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Handleman

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[54] **PORTABLE SYSTEM FOR THE PREPARATION OF SLURRIES AND SOLUTIONS**

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[52] **U.S. Cl.** **137/268,** 302/29, 302/52, 169/14

[51] **Int. Cl.** **A72c 37/06**

[58] **Field of Search** 137/268; 302/29, 302/52, 53; 23/272.7, 272.8, 284; 134/21, 25, 37; 169/9, 13, 14; 222/193; 261/29, 76

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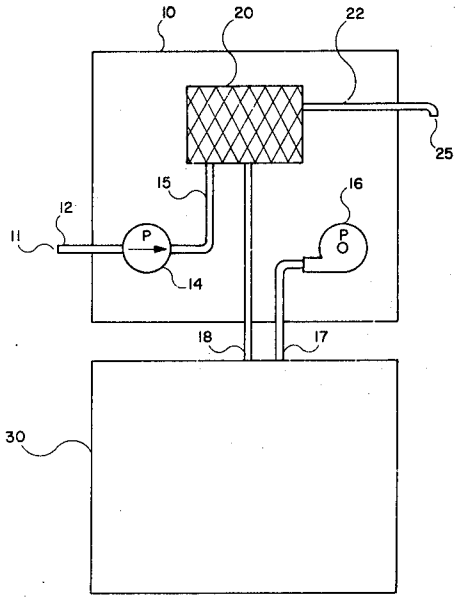
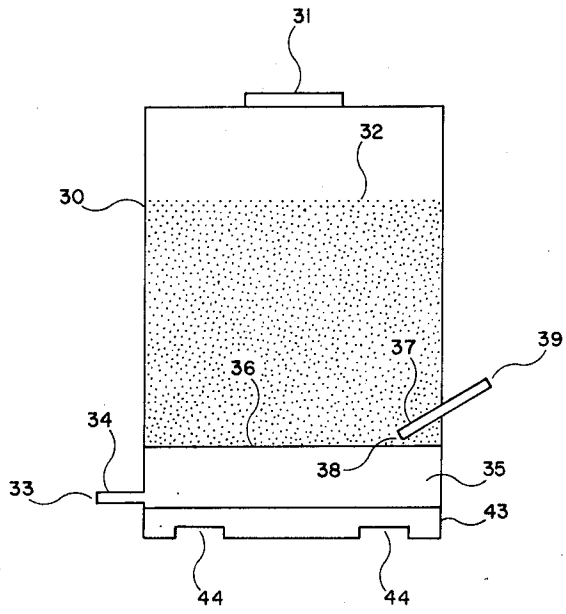
Assistant Examiner—Robert J. Miller
Attorney—Richard O. Zerbe et al.

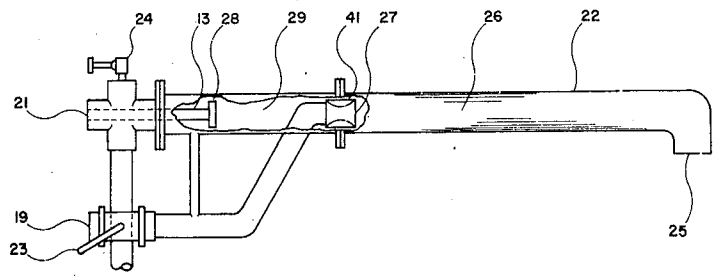
[57] **ABSTRACT**

A portable system is described for preparing slurries and solutions which comprises an out-of-door storable bulk supply of particulate solid material in a container having a porous floor in combination with a mixing assembly which combination permits pneumatic fluidization and discharge of the particulate solid.

13 Claims, 4 Drawing Figures







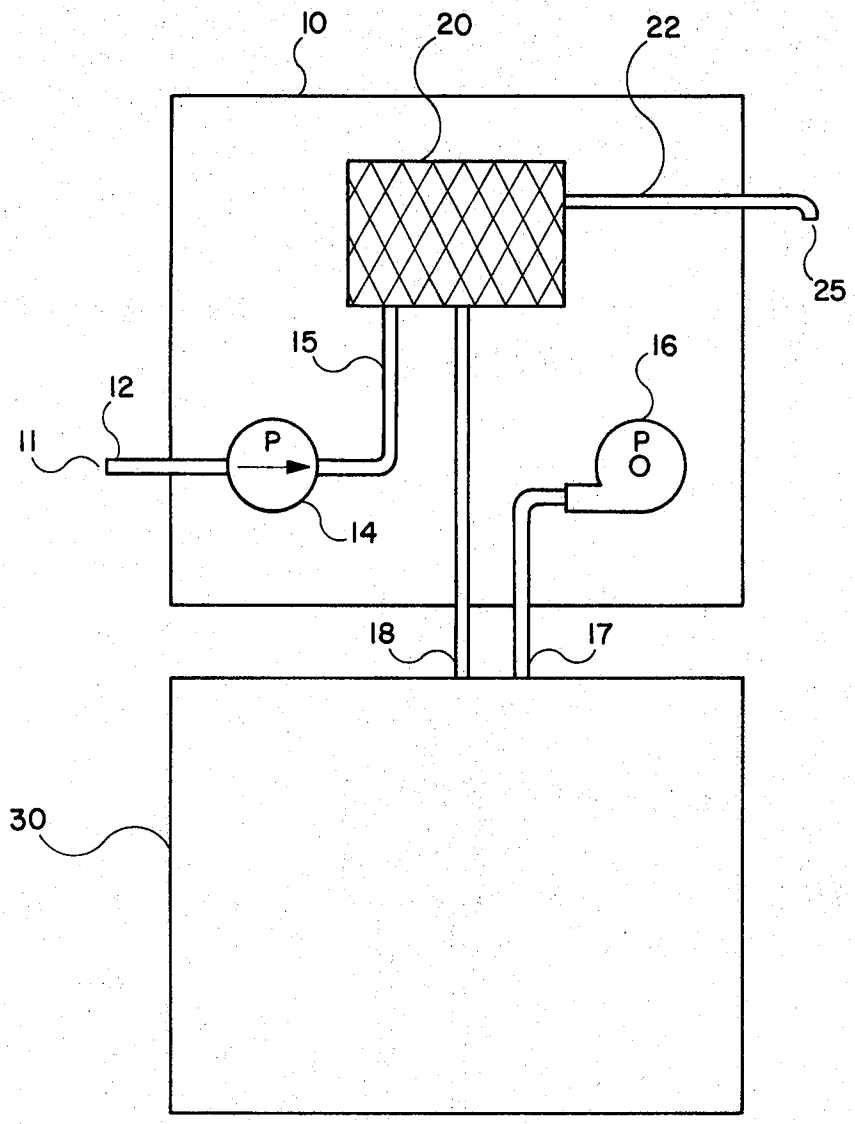


FIGURE 1.

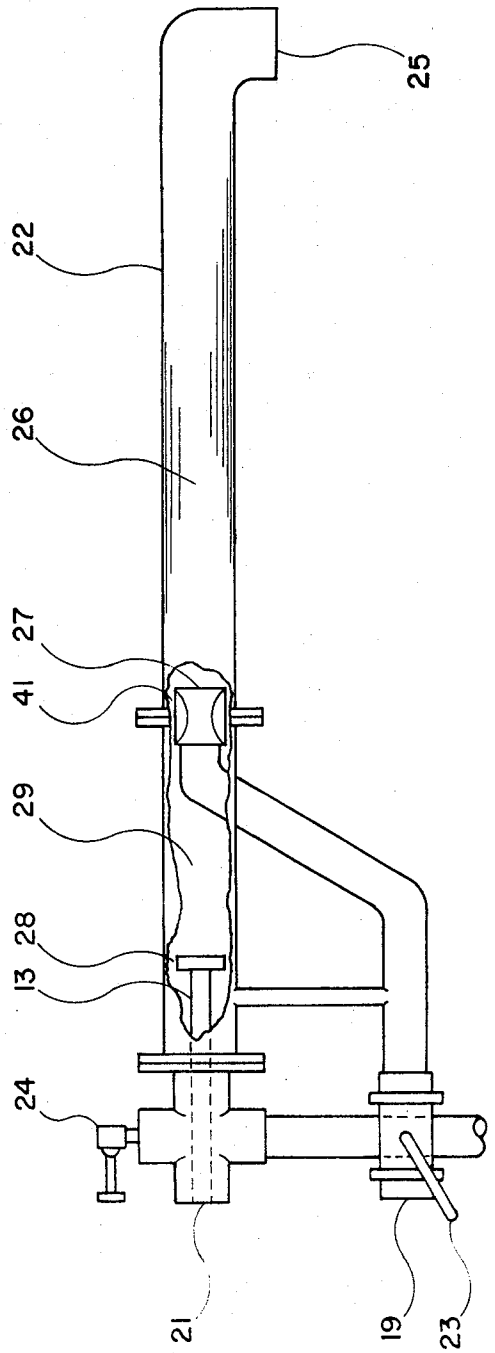


FIGURE 2

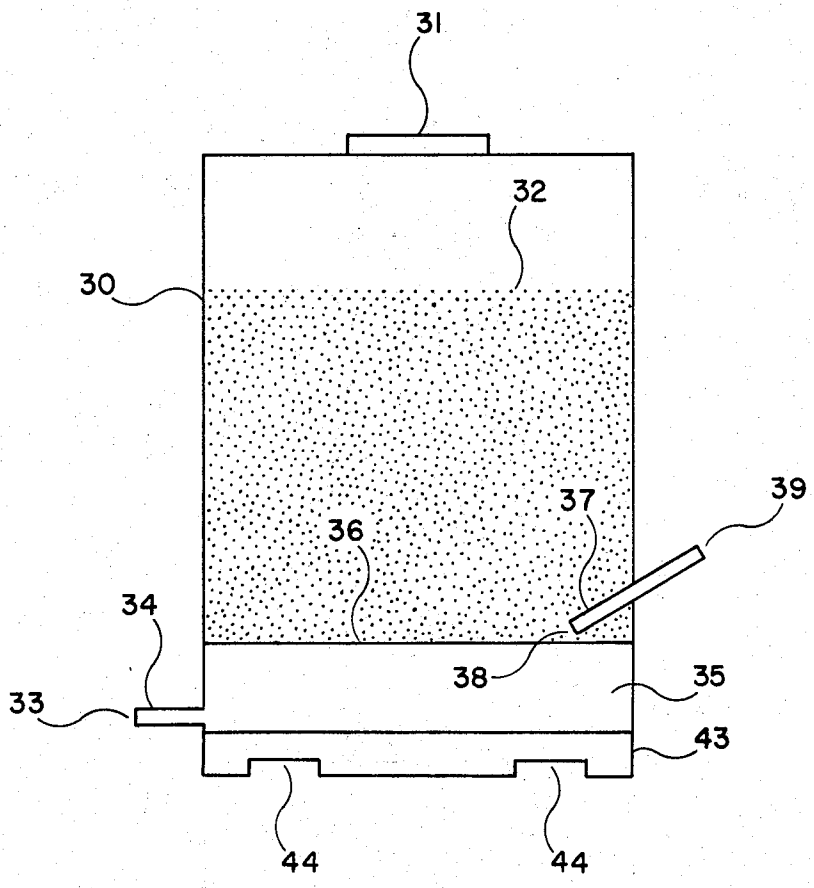


FIGURE 3

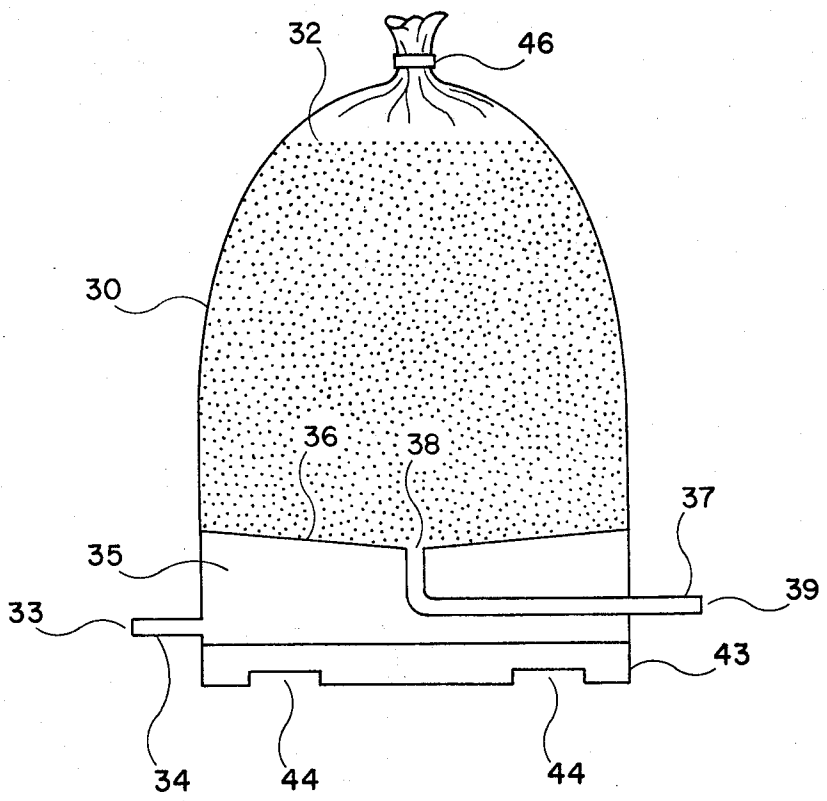


FIGURE 4

PORTABLE SYSTEM FOR THE PREPARATION OF SLURRIES AND SOLUTIONS

FIELD OF THE INVENTION

This invention relates to the preparation of slurries and solutions from bulk particulate solid material. More particularly, it relates to a system for preparing fire retardant solutions near the site of forest fires.

BACKGROUND OF THE INVENTION

Forest fires, especially in the unpopulated areas of the western United States, Canada and Alaska, destroy many thousands of acres of timber annually. Huge damage occurs because usually by the time the fire is detected and before control measures can be applied it is out of control in a condition known as "wildfire". The perimeter of the fire to be fought is then extensive, often presenting a front of many miles. Fighting the fire is often further complicated because the fire is located in relatively inaccessible areas to which delivery of fire fighting apparatus and application of control measures is difficult. Instead of applying water alone to put out or control the fire, it is highly expedient in terms of making more efficient use of manpower and equipment to dissolve a fire retardant in the water before applying it. The retardant aids in extinguishing and prevents rekindling of the fire. Since time is of the essence, it is important to deliver fire retardant solution as quickly as possible. The retardant solutions are transported and applied to the fire by fixed wing aircraft, helicoper, and motor vehicles. To avoid undue transport of water, the retardant solutions are prepared as close to the site of the fire as possible.

Presently, particulate retardant is delivered to the mix site via truck either in bulk trailer or palletized bags. In either case, preparation of the retardant solution requires a water pump, compressor, and porous fluidizing floor for conveying particulate retardant pneumatically to an eductor-type mixer together with water. An eductor-type mixer provides rapid mixing of a powder-laden air stream and water and discharges a thoroughly mixed retardant solution. A duel eductor, known as a Hamp Mixer, is often used for this purpose.

In the case of a bulk trailer, a porous floor, an air compressor, and power supply for the compressor are integral parts of the trailer. Air is passed through the porous floor to fluidize the retardant and the retardant is withdrawn through a conduit connected to the suction side of the eductor. Although the bulk trailer has the advantage of supplying retardant in large quantities, often it cannot be used because of the lack of access roads which will accommodate the truck and trailer. Another disadvantage of a trailer is that to sustain a multipoint attack upon the fire requires large capital expenditures since a trailer is required for each point of attack. Also, once a trailer is empty, a round trip of several hundred miles may be required for recharging and returning to the mix site.

In the case of bagged retardant, the bags are emptied into a hopper which is equipped with a porous floor, an air compressor and power supply for the compressor. Air is passed through the floor to fluidize the retardant and the retardant is withdrawn via a conduit connected to the vacuum side of the eductor. The bag-hopper system of powder feed offers greater mobility since the bagged retardant and hopper may be transported to areas inaccessible to trailers. A major disadvantage of the bag hopper system is that several men are required to empty bags into the hopper to keep the system operating continuously and to maintain an adequate supply of retardant solution. This creates a serious handicap since under fire fighting conditions there is a severe manpower shortage and each man required to feed the hopper removes a man from the line which could be directly fighting the fire. In addition, bags of retardant must be protected from the elements which usually requires storage in warehouses.

The present invention provides a system which possesses the combined advantages of bulk handing, mobility, out-of-door storage and low manpower operation requirements.

SUMMARY OF THE INVENTION

According to this invention an efficient portable system for the facile preparation of fire retardant solutions from particulate solid fire reactants is assembled which greatly simplifies the logistics of providing fire retardant solutions to remote areas and minimizes manpower requirements. The heart of the system is a particulate solid supply assembly especially adapted for bulk storage and to accommodate pneumatic fluidization and discharge to a mixing assembly. Thus, the storage bin is sealable against the elements and of a capacity constituting a stationary but portable bulk storage unit. That is to say, the bulk is so great that it cannot be handled manually but small enough that it can be easily handled by common mechanical equipment. By stationary is meant that the bin is not a self contained mobile unit, i.e., it does not have its own wheels. On the contrary the bin is of simple construction from cheap and, in general, disposable materials being provided merely with a porous floor supporting the solid beneath which is a space for introducing the fluidizing gas, presumably air, and suitable inlets, outlets and vents but none of the mechanical mixing components are present. To complete the system it is connected to a mechanical mixing assembly comprising an eductor-mixer for mixing airborne powder and water, a fluid pump, air compressor, independent power supply for the pump and compressor and connecting means for connecting the fluid pump and mixer and connecting means for connecting and mixing assembly and bulk retardant supply assembly; all of which components may be mounted on a platform or skid which make them easily transported by pick-up truck, two-wheel trailer, airplane or helicopter.

The retardant is stored in sealed bins which may be emptied by pneumatic conveying. Since each bin has a porous floor and is already full of particulate reactant, the need for men to charge portable powder feed units is eliminated. The bin has a capacity of about five hundred to four thousand pounds of retardant, preferably five hundred to two thousand pounds, which makes it like the mixing assembly, easily transportable by pickup truck, airplane or helicopter thereby providing access to areas not open to bulk trailers. The smaller capacity bin may be dropped by parachute to isolated sites which cannot be reached by motor vehicles. In addition to facilitate mechanical handling and storage, the bins are designed with an open space under the bin to accommodate lifting means and with features to accommodate stacking of the bins on top of one another.

The portable particulate solid supply assembly comprises a bulk retardant supply contained in a weather-

proof bin with a porous floor which supports the retardant and which may be slightly tilted toward the outlet. The particulate solid is fluidized by passage of a gas through the porous floor. An enclosed air chamber is provided in the bottom of the bin to accommodate fluidization air supplied from the compressor of the mixer assembly. An inlet to the air chamber is provided, which is sealable during storage and connects to the air compressor of the mixer assembly when operating the system. A conduit for discharging the retardant to the mixer assembly is situated within the storage space of the bin. The outlet which is sealable during storage connects to the vacuum side of the eductor-mixer when operating the system. The bin is provided with a means for venting the storage space and with a sealable opening for charging the bin with retardant which opening may optionally serve as a vent when the system is in operation. The base of the bin has legs or channels which provide an open space between the ground and the enclosed air chamber to accommodate handling by forklift. The bin is substantially flat on the top and bottom which permits stacking of bins during storage or transit.

In one embodiment of the invention, the walls and top of the bin above the porous floor are made of flexible plastic film, for example, 1–6 mil, preferably 3–4 mil, thick water and air impermeable polyethylene film. The bin is assembled simply by sealing one end of a cylinder of polyethylene film to the top outside edge of the bottom of the bin thus forming a bag with a rigid bottom. The bottom of the bin comprises a porous floor, enclosed air space beneath and a base. The bag is filled with retardant and the top twisted shut and sealed by twisting a small wire or by use of a split plastic tab in the same manner as sealing a loaf of bread. The use of plastic film for the main body of the bin is advantageous because plastic film is both light in weight and inexpensive. Bins made of plastic film are also stackable since they flatten when another bin is placed on top and the film has sufficient strength to hold the weight of one or more bins. However, it is recommended when stacking plastic film bins that a flat sheet such as plywood be inserted between each bin.

An important feature of the bin is that it is weather proof and relatively inexpensive thus it can be stored out-of doors which permits spotting the bins throughout the fire control region and provides a retardant supply nearer to the fire when needed. In addition to eliminating widely spaced supplies of bagged retardant presently stored in warehouses, the strategically scattered supply of retardant-filled bins greatly reduces the time required to deliver retardant to the mix site. Often the bins are stored adjacent to water sources which means that only the equipment assembly needs to be delivered and connected to the bins to complete the system. However, when the mix site is remote from the storage area, the convenient size of the bin provides for quick and easy transport to the desired area and because of the random placement of the bins a large nearby supply of retardant is always available.

Although the invention is described in terms of particulate fire retardants, of course, it is understood that the invention is suitable for the preparation of solutions or slurries from particulate solids other than fire-retardant materials. The invention is especially suited for unpredictable situations where a particulate solid supply is needed quickly but exactly when and where the supply is needed is uncertain. The invention is applicable to any powdery solid which may be fluidized by passage of air or other gases through a porous membrane. The system is adaptable to a wide range of powder sizes as long as a dry non-sticky particulate solid is used. Ordinarily, 40 mesh or finer sized particles are recommended but larger particles are suitable particularly with low bulk density materials.

The system and supply assembly is particularly useful for application of chemicals to neutralize streams which have been polluted by accidental spills in which quick application of control measures substantially reduces the extent of the damage resulting from the presence of the toxic material.

The invention may also be used for the preparation of drilling mud slurries at remote oil drilling locations. Other uses for the invention are the preparation of fed streams for chemical processes, the preparation of cement mixtures, and the preparation of sugar solutions in cannery operations.

A better understanding of the invention may be obtained be reference to the drawings and description thereof.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic representation of the complete system;

FIG. **2** is a side view, partly cut away, of an educator-type mixer;

FIG. **3** is a side view of a retardant storage bin; and

FIG. **4** is a side view of a retardant storage bin with walls and top of flexible plastic film.

DETAILED DESCRIPTION

Referring to FIG. **1**, the system comprises two main components in combination, namely, the mixing assembly and bulk retardant supply assembly. The mixing assembly **10** comprises an eductor-mixer **20** which includes conduit **22** and outlet **25**, a water pump **14**, an air compressor **16**, hose **15** which connects the mixer and water pump and hoses **17** and **18** which complete the combination by connecting the supply assembly to the mixing assembly. In operation, water from any convenient source enters inlet **11** and passes through conduit **12** to water pump **14** which provides water at the desired pressure and flow to the mixer through hoses **15.** Air from compressor **16** passes through hose **17** to the retardant storage bin **30** and fluidizes the particulate retardant. A retardant-laden air stream is withdrawn into the mixer through hose **18** via the pressure differential created by the vacuum of the eductor. The water and retardant-laden air streams are combined and mixed in mixer **20** and pass through conduit **22.** A solution of retardant is discharged at outlet **25** either to a surge tank or directly to the fire control apparatus. Not shown but comprising an integral part of assembly **10** are internal combustion engines which operate water pump **14** and air compressor **16.** Of course, a single engine can perform both functions by the appropriate gears or belts. The integral power supply imparts versatility and mobility to the system and provides for operation of the system independent of external sources. Also not shown are connecting means for hoses **17** and **18** the use of which provides a fast means for disconnecting empty bins and reattaching bins full of retardant.

Referring to FIG. 2, a dual eductor mixer designated 20 in FIG. 1 is further illustrated. Water enters the mixer through inlet 19 from hose 15 shown in FIG. 1 and retardant-laden air enters the mixter through inlet 21 from hose 18 shown in FIG. 1. Handle 23 is tandem connected to a water-inlet valve and a vacuum break valve. The retardant fed is regulated by vacuum bleed valve 24. In the cut-away, water passes through nozzle 27 producing vacuum for the retardant feed. The incoming retardant-air stream discharges from conduit 13 into chamber 29 and is completely surrounded by water flowing through orifice 28. Initial mixing takes place in chamber 29 and the mixture is drawn by vacuum through orifice 41. Final mixing takes place in chamber 26 within conduit 22. The retardant solution discharges at outlet 25. The capacity of the mixer varies depending upon the size of the nozzle and the water pressure. Mixing rates of 100–600 gallons of retardant solution per minute are not uncommon with water supplied at 50–150 psig flowing pressure and retardant having a bulk density of about 60 lbs./cu. ft. A typical retardant solution contains about 100–200 pounds of retardant per 100 gallons of water. The ratio of retardant to water is conventionally controlled by varying the amount of vacuum by manipulation of valve 24.

FIG. 3 illustrates the bulk retardant supply assembly comprising bin 30 containing particulate fire retardant 32. The bin is constructed of moisture impermeable material usually metal or plastic. The bin is filled via sealable hatch 31 which hatch is opened to serve as a vent when the retardant is being pneumatically discharged from the bin. The particulate retardant rests upon an air permeable diaphragm 36 which generally comprises a textile fabric supported by a rigid grid. Plenum chamber 35 is provided by the space between the porous diaphragm and the bottom wall of the bin. In operation, air from the air compressor 16 via hose 17 shown in FIG. 1 enters inlet 33 and passes through conduit 34 into plenum chamber 35. The air from chamber 35 passes through diaphragm 36 and fluidizes the retardant. The fluidized retardant discharges into inlet 38 which is positioned adjacent to the diaphragm, passes through conduit 37 and exits through outlet 39 into hose 18 shown in FIG. 1 which is attached to the vacuum side of the mixer. Inlet 33 and outlet 39 are sealed during storage of the retardant-filled bin and are equipped with connecting means for quickly connecting with the hoses of the mixing assembly. Base 43 of the bin contains open spaces or channels 44 to accommodate the tongs of a forklift. The channels completely traverse the bin and intersect similar channels which traverse the bin in the opposite direction thus enabling engagement with a forklift in any direction.

Although dimensions are not shown in FIG. 3, the bin is designed to accommodate five hundred to four thousand pounds of retardant which size contributes to the efficiency of the system. The storage volume of the bin is 5–75 cubic feet. For fire retardant such as diammonium phosphate having a bulk density of 50–70 lbs./cu. ft., a bin having a capacity of five hundred to two thousand pounds, storage space of 10–50 cubic feet is recommended.

FIG. 4 illustrates the bulk retardant supply assembly comprising particulate solid fire retardant contained in bin 30 having walls of the storage space of the bin comprising flexible plastic film. The bottom of the bin is essentially the same as shown in FIG. 3 comprising base 43, plenum chamber 35 and porous diaphragm 36 supporting the retardant except that diaphragm 36 is tilted slightly, for example 4°–10°, toward inlet 38 which inlet is flush with the diaphragm. Conduit 34 is unchanged. Conduit 37 is modified; instead of extending through the wall of the storage space it passes through diaphragm 36 and exits through the wall of the plenum chamber 35. The flexible plastic film is sealed to the bottom of the bin with a sealing means not shown which means may be an adhesive or a tightly drawn band. The top of the bag is sealed by sealing means 46. When the system is in operation the bin is vented by opening or breaking seal 46 or by simply poking a hole in the top of the plastic bag.

Although the invention has been illustrated by typical examples, it is not limited thereto. Changes and modifications of the examples of the invention herein chosen for purposes of disclosure can be made which do not constitute departure from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A system for preparing solutions and slurries from particulate solid material which comprises in combination a mixing assembly and a bulk particulate supply assembly; said mixing assembly comprising an eductor-mixer, a fluid pump, connecting means for connecting the mixer and fluid pump, an air compressor, a power supply, and connecting means for connecting the mixing assembly and the bulk supply assembly; said supply assembly comprising bulk particle material contained within an out-of-door storable bin of five hundred to four thousand pounds capacity which bin has sealable openings, a porous floor and an enclosed air space beneath which in concert with the mixing assembly connected thereto permits pneumatic fluidization and discharge of the particulate material.

2. The system of claim 1 for preparing fire retardant solutions near the site of the fire from particulate solid fire retardants wherein the bulk particulate supply is solid fire retardant.

3. The system of claim 2 in which the walls of the storage space of the bin comprise flexible plastic film.

4. The system of claim 3 in which the volume of the storage space of the bin is 10–50 cubic feet.

5. The system of claim 1 in which the proportion of liquid and solid material is controlled by varying the vacuum to the eductor-mixer.

6. An out-of-door storable particulate solid supply assembly consisting essentially of bulk particulate material contained within a bin comprising a weatherproof container of five hundred to four thousand pounds capacity, a sealable opening for charging with particulate material, a porous floor, an enclosed air space beneath the floor, a sealable opening for introducing air into the enclosed space, means for venting the storage space of the container, a sealable conduit extending out of the storage space for discharging airborne particulate solid, and said bin having substantially flat top and bottom to accommodate stacking of the assembly.

7. The supply assembly of claim 5 in which the particulate material is solid fire retardant.

8. The assembly of claim 7 in which the walls of the storage space of the bin comprise flexible plastic film.

9. The assembly of claim 8 in which the volume of the storage space of the bin is 10–50 cubic feet.

10. The assembly of claim 9 in which there is provided an open space under the bin to accommodate a lifting means.

11. An out-of-door storable bin comprising a weather proof container of five hundred to four thousand pounds capacity, a sealable opening for charging with bulk particulate material, a porous floor, an enclosed air space beneath the floor, a sealable opening for introducing air into the enclosed space, means for venting the storage space of the container, a sealable conduit extending out of the storage space for discharging airborne particulate material and said bin having substantially flat top and bottom to accommodate stacking.

12. The bin of claim 11 in which the walls of the storage space comprise flexible plastic film and the volume of the storage space is 10–50 cubic feet and there is provided an open space under the bin to accommodate a lifting means.

13. A bin of claim 10 in combination with a pressurized water supply and a pressurized air supply.

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