

May 5, 1953

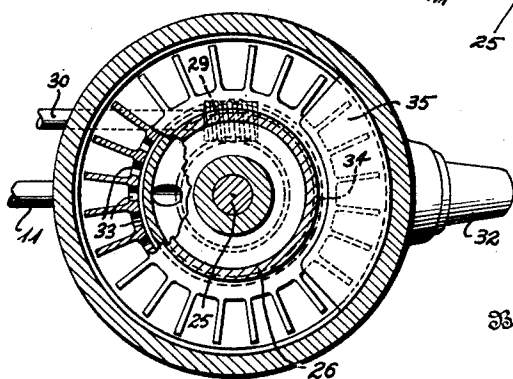
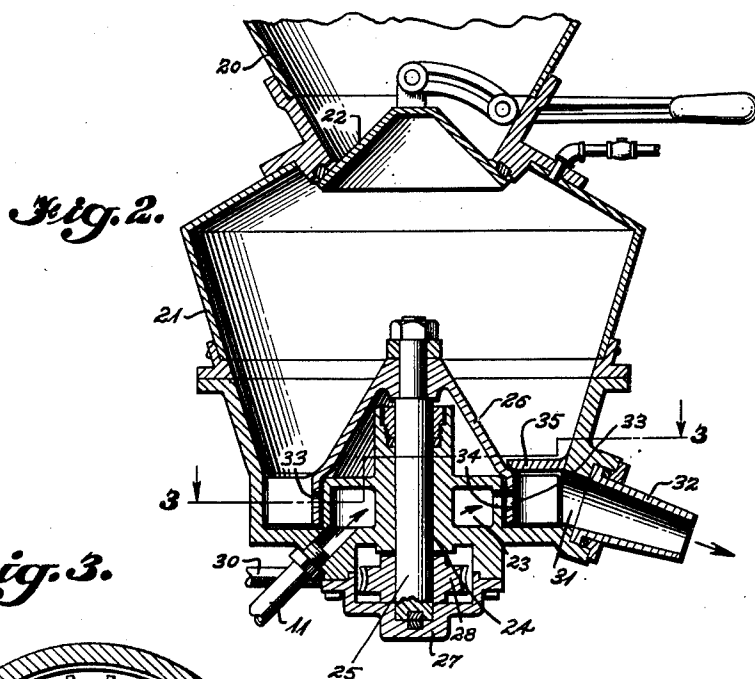
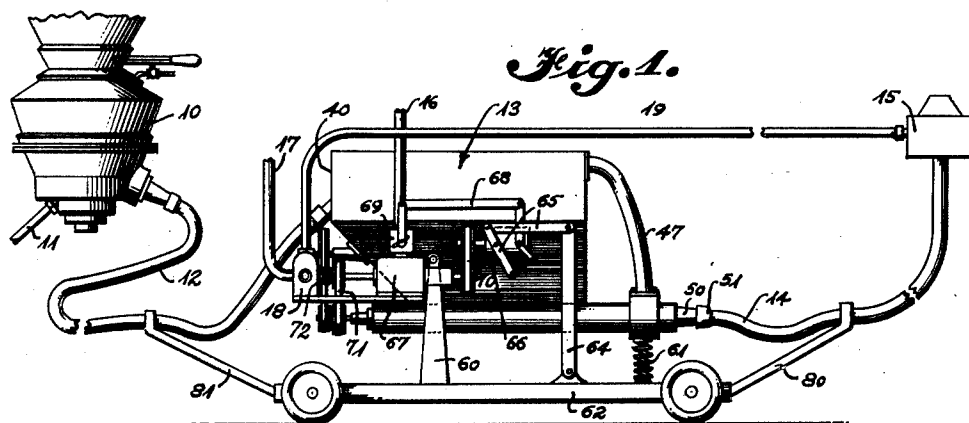
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2,637,539

DISTRIBUTION OF SOLIDS IN AIR

Filed April 1, 1949

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

Fig. 4.

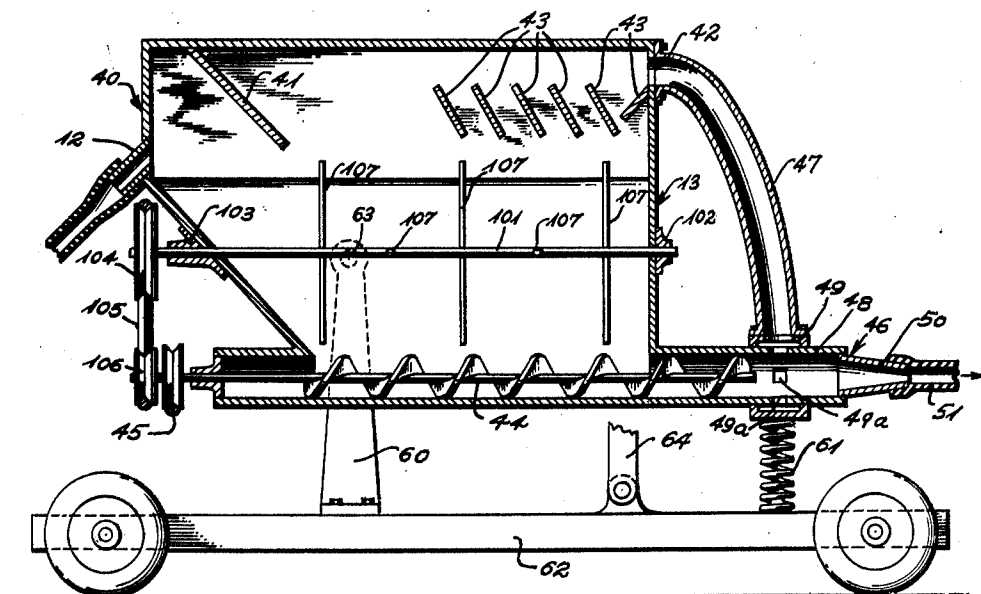
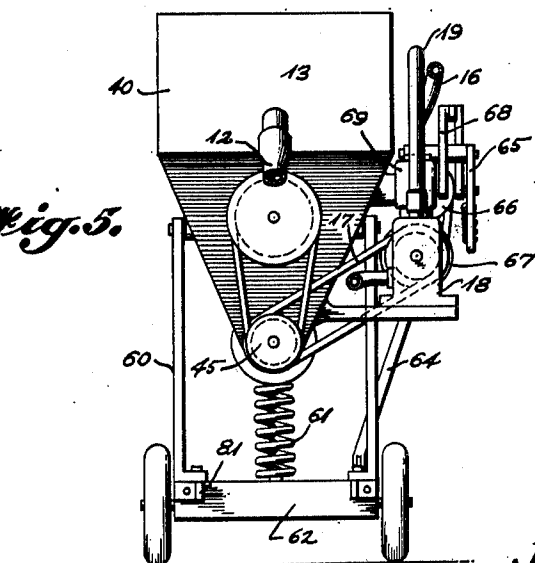


Fig. 5.



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UNITED STATES PATENT OFFICE

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DISTRIBUTION OF SOLIDS IN AIR

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This invention relates to a method and apparatus for applying plastic material, such as hydraulic cement or concrete or other similar material, to walls or other surfaces to be coated. More particularly this invention relates to improvements in what is commonly known as the "hydraulic projection" method of applying cement and concrete, and to certain improvements in apparatus to be used therein.

In the hydraulic projection method of applying cement, concrete or the like, the cement, sand and any other solid materials that are to be incorporated in the coating, are brought to the nozzle from which they are to be applied to the surface to be coated, there mixed with water and immediately projected forcibly against the surface to be covered. In United States Letters Patent 1,494,669, issued to John M. Crom May 20, 1924, there is shown and described one form of apparatus adapted to feed the dry materials into a hose, under air pressure, for transmission to the nozzle.

Although such devices as the one shown in the above-mentioned patent function, in general, satisfactorily, there are difficulties attendant their use which it is the object of the present invention to eliminate. One such difficulty is the tendency of the dry materials to enter and pass through the hose connecting the distributor and the nozzle, irregularly. Another is the tendency of the dry materials to segregate in the connecting hose and arrive at the nozzle in spurts or slugs even though they are well distributed at the entrance end of the hose.

Any unbalancing of the air pressure in the chambers of the original distributing mechanism will cause a slug in the line that extends to the applying nozzle. Thus, if the hose is kinked by handling the flow of air will be partially blocked and the air pressure in the chambers of the distributor will be increased. When the hose is unkinked a sudden flow of air will tend to eject a slug of solid material into the hose and there is no known practical means by which the seal around the entrance to the air hose can be made tight enough to prevent this excess air from carrying with it an excess of solid material in the form of a slug.

On other occasions although the solid material is evenly distributed in the air at the point at which it is originally distributed, it may tend to accumulate in slugs in the conveying hose.

Still another difficulty arises from the fact that the distributor operates independently of the supply of water to the nozzle. This means that the operator must at all times be on the alert to prop-

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erly adjust the water supply so that it will be exactly correct for the amount of dry material being furnished to the nozzle by the distributor. These and other difficulties are overcome by the use of the method and apparatus of this invention.

In accordance with the method and apparatus of this invention the dry materials are blown into the entrance end of the dry material hose in such a manner as to produce a relatively regular and smooth flow of dry materials therethrough. In addition, means are provided adjacent the nozzle and, if desired, at intermediate points, for redistributing the dry materials in the air stream so as to assure the smoothest possible flow of these dry materials to the nozzle. Still further the water supplied to the nozzle is arranged to be governed by the rate of flow of dry materials to the nozzle, thus assuring a correct mixture of water and dry materials at all times.

Still in addition, the new method and apparatus provides for the control of the motion of the nozzle in accordance with the amount of dry material and water fed to the nozzle. This eliminates great wastage of materials for by use of this feature a mechanically even coat of cement, concrete or other plastic may be applied to a surface whereas without the present method and apparatus it is necessary for an operator to judge by eye the thickness of the coating applied and this almost invariably results in the application of an uneven coating and the wasting of large quantities of material as well as time.

Automatic coating machinery such as is illustrated and described in United States Letters Patent 2,176,891 to John M. Crom, granted October 24, 1939, are already known. The principles of this invention are particularly applicable to such a device as the one illustrated in the mentioned patent but may also be applied to any other device of this general type, and the applicable portions of this invention may be applied to hand coating operations.

Further details and advantages of this invention will be apparent from a consideration of the following detailed description of one embodiment thereof and from the drawings which illustrate this embodiment.

In the drawings, Figure 1 is a side elevation of a preferred embodiment of the apparatus of this invention, including the distributor, the redistributor and controller and the applying nozzle. Figure 2 is a sectional view in side elevation of a part of the distributor. Figure 3 is a sectional view in plan of a part of the distributor. This

view is taken on lines 3—3 of Figure 2. Figure 4 is a side view partly in section of the redistributor and controller. In this view certain parts are omitted for the sake of clarity. Figure 5 is an end elevation view of the redistributor and controller.

As illustrated in Figure 1, cement, sand and any other solid material which it is desired to incorporate in the coating are injected into a compressed air stream by a distributor 10. This compressed air stream comes from an air compressor (not shown) through a line 11 and passes through the lower end of the distributor 10 into a hose 12 which conducts it along with the solid materials to the redistributor and controller 13. From the redistributor and controller 13 the compressed air with the solid materials redistributed in it passes through a hose 14 to the applying nozzle 15.

In practice, the air compressor and distributor are generally located at a considerable distance from the nozzle which, of course, is adjacent the point at which the cement is to be applied. The redistributor and controller will ordinarily be located close to the nozzle. Thus while the hose 12 between the distributor and the redistributor is relatively long, the hose between the redistributor and the applying nozzle will ordinarily be relatively short.

The redistributor will ordinarily be operated by compressed air furnished through a line 16 but can be operated by electricity or any other form of power. The water which is to be mixed with the dry materials in the nozzle will ordinarily be furnished through water hose 17 which will be connected to a metering pump or valve 18, from which it will flow through another hose 19 to the applying nozzle.

The distributor 10 is generally similar in construction to the distributor shown and described in Crom Patent 1,494,669, mentioned above, but has been modified from this design to provide for better distribution of the dry materials in the compressed air stream.

The distributor comprises two chambers, an upper chamber 20 and a lower chamber 21. Dry materials may be fed into the upper chamber through a hand operated valve and from there into the lower chamber through another hand operated valve 22. Only the lower part of the upper chamber has been shown but the upper part of this chamber is similar to the upper part of the lower chamber and the hand operated valve which permits dry material to be fed into this chamber is similar to the hand operated valve 22 which allows dry material to be fed from the upper chamber into the lower chamber. By placing dry material in the upper chamber with the valve 22 closed, thereafter closing the valve at the top of the upper chamber and opening the valve 22 at the bottom of the upper chamber, the material is passed down into the lower chamber without permitting the escape of any appreciable quantity of compressed air.

The bottom of the lower chamber is shaped to provide an annular compressed air chamber 23 extending around a centrally located bearing 24. Compressed air is supplied to this annular compressed air chamber 23 through the compressed air pipe 11.

Mounted in the centrally located bearing 24 is a short shaft 25, the upper end of which supports a distributing rotor 26 and the lower end of which extends into a gear box formed by the lower part of the lower chamber and a plate 27 bolted thereto. Within this chamber a gear 28 is affixed to

the short shaft 25 and the shaft 25 is driven through this gear by means of a worm gear 29 mounted on a shaft 30. The driving means for the shaft 30 are not shown but can be any conventional driving means such as an electric motor. The driving of the shaft 30 thus drives the distributing rotor 26 through the gears 29 and 28 and the short shaft 25.

The distributing rotor 26 is generally conical in shape with a lower edge extending down into a circular groove in the lower part of the lower chamber.

Along the lower edge of the distributing rotor there is formed a series of radially extending pockets which are open upwardly so that they can receive material from the lower chamber and open outwardly so that the material can be discharged radially therefrom at the appropriate time. The bottom of each of the pockets is closed by the bottom of the chamber and the chambers are prevented from discharging outwardly by the outer wall of the lower chamber except at one point where an outwardly directed opening 31 is provided. In this opening is mounted a hose connector 32 which connects to the hose that is to carry the compressed air stream and the solid materials entrained therein to the redistributor and controller. The inner side of each pocket is closed by a portion of a distributor rotor which extends downwardly to a point adjacent the lower floor of the lower chamber.

Each of the inner pocket walls thus provided includes an opening 33 through which air may pass at the appropriate time to blow the contents of the pocket into the connecting line 12. By fitting the inner surface of the distributing rotor closely to the outer surface of the compressed air ring 23 and providing only a single hole 34 in the compressed air ring 23 and placing that hole opposite the discharge opening 31, the pockets are caused to discharge their contents efficiently and completely into the connecting hose 12. To prevent the air which enters the pockets adjacent the discharge opening from blowing solid material upward into the lower chamber, a cover plate 35 is provided. This plate is fastened to the wall of the lower chamber and extends over and immediately above the pocket being discharged and several pockets immediately adjacent thereto.

In the distributor shown in United States Letters Patent 1,494,669 it was found difficult to obtain a smooth even flow of solid material from the distributor and it was also found difficult to obtain a complete discharge of the distributor pockets. These difficulties have been avoided by the present construction.

At the redistributor and controller the compressed air containing the desired solid materials is discharged into a baffled chamber 40 (Figure 4). The port through which the compressed air and suspended solids enter the chamber of the redistributor and controller is directed against baffle 41 which is mounted in the chamber in the path of this incoming air and solid material so that any large particles of solid material will impinge against this baffle and be dropped to the bottom of the chamber. The air and any fine materials still suspended in the air pass underneath the baffle and out through an opening 42 in the other end of the chamber. The approach to this outlet opening 42 is guarded by a series of additional baffles 43 so arranged as to remove additional particles of solid material

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from the compressed air stream. Naturally, dust and fine particles are not removed even by these baffles and hence continue with the air stream through the outlet opening.

The bottom of the chamber 40 is hopper-shaped and at the bottom of this hopper is mounted a screw conveyor 44 arranged to be driven through an extension of its central shaft on which there is mounted a pulley 45 outside the chamber. The screw conveyor 44 conveys at a uniform rate all solid materials knocked out of the air stream to the right as shown in Figure 4 into a mixing valve 46. This mixing valve is connected to the air outlet 42 of the chamber by a pipe 47. The mixing valve 46 consists of a shell 48 surrounded by an annular air space 49 into which the air from the air outlet of the chamber is conveyed. The solid materials are conveyed uniformly into the inside of the housing 48 and openings 49 in the housing permit the compressed air to enter and mix with the solid materials. The solid materials and air are then expelled through a nozzle 50 into a hose 51 that connects with the applying nozzle 15.

In order to prevent bridging in the chamber 40, a shaft 101 may be mounted for rotation in bearings 102 and 103 carried by the ends of the hopper. This shaft may be driven through a pulley 104 mounted on an extending end thereof and connected by an endless belt 105 to another pulley 106 on the central shaft of the conveyor screw 44. To the rotating rod 101 may be connected suitable cross rods or paddles 107, which will operate to break up any bridging of material in the chamber 40.

It is, of course, possible to drive the redistributor and controller independently of the distributor, independently of the supply of water to the nozzle and independently of the movement of the nozzle. However, it has been found desirable to govern the supply of water to the applying nozzle 15 in accordance with the speed of operation of the redistributor and controllers. It has also been found desirable to govern the speed of movement of the nozzle in accordance with the speed of operation of the redistributor and controller; and it has further been found desirable to govern the speed of operation of the redistributor and controller by the rate at which solid material is supplied to it by the distributor.

Of course, when the redistributor is modified and used as the original distributor, it will not be necessary to govern the speed of operation of the worm conveyor in accordance with the amount of solid material in the conveyor.

In order to govern the speed of operation of the redistributor and controller in accordance with the rate at which solid material is supplied to it, the chamber 40 of the redistributor and controller may be mounted pivotally on a pair of standards 60 and on a spring 61, the standards 60 and the spring 61 both being supported by a frame member 62. If the pivot point 63 is properly chosen, the added weight of solid material in the chamber 40 will tend to compress the spring 61 thus revolving the chamber slightly about the pivot point 63.

In order that the hose connections be prevented from interfering with the accurate operation of the tilting mechanism of the distributor, it has been found desirable to provide arms 80 and 81 extending from the front and rear ends, respectively, of the main frame 62 of the distributor, and to rigidly support the discharge

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and supply hoses, respectively, at the ends of these arms, at points some distance from the tilting part of the distributor. Enough slack may then be provided in each hose, between its supporting arm and the tilting part of the distributor, to avoid any possibility of binding.

This slight motion may be used to govern the speed of operation of the redistributor and controller by means of a lever arm 64 pivotally connected to the frame member 62 at its lower end and connected at its upper end by linkage 65 to a governor 66 (Figure 1). The governor 66 will then be connected to a power means 67, which is preferably a compressed air motor, so as to govern the speed of operation of this motor. In some instances the governor may be eliminated and the speed of operation of the air motor controlled by direct lever connections from the air valve to the frame.

As illustrated these connections consist of a linkage 68 connecting the governor 65 to an air valve 69 in the inlet to the air motor. The shaft of the air motor is then connected back to the governor through pulleys and belt 70 so that the governor can sense its speed.

The air motor through pulleys and belt 71 is connected to drive the screw conveyor 44 of the redistributor. Preferably, the air motor 67 is also connected to a metering pump 18 in the water supply line. As illustrated this is accomplished by a universal joint 72, the pump 18 being mounted on the frame of the redistributor, as is also the air motor and the governor.

With this arrangement the speed at which the redistributor and controller is operated will be governed by the speed at which solid material is supplied to it by the distributor and the amount of water supplied to the applying nozzle 15 will be controlled in accordance with the speed at which the redistributor and controller operates. Thus, as solid material accumulates in the chamber 40 of the redistributor, the spring 61 will be compressed and the governor 66 operated to speed up the compressed air motor 67. This will in turn speed up the screw conveyor 44 and a greater quantity of dry material and air will be supplied to the applying nozzle 15. At the same time the pump 18 will be speeded up, supplying a greater quantity of water. Thus the mixture will remain constant.

A further advantage may be achieved by mechanically operating the applying nozzle 15 and governing the speed of this operation by the speed at which the air motor 67 is operating. This can be done rather simply by driving the mechanism which operates the applying nozzle 15 from the air motor 67 or by arranging the driving mechanism for this nozzle so that it will be controlled as to speed by the governor 66.

In United States Letters Patent 2,176,891 to John M. Crom, a machine is shown in which the applying nozzle is mechanically operated. The principles of this invention may be expediently applied to such machines by mounting the redistributor and controller on the frame of such a machine and governing the speed of operation in accordance with the speed of operation of the redistributor and controller.

Numerous modifications and applications of the principles of this invention will immediately be apparent to those skilled in the art and such modifications and applications are contemplated as a part of this invention.

As will be apparent, when the air stream with its entrained solid materials is to be conveyed

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over a relatively long distance two or more redistributors may be positioned in the line of travel so that the solid material will be redistributed in the air stream before the slugs of solid material become too large to handle and for that reason plug up or stop up the tubular conveying member. Thus, with hose length up to 150 feet, the delivery of material can generally be quite large without encountering too much trouble by reason of slugs. Beyond this distance, however, the ratio of dry material to air must be materially reduced, with a consequent loss of rate of delivery, unless some means are provided to redistribute the material that has accumulated in slugs. By inserting in such lines, at whatever intervals it is necessary to do so, a redistributor or redistributors, of the type herein described, this difficulty may be eliminated and dry material delivered at any desired distance, still well distributed in the air stream.

Still further, instead of utilizing a distributor of the type illustrated in Figures 2 and 3, the redistributor of Figures 4 and 5 could be used as the original distributor by supplying air only to the inlet 12 of this redistributor and adding solid materials through an air lock such as is shown in Figure 2. The use of such a distributor in place of the distributor of Figures 2 and 3 is within the scope of this invention.

What is claimed is:

1. A device for conveying dry materials such as hydraulic cement or the like that comprises in combination a source of air under pressure, a distributor for distributing solid materials in said air, a tubular member for conducting said air and solid materials to a distant point, a chamber positioned at said point for receiving said solid materials from said tubular member, a conveyor at the bottom of said chamber for conveying separated solid material from the chamber, an outlet connection attached to said chamber for carrying air and fine solid material from said chamber, a mixing chamber connected to said outlet and to said conveyor for receiving air and fine material from said outlet and separated particles of solid material from said conveyor and mixing them.

2. A device for applying hydraulic cement or the like to surfaces that comprises in combination a source of air under pressure, a distributor for distributing solid materials in said air, a tubular member for conducting said air and solid material to a point adjacent the point of application of the coating, a chamber positioned adjacent the point of application of the coating for receiving said air and solid materials from the flexible tubular member, baffles in said chamber for removing the larger particles of solid material from the air stream, a conveyor at the bottom of said chamber for conveying separated solid material from the chamber, an outlet connection attached to said chamber for carrying air and fine solid material from said chamber, a mixing valve connected to said outlet and to said conveyor for receiving air and fine material from said outlet and larger particles of solid material from said conveyor and mixing them, a tubular member for receiving the mixed air and solid materials from the mixing valve, an applying nozzle connected to the tubular member to receive the mixed air and solid materials therefrom and means for supplying water to said nozzle also connected to said nozzle.

3. A device as defined in claim 11 further characterized in that means are provided for mov-

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ing the applying nozzle at a speed corresponding to the speed of the redistributing mechanism by providing control connections between the governor which governs the speed of the redistributing mechanism and whatever mechanism is used to move the applying nozzle.

4. In a distributor of the type in which solid materials are distributed in an air stream by rotating vanes forming pockets between them, the improvement that comprises an opening in the inner surface of each of the pockets formed between the vanes, a passage for supplying air through each of said openings to each of the said pockets at a predetermined position of rotation, and an outlet for air and solid material along the outer periphery of said pockets at a point opposite the point at which air is supplied to said pockets.

5. The improvement defined in claim 4 further characterized in that a cover plate is provided above said pockets adjacent the point at which air is supplied to said pockets and air and solid material permitted to flow out of said pockets.

6. A device for applying hydraulic cement or the like to surfaces that comprises a distributing means for distributing dry material in a fluid stream, an applying means remote from said distributing means, a conduit for conveying said distributed dry material and fluid stream to a point adjacent said applying means, a redistributing means located at said point adjacent said applying means for receiving said dry material and fluid material from said conduit and redistributing the dry material in the fluid stream, and a conduit for conveying the redistributed dry material and fluid stream to said applying means.

7. A device as defined in claim 6 wherein the redistributing means comprises a chamber through which the fluid stream is adapted to flow and in which the larger particles of dry material will drop to the bottom of the chamber, a conveyor at the bottom of said chamber for removing dry material, and means to remix the dry material with the fluid stream.

8. A device as defined in claim 6 wherein said redistributing means is mounted on a weighing mechanism and a control means is provided which is operated by said weighing mechanism to control the operation of said distributing means.

9. A device as defined in claim 6 wherein a metering pump for water to be supplied to said applying means is operated responsive to the operation of the redistributing means to correlate the supply of water and dry material to said applying means.

10. A device as defined in claim 8 wherein said control means correlates the movement of said applying means with the operation of said distributing means.

11. A device that comprises a weighing mechanism, a control means, and a redistributing mechanism adapted to receive a mixture of air and solid material from a distant point, redistribute the solid material in the air and supply the air with the redistributed solid material in it to an applying nozzle, said mechanism including a chamber through which the air is adapted to flow and in which it will drop the larger particles of solid material, a conveyor at the bottom of said chamber for removing the particles of solid material from the chamber and means to remix the particles of solid material with the air stream, said control means being operated by the weighing mechanism to control the speed of the conveyor of the redistributing mechanism in ac-

cordance with the changes in weight of the redistributing mechanism due to the accumulation of solid materials therein.

12. A device that comprises a redistributing mechanism adapted to receive a mixture of air and solid material from a distant point, redistribute the solid material in the air and supply the air with the redistributed solid material in it to an applying nozzle, said mechanism including a chamber through which the air is adapted to flow and in which it will drop the larger particles of solid material, a conveyor at the bottom of said chamber for removing the particles of solid material from the chamber and means to remix the particles of solid material with the air stream, a metering pump for water to be supplied to the applying nozzle and connections between said metering pump and the redistributing mechanism such that the speed of operation of the metering pump will be governed by the mechanism which also governs the speed of operation

of the redistributing device, thus controlling the amount of water supplied to the nozzle in accordance with the speed of operation of the redistributing mechanism.

JOHN M. CROM.

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