the tank. An operator may also be employed with a fire hose to assist in flushing the tank. The use of these sprayers on the tank will depend upon the composition and viscosity of the waste materials.

Accordingly, it is an object of this invention to provide an inexpensive and efficient device for removing oil field waste materials from storage tanks and for conveying the materials a distance from the tanks to an earthen disposal site.

It is another object to provide a jet ejector pump driven by a high pressure stream of water for removing oil field waste materials from storage tanks and for conveying the materials away from the tanks.

It is yet another object of the invention to provide a jet ejector pump having a vented mixing chamber with a constricted entrance port for a high pressure stream of water used to create a decreased internal pressure sufficient to draw waste materials from storage tanks into the mixing chamber.

It is a further object to provide a jet device for drawing oil field waste materials from a storage tank into a vented, partially evacuated chamber for entrainment in a high pressure stream of water passing therethrough.

It is yet a further object to provide a method for rapidly and efficiently removing oil field waste materials from a storage tank and depositing them at a preselected disposal site, including a vented jet ejector pump communicating with the waste materials and having a motive fluid of water under pressure passing therethrough, said pump functioning to draw in the materials and air, entrain them in the motive fluid, and expel the mixture through a conduit to the disposal site.

These and other objects and advantages of the invention will become more apparent upon reference to the following specification, claims, and appended drawings, wherein:

FIG. 1 is a front view in vertical section of a storage tank for oil field waste materials;

FIG. 2 is a top view of the tank of FIG. 1 having a portion cut away to expose the gravity discharge drain;

FIG. 3 is a side view in partial section of the jet ejector pump of this invention; and

FIG. 4 is a cross sectional view taken along line 4—4 of FIG. 3.

With attention to FIGS. 1 and 2, a typical storage tank 10 utilizes a sloping bottom 12 to form with drain 13 and conduit 14 a gravity discharge system for the waste materials accumulated in said tank. A valve 16 is utilized to control flow from drain 13.

In the event the material stored in the tank 10 is viscous and contains solids as is normally the case with oil field waste materials, an internal spray system 18 is also provided. The system 18 includes a pipe 20 having a plurality of evenly spaced spray holes 22. The water circulating through pipe 20 and exiting through holes 22 is directed toward drain 13. In this manner, the waste materials within the tank are agitated, diluted, and flushed through the drain 13. A hand-operated valve 24 on pipe 20 may also be utilized to control the flow through holes 22.

A catwalk 26 is also provided across the top 28 of tank 10. The catwalk enables an operator to direct a high pressure stream of water from, for example, a fire hose, onto the waste materials to direct the materials through the drain 13.

With attention to FIGS. 3 and 4, the jet ejector pump of this invention is adapted to be connected below the drain 13. Valve 16 controls the feed of waste materials from the tank 10 through conduit 14 and coupling 32 connected to the valve 16.

Jet ejector pump 40 of this invention comprises a conical mixing chamber 42 which serves as a funnel for discharge port 44. Port 44 is connected by a coupling 46 to a discharge conduit 48. Conduit 48 extends from

the pump 40 to an earthen disposal site (not shown).

In a preferred embodiment, water from a high pressure centrifugal pump (not shown) enters the mixing chamber 42 of pump 40 through a conduit 50 which terminates in a converging nozzle 52. Vent pipe 54 extends through the generally cylindrical portion 56 of pump 40, terminating at the conical mixing chamber 42, as shown in FIG. 4. The vent pipe 54 may be controlled by an external valve (not shown).

Waste material from drain 13 flows, when valve 16 is open, through coupling 30 and elbow 32 into the mixing chamber 42.

As shown in FIG. 3, the longitudinal axis of conduit 50 and nozzle 52 is coaxially aligned with discharge port 44. The discharge opening 58 of elbow 32, the opening 60 of vent pipe 54, and the terminus 62 of nozzle 52 lie in a common plane perpendicular to the longitudinal axis of said nozzle 52.

With attention to FIG. 4, it will be noted that the axis of vent pipe opening 60 lies above the axis of converging nozzle 52 and below the axis of discharge opening 58.

In a preferred embodiment, the diameter of opening 58 is identical to the diameter of opening 62, and the inside diameter of conduit 50 is the same as the diameter of exit port 44.

In a preferred version of the device of this invention, water under pressure of from 80–100 pounds per square inch from a high pressure centrifugal water pump passed through conduit 50 and nozzle 52 into conical mixing chamber 42. The inside diameter of conduit 50 was 3 inches and the inside diameter of opening 62, one and 1½ inches. Accordingly, the pipe 48 attached at discharge port 44 also had a 3 inch diameter.

Elbow 32 had an inside diameter of 1½ inches. The vent pipe 54, however, had a ½ inch diameter, and was open to the atmosphere during operation of the pump 40.

The jetting action was created and regulated by the ½ inch diameter vent pipe 54. If the pipe 54 is closed, cutting off the supply of air to mixing chamber 42, the jetting action utilized to entrain waste materials from conduit 32 in mixing chamber 42 with the water stream from nozzle 52 will cease. The water will merely proceed from nozzle 52 through chamber 42 exiting through port 44. Pressure will build at the rear 64 of pump 40 and the waste materials from tank 10 will not be drawn through the opening 58 in conduit 32.

It has been discovered that when the pipe 50 which carries the water stream has an inside diameter of 3 inches and the water passing therethrough is under a pressure of from 80–100 pounds per square inch, waste materials from tank 10 may be entrained in the said water stream and discharged from 80–100 feet from the pump 40. In this manner, the material may be readily conveyed from a barge which carries the tank to an earthen pit on shore.

In order to utilize the jet ejector pump of this invention, the high pressure centrifugal water pump (not shown) is started discharging water from nozzle 52 into chamber 42, exiting through port 44. The vent pipe 54 is then opened to the atmosphere and a jet stream through port 44 is created. Valve 16, normally closed during loading and transfer operations, is then opened and waste material from the tank is drawn through

opening 58 into conical mixing chamber 42. The waste material is entrained in the jet and discharged into conduit 48. The material then travels through conduit 48 to a disposal pit.

It must be emphasized that the dimensions of the pipes and openings may be varied within the scope of this invention. The formation of the jet stream action is determined by the size of the piping, the size of the water pump, and the pressure obtained. Larger or smaller pipes may be used, but when this is done, these variable must also be changed.

When it is desired to utilize a water system to flush tank 10 similar to the system 18 shown in FIGS. 1 and 2, a 2 inch pipe 20 may be used to surround the sloping floor 12 of tank 10. Water is normally forced through this pipe at a pressure of 80-100 pounds per square inch. If an operator is also used to manually flush the tank with a fire nozzle, a 2 inch hose is preferred with water under pressure of 80-100 pounds per square inch. The operator directs the stream of water in the manner which is best suited to facilitate the discharge of waste materials.

In summary, a jet ejector pump has been described for use in removing heavy, solid-containing, waste materials from a storage tank. Water under high pressure is admitted into a mixing chamber through a converging nozzle. When the chamber is vented to the atmosphere, a jet is created and the chamber is partially evacuated. When a gravity discharge drain from the tank is connected to the partially evacuated interior of the pump, the waste materials in the tank are drawn into the mixing chamber and entrained in the water jet. The entrained waste materials are then conveyed by the jet action through a conduit to an earthen disposal pit.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States letters Patent is:

1. A jet device for withdrawing oilfield waste materi-

als from storage tanks and for entraining them in a stream of water under pressure comprising:

a hollow chamber, a converging nozzle extending through a wall of said chamber, said chamber having a discharge port coaxially aligned with the longitudinal axis of said nozzle, said nozzle adapted to be coupled to a source of water under pressure and to discharge water therefrom into said chamber, the interior walls of said chamber adjacent the discharge port converging to funnel liquid within said chamber through said discharge port;

a conduit extending through a wall of said chamber and terminating in an opening, the opening being disposed perpendicularly to the longitudinal axis of said nozzle, said conduit opening into the converging walls of said chamber adjacent the discharge port;

means carried by said conduit for coupling said conduit to a drain in at least one storage tank disposed over said device so that the oilfield waste in said storage tank will flow from the drain therein into said conduit and into said chamber by gravity; and

an atmospheric vent pipe extending through a wall of said chamber and terminating in an opening, the pipe opening being disposed perpendicularly to the longitudinal axis of said nozzle, the opening of said conduit and the opening of said vent pipe being disposed in a common plane with the discharge end of said nozzle, the horizontal axis of said vent opening being disposed between the horizontal axis of said conduit opening and said nozzle opening, the ratio of the inside diameter of said nozzle, the inside diameter of said vent opening and the inside diameter of said chamber at the common plane containing said openings being about 3:1:12, respectively, so that when water under pressure flows through said nozzle into said chamber and exits from said chamber through said discharge port, air from said vent and waste material from said conduit are entrained, in said chamber, in the water and exit said chamber as a jet through the discharge port.

2. The device of claim 1 wherein the inside diameter of said conduit opening is about 1½ inches.

3. The device of claim 1 wherein the inside diameter of said vent pipe opening is about ½ inch.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,829,247

Dated August 13, 1974

Inventor(s) Russel B. Edmonson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 53, "tankds" should read --tanks--.

Column 2, line 46, "tnak" should read --tank--; line 61-62, "depnend" should read --depend--; line 68, "erathen" should read --earthen--.

Column 3, line 9, "sufficinet" should read --sufficient--; line 13, "evacauted" should read --evacuated--; line 14, "stram" should read --stream--; line 52, "piep" should read --pipe--.

Column 4, line 37, "diamter" should read --diameter--.

Col. 5, line 45, "letters" should read --Letters--.

Col. 6, line 6, claim 1, "siad" should read --said--; line 34, claim 1, "insdie diamter" should read --inside diameter--; line 45, claim 3, "diamter" should read --diameter--.

Signed and sealed this 26th day of November 1974.

(SEAL)

Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents