Nov. 18, 1952 W. G. BROWN ET AL 2,618,576

METHOD OF COATING SURFACES WITH CEMENTITIOUS MATERIAL

Filed Nov. 12, 1948 2 SHEETS—SHEET 1

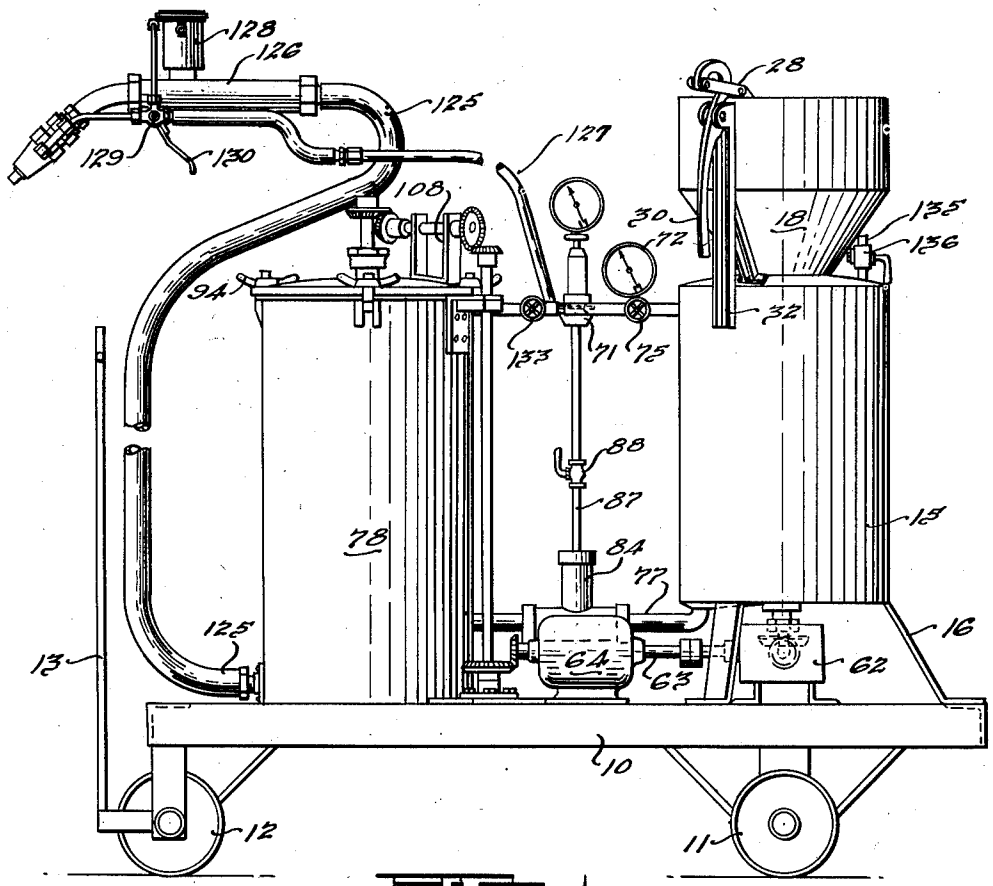


FIG. 1.

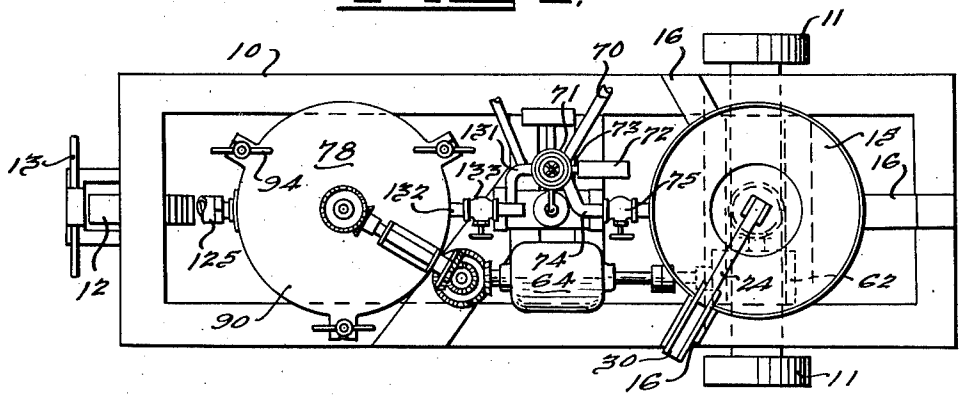


FIG. 2.

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FIG. 3.

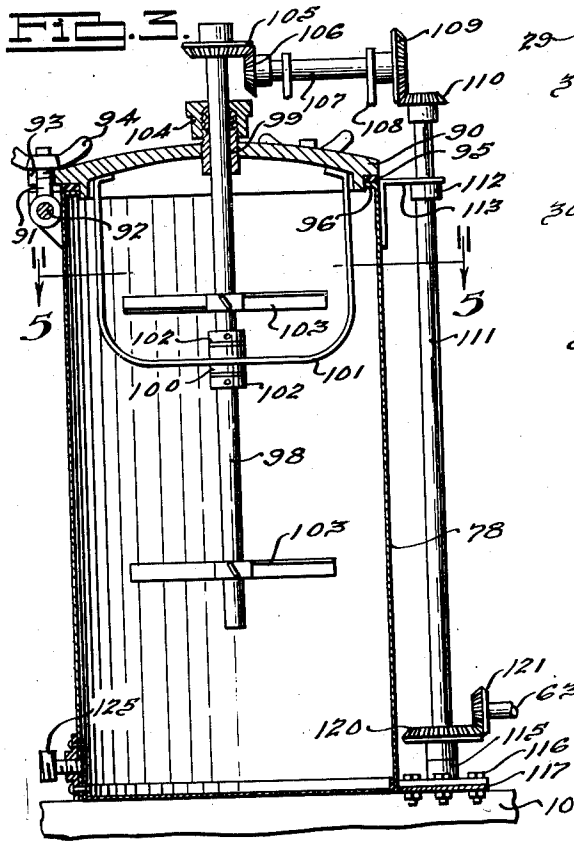


FIG. 4.

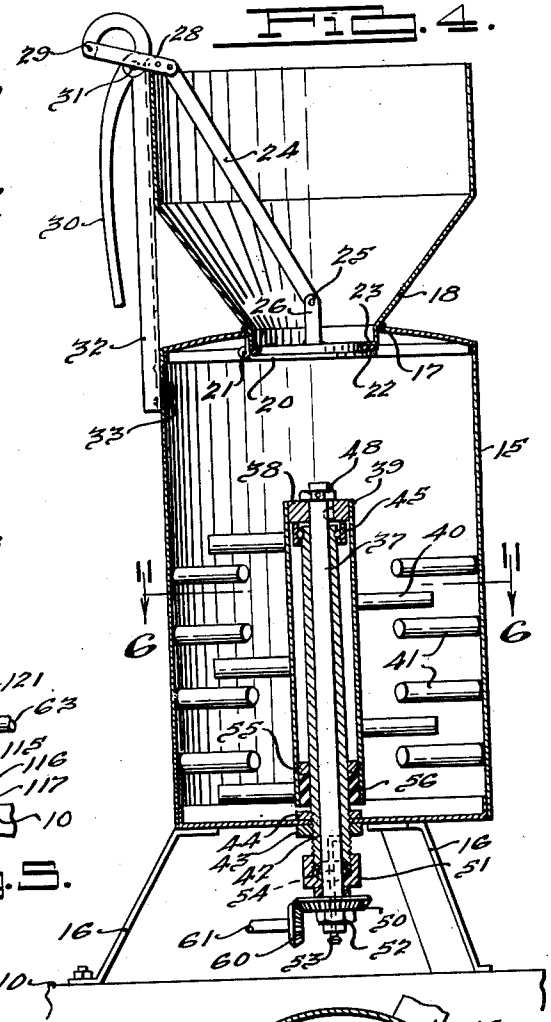


FIG. 5.

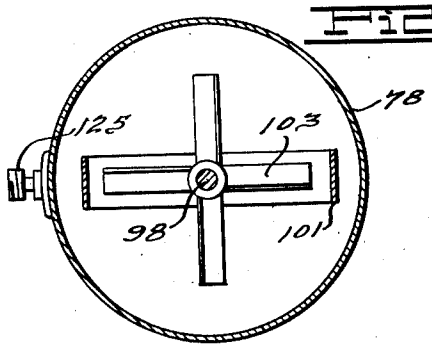


FIG. 6.

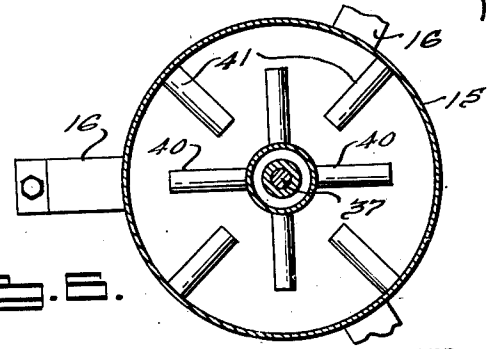
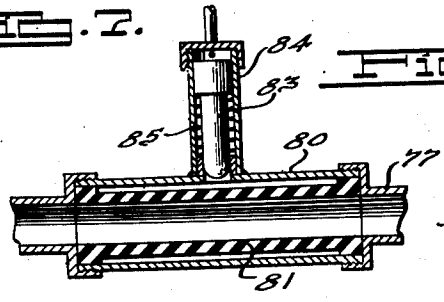


FIG. 7.



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METHOD OF COATING SURFACES WITH CEMENTITIOUS MATERIAL

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Application November 12, 1948, Serial No. 59,726

8 Claims. (Cl. 117—104)

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The invention relates generally to painting or coating surfaces and it has particular relation to a method of applying liquid cementitious material to a surface. This application is a continuation-in-part of applicants' copending application, Serial Number 467,680, filed December 3, 1942, now abandoned.

The application of liquid cementitious material heretofore has involved particular difficulties where the material includes a substance such as Portland cement. Application of a material of this character by brushing it on to a surface requires tedious manual effort, especially if the operator desires to obtain a smoothly distributed coating. Another factor which contributed to the inefficiencies and difficulties of manually applying the material in this manner was that the ingredients would not stay uniformly mixed and hence the coating would vary accordingly.

Another factor which contributed to the inefficiency and undesirability of the practice heretofore, whether by hand or by spray gun, was that the coating after setting and hardening would have minute cracks caused by shrinkage. This not only damaged the coating itself but it resulted in a relatively poor appearance. In other words, the coating did not have that solid, unitary appearance and structure which always is desirable in a surface coating.

During the mixing of concrete, the cement particles take up water by crystallization in a process known as hydration and form a cementing gel which, when it sets, serves to bind the aggregates together. The above mentioned hairline cracks result in cementitious coatings mixed in accordance with previously known practices because of the fact that in such mixing insufficient hydration of the cement is effected during the mixing. The partial hydration resulting from such mixing permits excessive evaporation of water during the setting of the concrete and the above mentioned hairline cracks result. These cracks, even though very fine, greatly accelerate weathering and accompanying deterioration of the concrete.

One object of the present invention is to provide a method of mixing and applying cementitious material in liquid form which overcomes the disadvantages mentioned and results in a uniform, smooth and strong surface coating.

Another object of the invention is to provide a method of mixing and applying a cementitious, liquid coating, wherein improved and bettter hydration of the cement particles is obtained.

Another object of the invention is to provide

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a method of mixing and applying liquid, cementitious material which will result in a coating substantially free from cracks normally caused by shrinkage of the material during setting.

Another object of the invention is to provide an improved method of mixing and applying a cementitious coating which will result in more uniform mixing of the material as it is applied to the surface.

Another object of the invention is to provide a method of mixing and applying liquid cementitious material which will allow continuous operation so that an operator handling a spray gun for instance may continue to apply the material for an indefinite period of time without interruption.

Another object of the invention is to provide an improved method of mixing and applying a liquid cementitious material permitting effective coating of surfaces disposed at an elevation considerably above that of the mixing apparatus employed.

Other objects of the invention will become apparent from the following specification, from the drawings related thereto, and from the claims hereinafter set forth.

For a better understanding of the invention, reference may be had to the drawings, wherein:

Figure 1 is a side elevational view of apparatus constructed according to one form of the invention;

Figure 2 is a plan view of the apparatus shown by Figure 1;

Figure 3 is a view showing a vertical section of the tank seen at the left in Figures 1 and 2;

Figure 4 is a similar, vertical section of the tank seen at the right in Figures 1 and 2;

Figure 5 is a cross-sectional view taken substantially along the line 5—5 of Figure 3;

Figure 6 is a cross-sectional view taken substantially along the line 6—6 of Figure 4; and

Figure 7 is a cross-sectional view of a valve employed in the conduit connecting the tanks.

Referring to Figures 1, 2, and 4, the apparatus includes a bed frame 10 supported on a pair of rear wheels 11 and a front steerable wheel 12 having a handle 13 for moving the apparatus from one place to another. A mixing tank 15 is supported on the bed 10 by legs 16, and, as best shown by Figure 4, the upper end wall of the tank has an opening 17 through which the lower end of a hopper 18 projects. The hopper and upper end wall of the tank may be welded together around the edge of the opening so as to

obtain a rigid as well as sealed joint. A cover 20 is provided at the lower end of the hopper and is pivotally connected thereto at one side, as indicated at 21. This cover is adapted to be moved upwardly and it carries a sealing ring 22, which in turn is adapted to abut an inwardly turned flange 23 on the lower edge of the hopper. For moving the cover 20 upwardly, a link 24 is pivotally connected, as indicated at 25, to a projection 26 on the cover and this link in turn at its upper end is rigidly fastened to a pair of toggle straps 28. The straps in turn are pivotally connected, as indicated at 29, to a gooseneck lever 30, which is in turn pivotally connected at an intermediate point 31 to a bar 32. This bar is rigidly fastened as indicated at 33, to the tank, and may be similarly fastened or welded to the side of the hopper. When the lever 30 is swung clockwise, as seen in Figure 4, the straps 28 and link 24 will be so moved as to open the cover 20 and it should be noted that when the parts are in the closed position, it is necessary first to break the toggle through movement of the lever before the cover 20 can open.

The mixture or coating to be used may comprise an argillo calcareous substance such as Portland cement, finely divided sand, and water, although it should be understood that other ingredients such as waterproofing agents may be added, or that the mixture may comprise various other combinations including Portland or similar cement. One part cement, three parts sand, and enough water to provide the required liquid condition may be used for instance and these ingredients are placed in the tank in proper proportions and then the cover 20 is closed.

For agitating and mixing the materials in the tank, a rotary shaft 37 extends upwardly through the bottom wall of the tank and this shaft is keyed to the upper end wall 38 of a sleeve 39 having radially projecting elements 40 at spaced points thereon for stirring the materials in the tank. These elements move in between other and stationary elements 41 fastened to the inner side of the tank, and from this it will be appreciated that thorough stirring and mixing of the material may be obtained. The shaft 37 is rotatable in a stationary tube 42 fastened tightly in the bottom wall of the tank by threaded nuts 43 and 44 disposed respectively at the lower and upper sides of the wall. At its upper end the tube 42 has a thrust bearing 45 which engages the end wall 38 in the sleeve and a nut 48 on the upper end of the shaft 37 retains the sleeve 39, tube 42, and shaft assembled.

Below the bottom wall, a bevel gear 50 is keyed to the lower end of the shaft, and this gear substantially abuts a packing gland 51 threaded on the lower end of the tube 42. A nut 52 is provided on the lower end of the shaft for holding the gear in place and it will be noted that a grease fitting 53 is provided which communicates with a central passage 54 in the shaft leading to the external surface of the latter, from which it follows that the outer surface of the pin may be lubricated.

For sealing the sleeve 39 relative to the tube 42, a collar 55 is fastened to the interior of the sleeve adjacent its lower end, and while this collar does not have sealing engagement with the tube, it acts as a shoulder against which a rubber sealing sleeve 56 may press. Pressure within the tank tending to force the rubber sleeve 56 upwardly in the sleeve 39 acts to force the rubber against the collar 55 and expand the rubber into sealing engagement with the tube 42, from which it will be seen that leakage of material in the tank upwardly along the tube 42 will be prevented.

For rotating the shaft 37, a second bevel gear 60 meshes with the gear 50, and this second bevel gear is fastened to a shaft 61 which, as best shown by Figure 1, is connected to a reduction gearing box 62. The reduction gearing is connected to a shaft 63 of a motor 64, and from this it follows that the agitator and mixer within the tank 15 may be rotated at a desired speed.

With respect to mixing of the materials in the tank 15, it has been found that faster and much greater hydration of the cement particles occurs if the mixture is maintained under substantial pressure. Where no pressure on the materials is provided, considerable time is required for the cement particles to take up water in hydrating and furthermore the hydration is not complete. During hydration, or taking up of water, the cement particles increase in volume, and where insufficient hydration has occurred, it has been found that during setting of the coating after it is applied to a surface, the particles shrink and leave fine, hairline cracks. Where the materials are maintained under substantial pressure during mixing and agitation, it has been found that more water is forced into the particles, more hydration of all particles occurs and that hydration is effected more rapidly. This results in less shrinkage in setting and the fine, hairline cracks previously obtained are practically eliminated. This is for the reason that the release of water which has been taken up as water of hydration requires a definite amount of energy and normal weathering does not supply sufficient energy to effect the release of any substantial proportion of this water of hydration. On the other hand, water in the free condition in which much of it exists when the material is mixed by previously known methods may readily evaporate and cause shrinkage. As an instance of pressure which has been found desirable for obtaining these results, an air line pressure of approximately 100 pounds per square inch may be used.

Now referring to Figures 1 and 2 again, an air pressure line 70 is provided which leads to a pressure reducing valve 71. A gauge 72 connected to the high pressure side of the valve 71 by a conduit 73 indicates the line pressure supplied to the valve. A conduit 74 also connected to the high pressure side of the valve has a manually operable valve 75 therein and this conduit leads to the tank 15. With a line pressure in the line 70 of approximately 100 pounds per square inch, it is apparent that this pressure may be applied to the materials in the tank 15 and that the line may be cut off at any time by means of the valve 75.

After the material is mixed under pressure in the tank 15, it may be conducted through a conduit 77 to a second tank 78 also mounted on the bed 10. As best shown by Figure 7, the conduit 77 includes a sleeve 80 containing a rubber tube 81 which is adapted to close the conduit to passage of fluid therethrough when the tube is collapsed at its center. For collapsing the tube, a plunger 83 is mounted in a small cylinder 84 welded to the side of the sleeve 80 and this plunger is adapted to be moved downwardly against the wall of the tube 81 by air pressure at the upper end of the plunger. A spring 85 is adapted to return the plunger to its inoperative position upon release of the pressure.

Referring again to Figures 1 and 2, the small cylinder 84 containing the plunger 83 is connected to an air pressure line 87 which in turn is connected to the low pressure side of the reducing valve 71. A manually operated valve 88 is provided in the line 87 so that the pressure may be cut off from the cylinder 84 and it might be mentioned in this connection that a suitable exhaust vent may be provided in the valve 88 so that when the valve is closed, air in the lower part of the conduit 87 and in the cylinder 84 may escape so as thereby to allow the spring to return the plunger to its inoperative position.

Referring now to Figures 3 and 7, the tank 78 has a cover 90 at its upper end which is adapted to be firmly held in closed position by a series of circumferentially spaced fastening means which may be readily released. Each of these fastening means includes a threaded shank 91 pivotally connected as indicated at 92 to the side wall of the tank and which may be moved into a slot 93 in the edge of the cover. A wing nut 94 on the end of the shank is adapted to be drawn tightly against the cover so as to hold it in closed position. A sealing element 95 between the edge of the cover and a flange 96 on the tank serves to seal the tank against leakage.

In order to continually agitate the liquid coating material in the tank 78, an agitator is provided which includes a shaft 98 journaled in a bearing element 99 fastened in the cover 90 and in a lower bearing element 100 fastened to a strap 101 having its ends welded to the underside of the cover. Collars 102 above and below the strap 101 and fastened to the shaft, serve to support and locate the later vertically. Blade elements 103 fastened to the shaft 98 serve to agitate the material when the shaft is rotated.

Above the cover, a packing gland 104 is threaded onto the bearing element 99 so as to prevent leakage along the shaft and the upper end of the shaft has a bevel gear 105 which meshes with a second gear 106. The latter gear is mounted on a shaft 107 which, as best shown by Figure 1, is rotatably mounted in a U-shaped bracket 108 welded to the cover 90. The opposite end of the shaft 107 has a bevel gear 109 which meshes with a bevel gear 110 mounted on the upper end of a shaft 111. At its upper end, this shaft is turnably supported in a bearing 112 fastened to a bracket 113 in turn fastened to the side of the tank while the lower end of the shaft is journaled in a bearing 115 fastened by bolts 116 to a plate 107 in turn fastened to the side members of the bed 10. A bevel gear 120 on the lower end of the shaft 111 meshes with a bevel gear 121 mounted directly on the opposite end of the motor shaft 63. The agitator in tank 78 therefore may be driven at a faster rate of speed than the agitator in the tank 15.

In order to spray the liquid mixture in tank 78 onto a surface to be coated, a conduit 125 is connected to the bottom portion of the tank and this conduit leads to a spray gun 126. This spray gun may be of the type shown in our United States Letters Patent No. 2,305,840, granted December 22, 1942, and briefly includes a rubber type valve on the order shown by Figure 7 which is normally held in a collapsed or closed position by air pressure delivered by a conduit 127 connected to the cylinder 128 of the valve and to the low pressure side of the reducing valve 71. A valve 129 having a trigger 130 may be used to open and close the conduit 127 and thus close and open the gun. It will be appreciated, however, that the plunger for closing the rubber valve might be held in a closed position by spring pressure and that a similar trigger might be used for moving the plunger and opening the valve.

For supplying a pressure to the liquid in tank 78, a conduit 131 is connected to the low pressure side of the reducing valve 71 and this conduit in turn is connected to a conduit 132 connected to the upper part of the tank 78. A manually controlled valve 133 in the conduit 132 enables cutting off the air pressure from the tank.

In using the apparatus described, the proper ingredients are placed in the tank 15, it being understood that the valve 75 is first closed and that the valve 88 is open so that the rubber valve in conduit 77 is closed. Then the cover 20 is closed, air line valve 75 is opened, and the motor 64 is started so as to mix the material under pressure. As before stated, better and more rapid hydration of the cement particles is obtained by this pressure. After the mixing for a sufficient time, the valve 88 may be closed so as to open the conduit 77 and then the mixture is forced by the air pressure above it in tank 15 into the tank 78. After the liquid material has been transferred to tank 78, the valve 88 is again opened so as to close the conduit 77 and the valve 132 then may be opened if not opened previously, to place the liquid mix in tank 78 under the reduced air pressure. Following this the spray gun may be used for applying the liquid to the surface to be coated. It might be mentioned at this time that normally a pressure in tank 78 of about sixty pounds is found desirable and hence a differential of approximately forty pounds exists betwen the two tanks. This differential permits the transfer of the mixed material from the mixing tank 15 to the spraying tank 78 in the manner above described. It will be appreciated that the amount of differential required, betwen the pressures in the tanks 15 and 78, will vary depending upon the consistency of the mix and the size of the conduit 77. It has been found desirable to have this pressure differential be at least twenty-five pounds per square inch.

The above mentioned sixty pounds pressure in the spraying tank 78 may also vary considerably depending upon numerous factors such as the size and length of the conduit 125 and the elevation of the spray gun 126 above the level of the material in the tank 78. By way of example, it has been found that with a three-quarter inch hose one hundred feet long, a pressure of at least thirty pounds per square inch plus three-quarters of a pound per square inch for each foot of elevation of the spray gun above the level of the material in the tank 78, is required to insure proper delivery of the mixed material from the tank 78 to the spray gun 126.

It will be appreciated of course that in spraying surfaces at great elevations above the tank 78 it may be necessary to employ a pressure within the tank 78 considerably greater than the above mentioned pressure in the mixing tank 15. In such cases it will be understood that the pressure within the tank 15 may be considerably more than one hundred pounds per square inch in order to provide the desired differential between the pressures in the tanks 15 and 78.

While the operator is using the spray gun and applying the liquid in tank 78, a second operator may close the air valve 75 and exhaust air in the tank 15 by means of a pipe 135 and valve 136. Then while the operator is spraying with liquid in tank 78, a new mix may be placed in the tank

and prepared. This new mix may be transferred to tank 78 at any time and even during operation of the spray gun, since it is only necessary to close valve 88 to open conduit 77 and then the differential in pressure will force the mix from tank 15 into tank 78. This manner of operating the equipment may be continued indefinitely and continuous spraying may thus be effected.

When it is desired to clean the equipment, the covers may be removed and the tanks filled with water and then the covers replaced. Following this, the water in both tanks may be agitated and the solution then evacuated completely through the spray gun by air pressure. Incidentially, this cleaning of the tanks also cleans the spray gun and the conduit leading to the latter. It might be stated too that if desired, water pipes having valves therein may be connected to both tanks so as to supply water thereto when desired and particularly to fill the tanks for cleaning. In this event opening of the covers would not be necessary to place water in the tanks. It may be added that an air escape valve might be provided too on tank 78 so that when desired this tank could be opened to the atmosphere so as to allow air under pressure therein to exhaust.

The apparatus and the method enable obtaining greater and faster hydration of the cement particles due principally to the fact that the mixing is effected under high pressure which forces the water into the cement particles more rapidly and more thoroughly. This is reflected in a better finish or coating which will not crack and which will not shrink at least nearly as much as shrinkage occurred in connection with prior practices. Since the entire apparatus is mounted on a movable bed, its use is greatly facilitated and it will be understood that air lines and water lines will be flexible to permit movement of the apparatus away from sources of air and water.

Although only one form of the invention has been illustrated and described in detail, it will be apparent to those skilled in the art that various modifications may be made without departing from the scope of the appended claims.

What is claimed is:

1. The process of coating a surface with a liquid cement including argillo-calcareous substances, which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure of about one-hundred pounds per square inch, and then applying the mixture to such surface while the mixture is in fluid form.

2. The process of coating a surface with a liquid cement including argillo-calcareous substances, which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure, of about one-hundred pounds per square inch, and then spraying the liquid mixture onto such surface while such mixture is in fluid form and under a pressure of about sixty pounds per square inch.

3. The process of coating a surface with a liquid cement including argillo-calcareous substances, which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure of at least one-hundred pounds per square inch, and then applying the mixture to such surface while the mixture is in fluid form.

4. The process of coating a surface with a liquid cement including argillo-calcareous substances, which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure, of at least one-hundred pounds per square inch, and then spraying the liquid mixture onto such surface while such mixture is in fluid form and under a pressure of at least sixty pounds per square inch.

5. The process of mixing and apply a liquid cement which comprises utilizing two closed tanks having a connection for transferring mixture from one to the other, mechanically mixing finely pulverized argillo-calcareous materials with water in one of the tanks while maintaining the mixture under a generally static air pressure of at least one-hundred pounds per square inch, then transferring the mixture to the second tank by means of the pressure in the first tank and then closing the connection between the tanks, maintaining the mixture in the second tank under an air pressure above atmospheric but below the air pressure in the first tank and using this pressure in the second tank to apply the mixture to a surface to be coated.

6. The process of mixing and applying a liquid cement, which comprises utilizing two closed tanks having a connection for transferring mixture from one to the other, mechanically mixing finely pulverized argillo-calcareous material with water in one of the tanks while maintaining the mixture under a generally static air pressure of at least one-hundred pounds per square inch, then transferring the mixture to the second tank by means of the pressure in the first tank and then closing the connection between the tanks, maintaining the mixture in the second tank under an air pressure above atmospheric but below the air pressure in the first tank, using this pressure in the second tank to apply the mixture to a surface to be coated, and simultaneously mixing new materials in the first tank while applying the mixture from the second tank.

7. The process of coating a surface with a liquid cement including argillo-calcareous substances, which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure of at least one-hundred pounds per square inch, then transferring the mixture to a second closed tank by means of the pressure in the first tank while maintaining the second tank at a pressure above atmospheric but below the pressure in the first tank and suitable for supplying the mixture through a suitable line to the highest portion of the surface to which the material is to be applied, then applying the liquid mixture to such surface while the mixture is in fluid form.

8. The process of coating a surface with a liquid cement including argillo-calcareous substances which comprises mechanically mixing finely pulverized argillo-calcareous materials with water in a closed tank for hydrating the materials while maintaining the mixture under a generally static air pressure of at least one-hundred pounds per square inch, then transferring the mixture to a second closed tank by means of the pressure in the first tank while maintaining the second tank at a pressure suit-

able for supplying the mixture through a suitable line to the highest portion of the surface to which the material is to be applied, said pressure in said second tank being at least equal to thirty pounds per square inch plus three-quarters of a pound per square inch for each foot of elevation of said highest portion of said surface above the level of the mixture in said second tank.

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