

March 20, 1962

M. M. TRUE

3,026,094

METHOD OF MIXING AND DELIVERING AGGREGATE MIXTURES

Filed Jan. 20, 1959

4 Sheets-Sheet 1

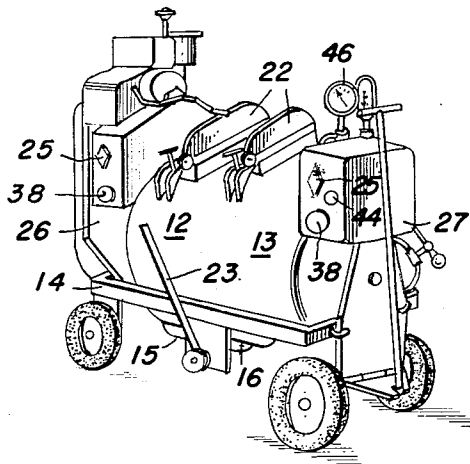


FIG. 1

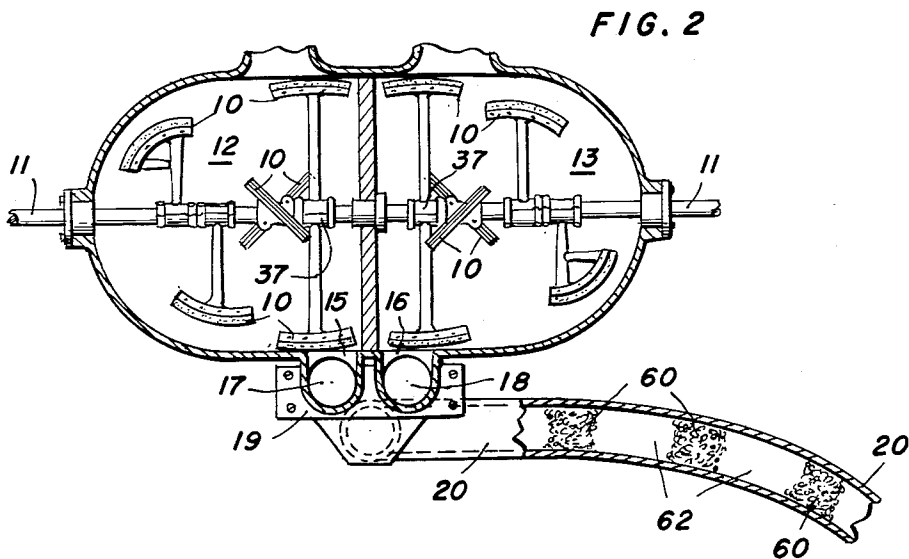


FIG. 2

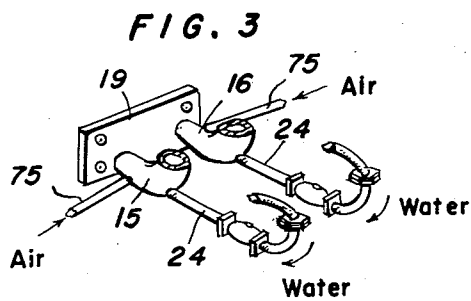


FIG. 3

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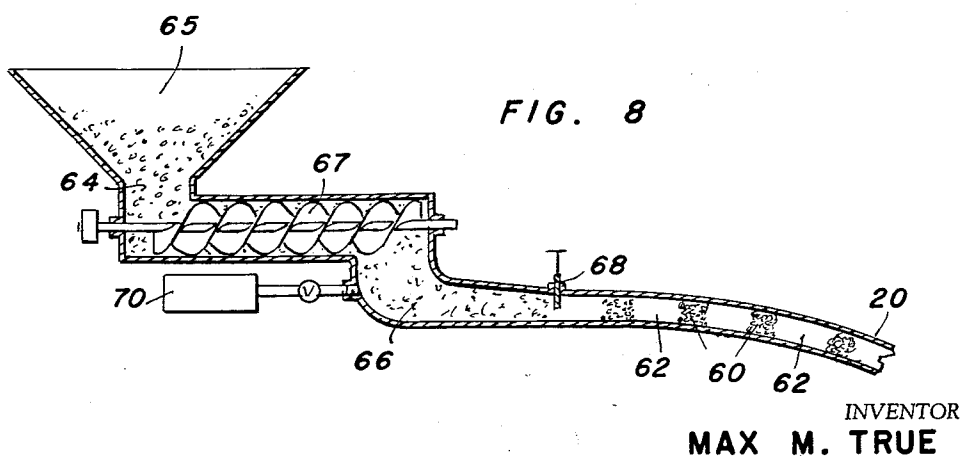
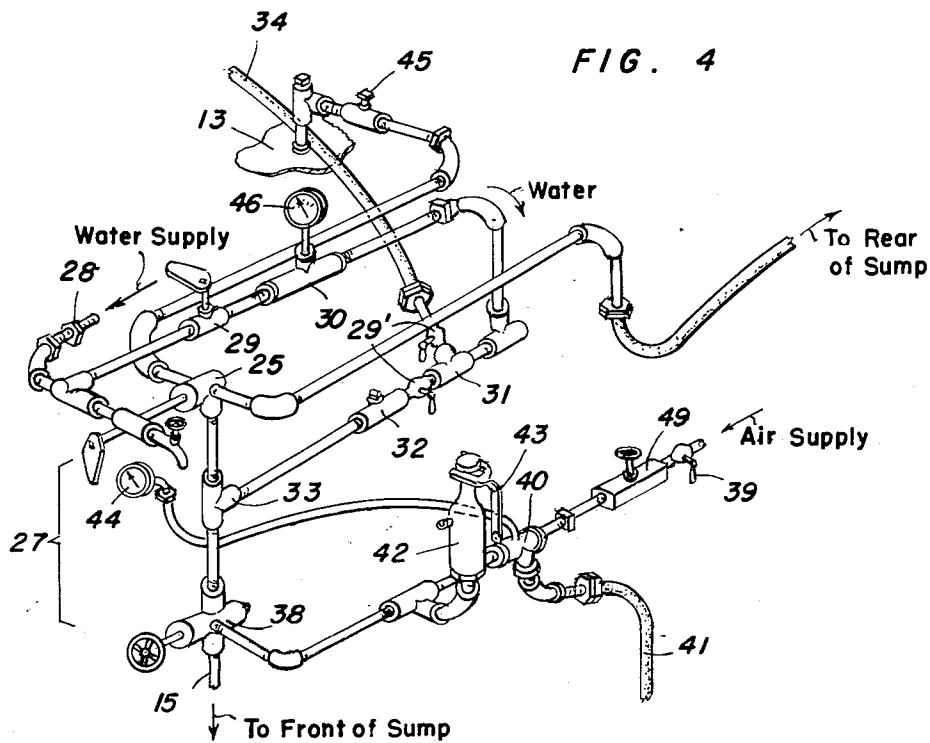
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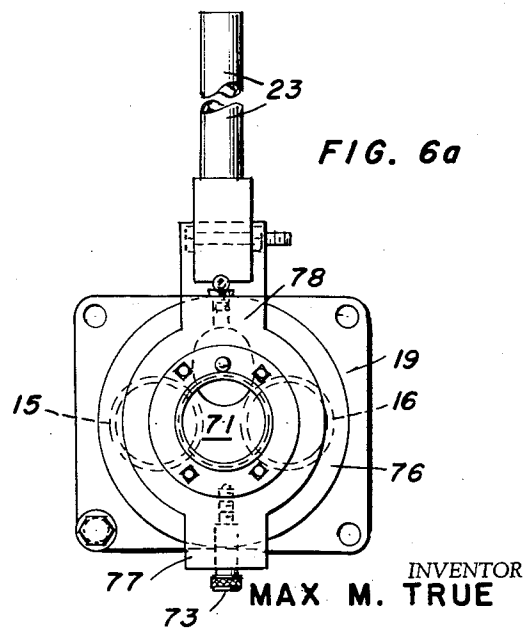
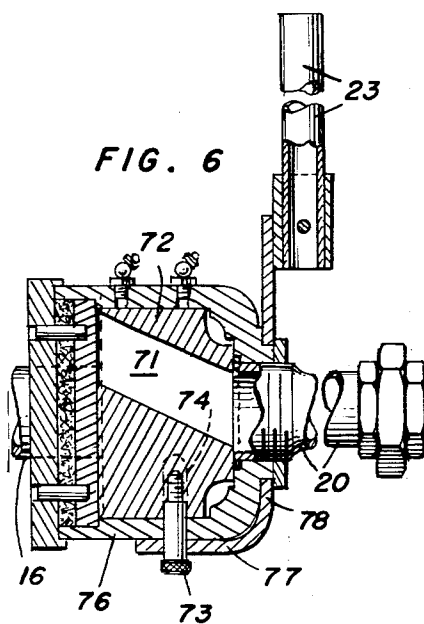
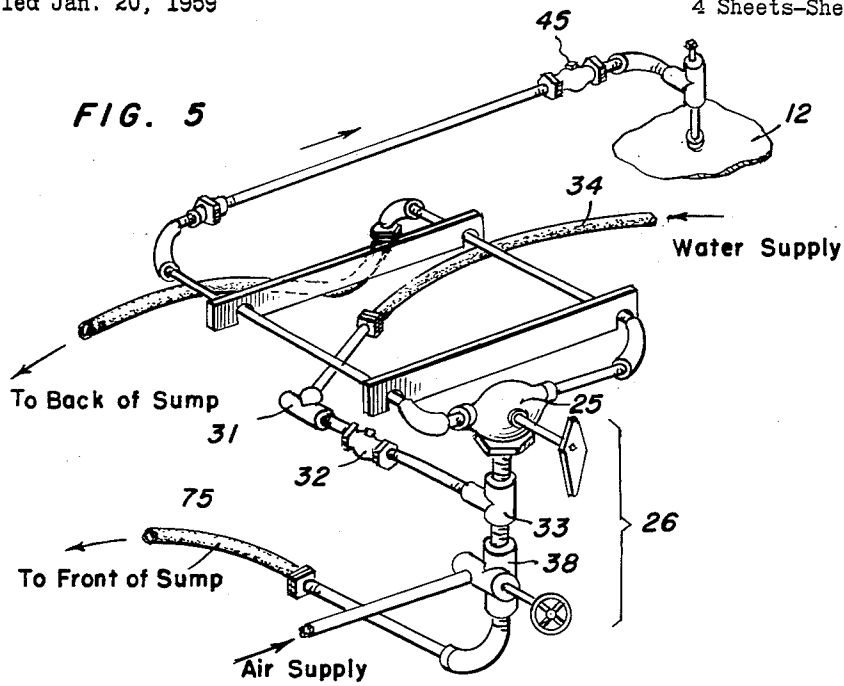
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METHOD OF MIXING AND DELIVERING AGGREGATE MIXTURES

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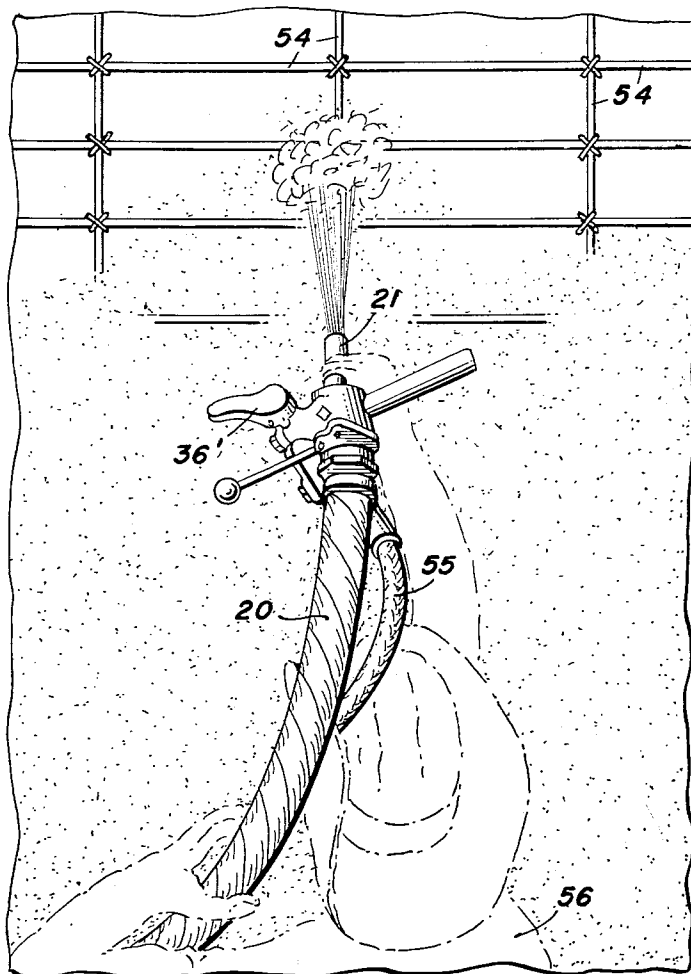
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METHOD OF MIXING AND DELIVERING AGGREGATE MIXTURES

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FIG. 7



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3,026,094 METHOD OF MIXING AND DELIVERING AGGREGATE MIXTURES

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Filed Jan. 20, 1959, Ser. No. 787,871
2 Claims. (Cl. 259—147)

This invention relates to mobile mixers of the type that carry spraying or other delivery means for concrete or the like spray materials after adding the required water to form the desired mixture wetness prior to feeding it to a flexible hose for delivery to the place of application of the wet material to the building construction, and the method of facilitating such delivery, especially when a mixture of comparatively low degree of wetness and high coarseness is used.

This application is a continuation-in-part of my pending application S. N. 558,765 filed January 12, 1956, now U.S. Patent No. 2,880,976.

The present spraying system and method is an improvement over previous methods, which usually added the water to the dry mixture at the spray nozzle, thus causing incomplete mixture of improper proportions of water with the solid ingredients, and required experienced operators; and even then, these methods were very inefficient and wasteful of water and compressed air.

In the event the water was added to the mixture before delivery through conduits to the spray nozzle, mixtures of low moisture content were difficult to force through the conduits and would often pack in bends or elbows, causing interruptions in the work while the packs were cleared.

If the water was not added until the mixture reached the nozzle, a lot more air was required to blow the dry ingredients through the conduits to the nozzle, where dusting would also occur, and an excessive rebound or reject would result.

The main object of the present invention is to make it possible to efficiently handle wet mixtures of low moisture content after they have been thoroughly mixed with the correct proportion of water, and deliver them in a desired spray for application to reinforced concrete layer construction or the like.

A further object is to mix the proper proportion of water with the dry ingredients in a mobile mixer, and facilitate the delivery of slugs of this correct mixture from the mixer to the spray through a conduit by introducing air under pressure in controlled amounts to the top of the mixed batch in the mixer or to the conduit connection at the bottom of said mixer, or both, depending on the fluidity of or degree of moisture in said mixture.

A further object is to use additional compressed air connected directly to the spray nozzle to improve spraying of the slugs evenly over the work.

A further object is to provide piping assemblies and mixer blades on the mobile mixer to facilitate carrying out the above objects.

A further object is to provide means including a piping system for a two tank mobile mixer to adapt it for use in the above process by using a horizontally mounted common rotor shaft extending through both tanks and having peripheral mixing blades mounted thereon to thoroughly mix and sweep the correctly proportioned wet mixture in each tank in a circulatory path toward the adjacent ends of the tanks at the periphery and in the opposite axial direction at the center, so as to continuously feed the mixture past the sump outlets of the tanks at their adjacent ends, the two sumps being connected to a selector valve for selectively opening one of the sumps to the spray delivery hose while closing the other sump, so as to enable the corresponding tank to be reloaded and mixed while the other one is sealed and used for supply-

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ing the slugs of the mixture under pressure through the sump to the delivery hose, thus providing a continuous supply of freshly mixed wet mixtures to the spray nozzle upon demand.

5 A further object is to mount similar water and air supply and control assemblies at the front and rear of the above mixer, each comprising a connection from the air inlet through an air cut-off valve and a T, in series to the inlet of a 3 way proportioning valve, the T, being also
10 connected to the water supply inlet, the two outlet ports of the proportioning valve branching off through a pipe line having a check valve to the top of the corresponding tank, and through a coupling and hose line to a check valve into the side of the corresponding sump connection opposite its outlet.

15 A further object is to provide hose connections between the other connections of the T's connected to the air inlets and the water inlets of front and rear piping assemblies together for parallel operation, and to provide
20 panels on the housings over the front and rear assemblies on which the corresponding proportioning and air cut-off valve control knobs may be mounted; and to provide a pressure gauge connected to the pressure control chamber and visible from the nozzleman's station.

25 Other and more specific objects will become apparent in the following detailed description of one form of the invention as illustrated in the accompanying drawings, wherein:

FIG. 1 is a perspective view of a portable mixer incorporating the present invention,

30 FIG. 2 is a sectional view through one of the tanks showing the general shape of the mixing blades and location of the sump connection,

FIG. 3 is a perspective view, partly in section, and
35 broken away, of the sump piping connections,

FIG. 4 is a perspective view of the front piping assembly, with air and water supply controls,

FIG. 5 is a perspective view of the rear piping assembly,

40 FIG. 6 is an enlarged sectional view through the sump material feed valve,

FIG. 6a is a front elevational view of the feed valve lever control,

FIG. 7 is a perspective view of the nozzle in action, and

45 FIG. 8 is a sectional view of another form of means for performing the novel method of delivering the mixture in slugs separated by air slugs.

As a result of the use of spraying systems of the prior art, the concrete structural jobs performed were plagued with tendency to form "sand-pockets" beneath and around closely placed reinforcing structure, and the water-cement ratio seemed to vary considerably, giving an uncontrolled variety of color, texture and strength.

50 The present system has not only eliminated these potential defects but is free of failures by clogging of the delivery conduits and is much more economical to make and to operate. It provides good embedment of the reinforcing structures both on vertical walls and horizontal slabs. Metered water and thorough premixing have been found to be essential to elimination of sand pockets and rebound, and quality controlled concrete.

In using this system, a vibrating effect is obtained at the nozzle, or a sort of pulsation, which causes the concrete to flow around the steel reinforcement.

65 For purposes of illustration the present system is applied to a dual-tank mobile mixer such as shown in FIG. 1, having rotating mixer blades 10 on a horizontal shaft 11 in coextensive substantially cylindrical tanks 12 and 13 extending longitudinally of the mobile chassis 14 and having their sumps 15 and 16 at adjacent ends of the tanks connected to ports 17 and 18 in a common valve
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plate 19 leading through a selector slide valve to a conduit or hose 20 for delivery to the spray nozzle 21. The tanks are provided with independent manhole covers 22 or doors on top for charging the dry ingredient batches therethrough and sealing them for operation under pressure selectively, so that continuous nozzle operation is available by premixing a batch in one tank while the material valve lever 23 is moved in a position to open the sump of the other tank to supply the demands of the nozzle operation.

Although it was necessary in previous nozzle constructions to use compressed air fed directly to the nozzle for breaking up and distribution of the material in the spray, the present system requires only a plain wedge shaped nozzle (not shown) which may be operated by inexperienced nozzle men, because the air under pressure is supplied in correct proportions to the top of the mixture in the tank and to the corresponding sump connection in accordance with the flow-ability of a correct low moisture content well-mixed concrete or other cement mixture, and the mixer blades passing over the sump provide an intermittent supply of the mixture and top air into the sump, while the sump air is added at 24 in sufficient quantity in slugs 62 under pressure to move the slugs 60 of the mixture through the conduits and to break them up at the nozzle into a homogeneous spray.

In order to provide this control and delivery of the perfectly proportioned and mixed materials through the nozzle we have inserted a 1" nipple 24 with 1" lines into each sump as shown which allows a flow of air through this point when required. This is accomplished by the same means of a proportioning valve 25. The purpose and accomplishment of this improvement is as follows: Whereas previous guns would not flow a real dry concrete or a real coarse aggregate because they plug up the sump from air pressure pushing down on them, in the present gun the use of the bottom or sump air in combination with the top air allows us to blow any material from a complete dry state down the line to as much water content as is desired. In other words, when we blow a wet material, we use top air only, and when we use a dry material, we use bottom air with a small amount of top air to keep the material from floating in the tank. This works very nicely with no plug-up in the sump.

We have also changed the paddles, disclosed in our prior patent application Ser. No. 461,483, for Mobile Mixer, now Patent No. 2,788,197, to further aid the gunning of this dry material. In other words, the paddles 10 act as a distributor and actually deliver small amounts or slugs of material into a rapidly moving stream of air in the sump causing a very slight pulsation in the hose line, which is very important in keeping the materials from getting packed in the hose. We found out with any other type of paddles that the materials, such as Ramsett and others as manufactured by Basic Refractories, Inc., would plug up in the hose unless we used the paddles that are shown in the drawing, FIG. 2.

The gun is now really a concrete gun inasmuch as we can measure the water exactly in our tank and give a guaranteed concrete. It is well known that the previous type guns or dry mix guns that are on the market, cannot do this, as they guess at the required water at the nozzle, which produces a guess water mix. As is well known, concrete is largely a water-cement ratio mixture. It takes a certain amount of water for hydration of the cement in the concrete, and then any excess of the water causes voids in the concrete or weakens it, so that with our gun we can establish the water-cement ratio because we measure the water exactly in the dual tank chambers. This is readily acceptable to any concrete engineer or architect over previous types of guns. This also eliminates any sand pockets behind reinforcing steel, which is very frequently the case with the dry mix type of guns, because they have a poor mix; as in the premix or wet mix each particle of aggregate is surround-

ed by cement paste and eliminates any possibility of sand pockets.

Also through a wet mix gun such as this, we practically eliminate rebound. Rebound is caused because of a very poor mix of water and aggregate in the tanks and thus we practically eliminate rebound.

The important feature of the present gun over previous air guns is that they require a dry sand to go through their hose, and if too wet it will plug the hose. Our machine does not require a dry sand but will shoot any sand whether dry, medium or wet. Proper reduction of the water content is accomplished by accurately reducing the amount of water running into the tank.

Also our gun does not require a large compressor like the previous types of guns. A compressor of 125 c.f.m. of the gyro flow type, like Ingersoll-Rand manufactures, is large enough for the present gun. The previous type of guns requires a 315 to 600 c.f.m. compressor, consequently we can place concrete with an investment, including the truck, compressor, conveyor and the complete machine, for about \$12,000.00, compared to some previous types of guns with their 500 c.f.m. compressor which costs about \$15,000.00 by itself, and requires a concrete mixer, as they do not mix their material in the machine like ours, also a large truck and gun, the total investment for which is around \$30,00.00 for a comparable capacity.

Previous types of guns use all volume of air for conveying the materials substantially in suspension by the force of kinetic energy of the air. The present gun uses a combination of air pressure and volume, therefore less volume of air is required. To further explain the proportioning selector valve 25, this valve allows either a top air or complete bottom air, or any fraction of either one, or a combination of both. We call this a selector valve. You will also note in the drawings that we have two panels 26 and 27, one for each tank. The top valve 25 is the selector valve, or proportioning valve, as it is set every day for the type of material you are shooting. If it happens to be a wet material, you use top air. If it is low slump material, you use about 70 lbs. bottom air and 50 lbs. top air. This of course really simplifies the operation of this machine. The water is fed from a water hose connected to a coupling 28 through the piping shown in FIG. 4, the cut-off valve 29, the flow meter 30, the T fitting 31, the individual water supply valve 29', the check valve 32 in either front or rear piping assembly, T fitting 33, and then through the selector valve 25. A hose 34 may be used to interconnect the two T fittings 31 in the front and rear pipe assemblies. The check valve 32 stops the water from going into a tank that is under pressure also because of the air pressure, and the water runs into the other tank which is desired.

Referring to the booster air valve 36, it may be coupled to an air hose 55, as shown in FIG. 7, and is mounted on the nozzle 21 for supplying additional spraying air to the nozzle when more dispersion is desired.

By proper adjustment of selector valve 25, both bottom air and top air is used to aid in feeding a low moisture content material such as concrete or refractories of 8% moisture approximately. Bottom air permits the material to move out of the sump. Top air feeds the sump and produces slugs of material intercepted by volumes of compressed air. Without bottom air the sump will pack, without top air the material will float. So therefore a combination of bottom and top air feed is required. The paddles 37 operating over the sump act as a distributor and permit intermittent feeding of slugs of material and air. Thus the hose will not plug up and when the material valve is shut off at the tank the sump is emptied by the continued flow of compressed air through air lines 75 to the front of the sump. A nozzle with added air is not ordinarily necessary as the air introduced in the hose between the material wads is suffi-

cient to break up the material in a nice spray and only a wedged pipe nozzle is required.

The top air is used for pushing by pressure a material that flows through the hose. The combination top and bottom air carries the harder flow or low moisture content material through the hose in a volume method of wads of material and pockets of air. This is accomplished by a selector or proportioning valve 25, which introduces top and bottom air to provide the correct pressure and flow. We eliminate dusting and rebound that is common in other known sprayer systems, because of premixing.

This machine will feed material of any low moisture content down to a perfect dry by using the combinations of air mentioned.

The nozzle man does not have to have any control over the quality of the concrete because it is controlled at the machine. Therefore a trained man is not necessary. The nozzle man, in some known systems, adds the water at the nozzle and has a guess control of the quality of the concrete. An experienced nozzle man is therefore required to operate that type of machine. Usually 2 to 3 years experience is necessary, and still they guess at the water amounts.

The present machine will also sand blast wet or dry, by using a regular sand blast nozzle.

Due to the slugs of properly premixed material, it traps the air and conserves it. Accordingly, only a 125 c.f.m. air compressor is required to blow the material through the 1½" hose where some other systems have to have a compressor 4 or 5 times this capacity. The so called dry mix guns of the prior art carry their material through in a dry state and mix water at the nozzle, therefore they waste a considerable amount of the air and require a 315 to 600 c.f.m. air compressor to do the same volume of work as the present sprayer system.

The premixing gives controlled concrete. Others guess at the water supply at the nozzle and do not have controlled installations. We can use wet sand, others have to dry their sand for sand blasting or for concrete work. They pick up drift or sand pockets in the concrete, shooting around reinforcing steel, because of the poor mix. The premixing eliminates sand pockets.

Each pipe assembly on the front and rear of the machine is similarly operated and constructed. The selector valve 25 is a 3-way valve with two adjustable ports to the tank and sump lines respectively, to provide variations in the amounts of their opening, or to close one or the other entirely, while maintaining the supply port at the bottom of the valve open all the time. The hand wheel valve 38 is a three way cut-off valve for the compressed air which is supplied from the compressor by a hose line connection through main air supply valve 39 and the regulator 49, shown in FIG. 4, to the cut-off valve 38 in each pipe assembly, by means of the T-fitting 40 (FIG. 4). A hose line 41 may be connected between this T-fitting 40 and the cut-off valve 38 in the rear pipe assembly. A safety pressure relief 42 may be provided in the air supply line with a manual relief control 43 which may have a pull string tied to it and extended to a convenient place on the front control panel 27 for operation therefrom. A pressure gauge 44 may also be suitably mounted on this panel for indicating the regulated air pressure delivered to the air supply line, the regulation of this pressure being provided, as already mentioned, by the regulator 49. Check valves 45 are provided in the lines from the selector valves to the tanks to prevent return leakage from one tank back through the pipe assemblies to the other tank to interfere with the water feeding into the latter, when the air supply is cut off.

The flowmeter 30 has a continuous indicator dial 46 to enable the operator to supply measured amounts of water to the mixes as may be required.

FIG. 7 illustrates a plain nozzle 21 in use in applying

a premixed material 53 to a reinforced wall construction 54. A hose 55 may be connected to the valve 36 to supply additional spray air to the nozzle 21 when desired.

The method of delivering the mixture in slugs separated by slugs of compressed air may be performed by other means than the arrangement shown in the above described apparatus. One such means is illustrated in FIG. 8, wherein the bottom of each sump 64 from any mixture supply tank 65 may be provided with an auger type feeding worm 67 or a pump piston type (not shown) feeding means for providing a continuous supply of the mixture to the outlet port 66 which is connected through the material valve 68 to the delivery hose 20. An air pulsator 70 is connected to the outlet port 66 for feeding slugs of compressed air 62 at controlled intervals as may be required for any particular mixture to form the slugs of mixture 60 and facilitate their movement through the delivery hose and spray nozzle to the work. In this case the top air pressure is not required in the tank 65, if the auger worm is relied on for feeding the mixture under sufficient pressure.

It is to be understood that this novel method and apparatus is adaptable for supplying cement, aggregate and water mixture of any type as well as other wet or dry mixtures of any fluidity, which are to be applied to any surface by spraying thereon.

This invention is particularly adapted for comparatively dry mixtures of low fluidity which could not otherwise be forced to flow through the delivery hose because of the high friction and resistance to flow especially around bends in the hose.

The injection of the air slugs reduces the total resistance to flow in the entire length of the hose and requires a reasonably reduced air supply pressure, while still permitting a substantially continuous and uniform spray from the nozzle 21 at the end of the hose, by suitably reducing the size of the individual slugs of material and air.

The amount of air required in the present method is very small compared to some of the prior methods of delivering dry ingredients of the mixture by blowing them through with a large volume of air. These prior methods, which relied on adding the water to the mixture in the spray nozzle, were very wasteful of the mixture ingredients also, because of poor mixture with the water and poor adhesion to the work. Sand pockets in the work were almost impossible to eliminate, and proper water content was difficult, if not impossible, to control by these prior methods, resulting in poor quality work. Also structural engineers can now design structure around the present gun but could not do so with other types, such as the dry mix guns.

The present method uses properly proportioned mixtures of exact water content and permits its delivery through a long flexible hose to do a good job efficiently in remote and hard to get at places by unskilled personnel.

The feed tank selector valve may be made as shown in FIGS. 6 and 6a. A rotatable plug 72 in which the angular port 71 is located, is connected by means of the stud bolt 73, operating in arcuate slot 74 in the valve casing 76, to an arm 77 of a rotatably mounted plate 78 on the front of the valve casing 76. This plate has the control lever 23 firmly fixed to it so as to rotate the port 71 selectively into communication with sump 15 or sump 16 at its inner end while its outer end remains axially aligned in communication with the entrance to the feed or delivery hose 20.

Many obvious modifications in the form and arrangement of the parts may be made without departing from the spirit and scope of this invention, as defined in the appended claims.

What is claimed is:

1. The method of facilitating the delivery of a ready-mixed, high-density, low water content cement-aggre-

gate-water mixture through a flexible flow line for remote application, comprising impelling a flow of said mixture into the feeding end of said flow line, reducing the frictional drag on the material in said flow line by injecting slugs of air thereinto of such size and frequency 5 as to decrease the density of the material per unit length by the provision of a plurality of alternately arranged slugs of air and material per said unit length.

2. The method defined in claim 1, and regulating the size of said slugs of air and mixture to such a reduced 10

length as to provide a substantially continuous and uniform flow from said flow line.

References Cited in the file of this patent

UNITED STATES PATENTS

2,261,347	Di Santo et al.	Nov. 4, 1941
2,735,276	Thompson	Feb. 21, 1956
2,797,149	Skeggs	June 25, 1957
2,858,116	Hale	Oct. 28, 1958
2,880,976	True	Apr. 7, 1959