Aug. 15, 1950 B. P. NICHOLSON 2,518,811

CEMENT GUN

Filed Nov. 26, 1946 2 Sheets-Sheet 1

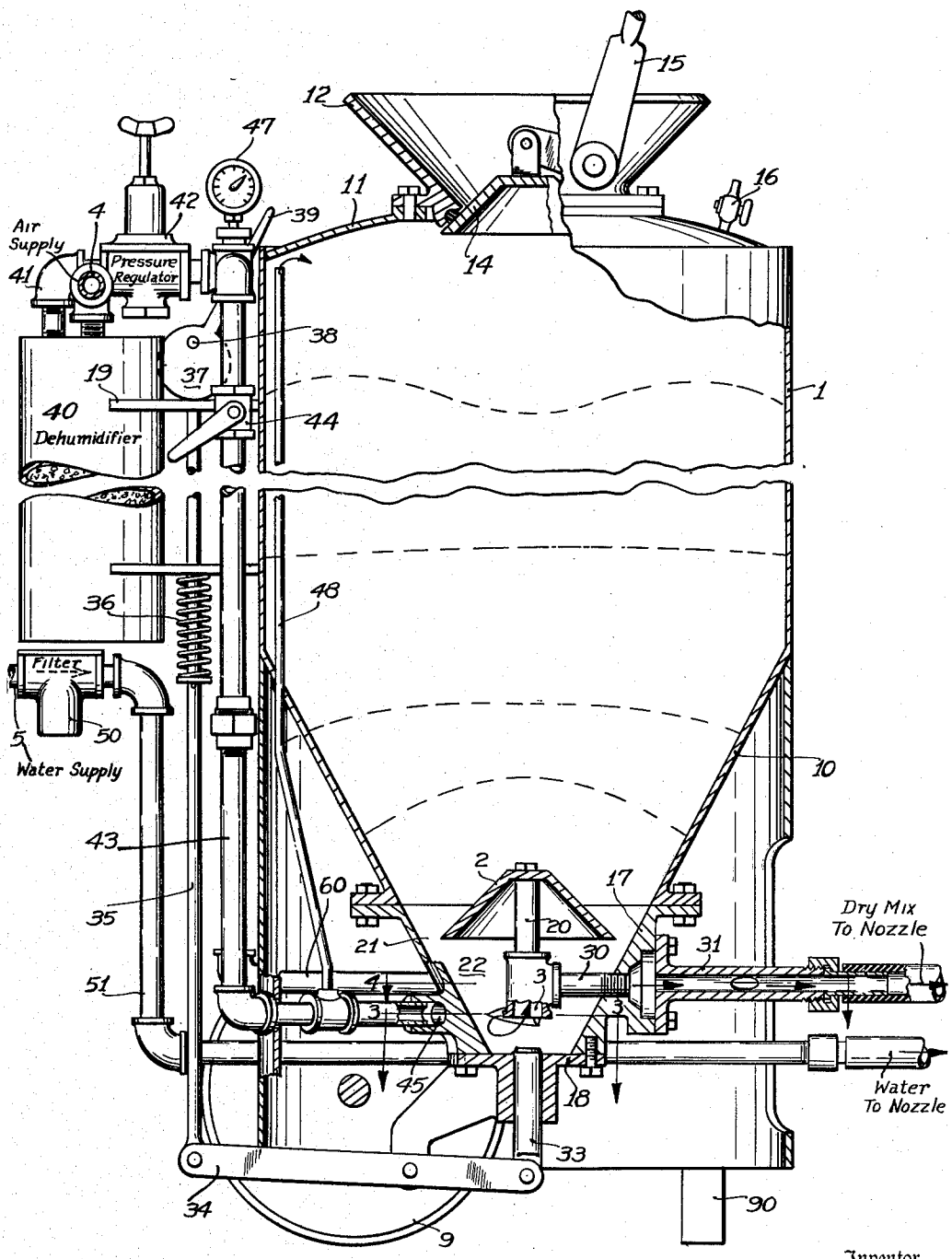


Fig. 1

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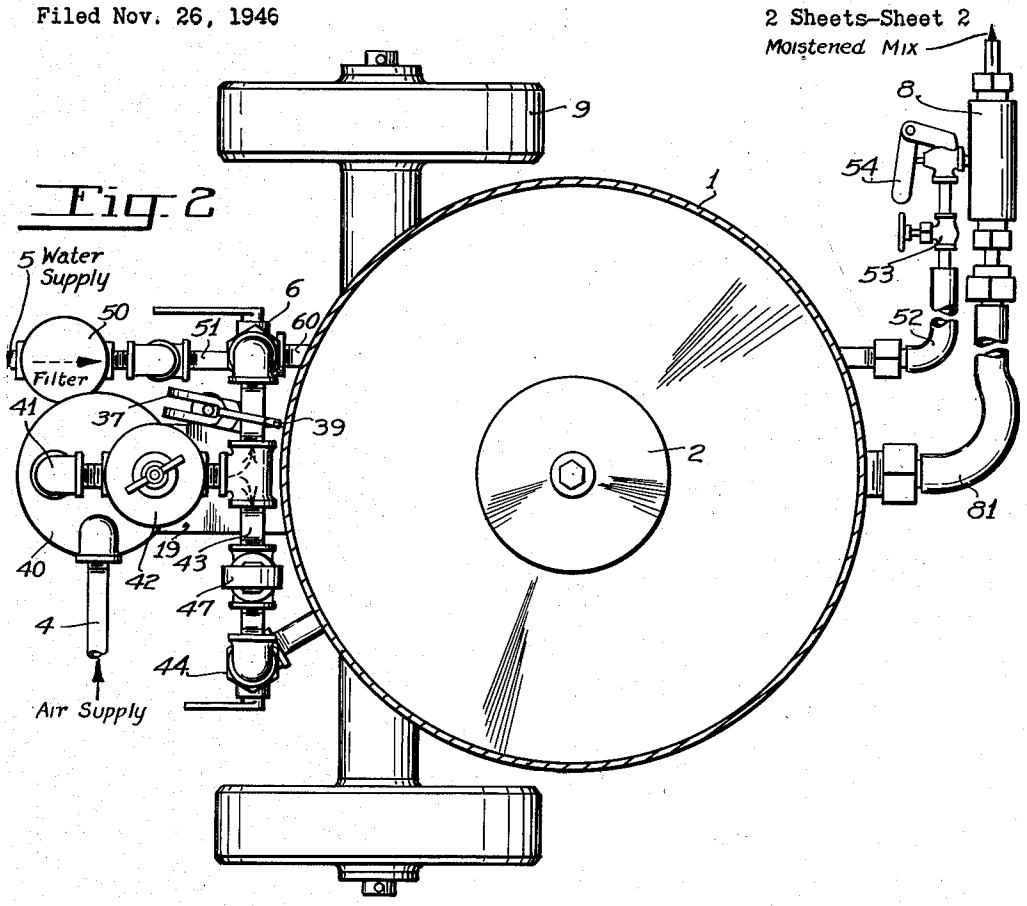
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Fig. 2



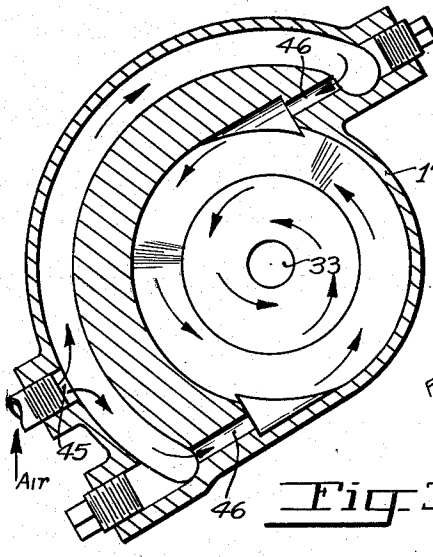


Fig. 3

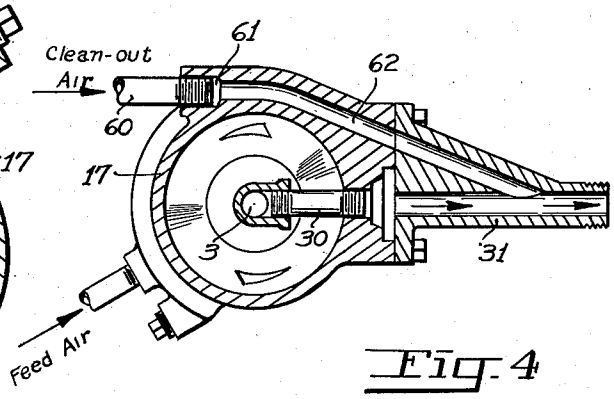


Fig. 4

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UNITED STATES PATENT OFFICE

2,518,811

CEMENT GUN

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5 Claims. (Cl. 302—53)

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This invention concerns the handling of cement mixtures, more particularly in operations such as cementing the joints of pipes, for instance, concrete sewer pipe, by forcing the cement mixture through a nozzle into the joint under pressure. Mechanism of this nature is frequently referred to as a cement gun.

The mixture employed is a homogeneous mixture of fine, dry sand and dust-like cement, in some preferred ratio. It must be delivered from a hopper, by way of a conduit to a nozzle at the distant end of the conduit, there to be immediately projected, hydrated, in small volume and at low pressure, into the joint between two concrete pipe sections. The delivery must be subject to substantially instantaneous cut-off and resumption, frequently. Wastage of material, from whatever cause, must be kept to the very minimum. It goes without saying that all the mixture delivered must be adequately and uniformly hydrated, yet normally the mixture delivered should be so dry that it gives off some dust, and when it sticks it becomes at once so hard that one's finger can not dent it. At the same time, provision must be made, in simple manner, for more greatly, and still uniformly, hydrating the mixture whenever a runny mixture is required, or even for delivering at the nozzle water alone, for pre-moistening joints to be cemented.

Mechanically, it is desirable to employ air, preferably at low pressure, as the vehicle for transporting the mixture through the conduit and out at the nozzle, yet to regulate the amount of mixture in the air stream, and the manner of application of the air stream to the mixture, particularly at the point of pick-up, in such manner that the density or rate of delivery is constant, there is no interruption of its advance through the conduit nor piling up at the nozzle, and the homogeneity of the mixture remains constant. It is also preferable that moving elements be eliminated to the highest degree possible, particularly at the hopper.

The attainment of the above ends constitute the principal objects of this invention. By achieving them other highly important objects are attained.

For example, unless the mixture moves through the conduit and out at the nozzle at a rate which is constant, with no fluctuations, pulsations, or surges, and unless the issuing mixture is homogeneous and constant in its ratio, it is impossible to hydrate it in the manner desired, and necessary, for cementing pipe joints. Such joints are

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of small volume, and a mass of inadequately hydrated or imperfectly mixed mixture forms a potentially leaky sand pocket. On the other hand, mixture which is overly hydrated will not stick, but runs out, not only wasting material but constituting a potential leak. Only a homogeneous mixture wet enough to stick when it hits, but dry enough to give off a little dust, and to harden at once sufficiently that one's finger can not dent it, will ordinarily fulfill the requirements in this field of use. The amount of water is so critical, in ratio to the cement mixture, that the delivery rate of the latter must be constant in order that the water delivery rate at the nozzle can be adjusted precisely to correspond.

Since the volume required in a pipe joint is small, low-volume delivery is necessary, for otherwise the material will be wasted, and improperly directed and placed. Low pressure delivery is required for similar reasons, and to avoid splash-back in the face of the nozzle man, such as is not only injurious to him but prevents him from seeing what he is doing. Low pressure delivery also reduces the cost and weight of the required compressor.

Prompt and intermittent cut-off and resumption of delivery also lessens waste, for the nozzle man is working in a restricted space, and must frequently change his position or the direction of his delivery. During all such times he should cut off delivery, but unless he can cut off whenever desired, and resume at once, he must continue the delivery, either averting and wasting it, or building up unwanted thickness about the joint. At the same time, during cut-off no mixture should remain in the conduit, where it might settle and be hard to pick up again, and where it might create an obstruction and uneven feed, or even gradually set up and harden. The cut off, then, must be so related to the delivery as to attain these ends.

It is desirable to avoid the complications which arise from the use of moving parts, especially rotary parts, at the hopper, for it is difficult to maintain their bearings, and the mixture sticks thereto unless it is bone-dry, hence the device must be frequently shut down for cleaning. They tend also to create pulsations in delivery rate.

Such a machine must be kept dry at all times, notwithstanding the probability that it will usually be operating under conditions of very appreciable humidity. Likewise, it must be possible to clean out such a machine simply, easily, and thoroughly when the day's work is done,

so that it will not be obstructed when work is resumed by caked cement in the passages through which the mixture must pass. The attainment of these ends are among further objects of the present invention.

Such a machine though it should have the capacity to contain sufficient material for operation over an appreciable period, must be small, compact, and portable, or at least mobile, for it must be moved frequently, from one joint to the next, along the length of the pipe line, and it goes without saying that it must be rugged and dependable in operation. These are among further objects of the invention.

In the particular machine which incorporates the present invention an air stream is caused to move through a space within a hopper or through a cavity in the bottom of the supply of cement mixture in such a hopper, for the purpose of picking up or segregating from the localized supply and advancing, the desired quantity towards the nozzle. Since portions of the mixture are thus segregated from the localized supply, to be lifted by the air stream, and thus are carried through an outlet which is above the level of the localized supply, and the rate of supply of the mixture will tend to vary if the air stream moves in a changed relationship to the localized supply, or must lift the segregated portions by varying distances above the surface of the localized supply, it is an object of the invention to maintain without material variation the level of the localized supply relative to the outlet and to the air inlet or inlets, and in particular to supply decrements from the localized supply by addition of like amounts from the main supply, yet without oversupply to the localized supply.

With these and other objects in mind, and especially such as pertain to the mechanical arrangement, as will appear more particularly hereafter, the present invention comprises the novel method, as shown in the accompanying drawings in an illustrative form, and as will be hereinafter more particularly pointed out and defined.

Figure 1 is a general vertical sectional view through the apparatus, and Figure 2 is a plan view of the same, with the hopper shown in section.

Figures 3 and 4 are horizontal sectional views on the respective lines indicated at 3—3 and 4—4 of Figure 1.

The dry cement mixture, consisting of cement and fine sand, is contained within a hopper 1, having the usual sloping or conical bottom 10. The hopper should be large enough to furnish a small but continuous supply over an appreciable period. Its top 11 has a filler opening, to which leads a chute 12, and during operation this is closed by a closure plate 14, operable by the handle 15. The closure plate 14 is preferably conical in shape, serving to distribute the materials entering by the chute 12 toward the outside walls of the hopper. Suitable sealing means may be employed, if required, so that the interior of the hopper may be maintained under pressure. A pressure relief valve 16 prevents over-pressurization.

The bottom of the hopper is closed by a conical collar 17, which preferably is removable for cleaning, and by a removable cap plate 18. The entire hopper is mounted upon wheels 9, and may be supported additionally by a leg 90. Thus it may be transported from place to place, at least

over short distances, and may be supported in an upright position in each new location.

Adjacent but spaced above the bottom of the hopper are means to support the main supply of material within the hopper, and to induce the formation of a cavity in the bottom of the hopper. For instance, a spreader 2 is provided, supported upon a post 20 centrally of and raised above the bottom portion of the hopper. Preferably the hopper is of circular cross section, at least in its coned bottom portion, and the spreader 2 is similarly circular and oppositely coned, to support the central mass and to afford restricted communication through the gap 21, from the main supply into the cavity 22 beneath the spreader.

From this cavity leads the outlet 3, and it is particularly to be noted that this outlet is upwardly directed within and above the bottom 10 of the hopper, and thence leads outwardly at 30 to an exterior connection at 31. From this point to the nozzle 8 the mixture is transported by any suitable means, such as the flexible hose 81. Such nozzles are known, and while the particular form of the nozzle and the hose are not in themselves part of the present invention, the manner in which uniformity of hydration at the nozzle is achieved by the general combination is considered to be part of the invention.

In order to terminate or to initiate the passage of the cement mixture from the hopper to the nozzle I provide preferably a cut-off valve, in the nature of a plug 33, which is guided in the cap 18 for upward movement, but which is normally held open, against spring tension tending to close it. Any suitable mechanism to these ends may be employed, and the connection shown includes a lever 34, a link 35, a spring 36 tending to close the valve 33, and a cam 37 pivoted to the rod 35 at 38, and riding upon a shelf 19. When the cam 37 is thrown to the left, as viewed in Figure 1, by the handle 39, the spring 36 will effect immediate closure of the valve 33, whereas in the position shown the valve is held open. The cut-off occurs at the hopper outlet, within the hopper, not in the hose line nor at the nozzle, hence there is no accumulation in the latter of mixture which will disturb subsequent uniformity of delivery.

Air under low pressure, perhaps 35 pounds per square inch, is used as a vehicle to pick up the dry cement mixture within the cavity 22, and to lift and deliver it through the outlet 3 towards the nozzle 8. Air is supplied under pressure at 4, and since the air must be dry, in order that it will not tend to moisten the dry mixture within the hopper, it is preferably passed immediately through a dehumidifier 40, whence it issues at 41. It passes thence through a pressure regulator 42, and the air is supplied to the hopper by way of a branch 43, and past a cut-off valve 44, to a connection at 45, externally of the collar 17. A branch 48, within the hopper, supplies the same pressure to the hopper above the main supply of mixture therein.

The collar 17 is formed with passages leading from its inlet 45 to the interior at the tangentially directed ports 46. These are located within the cavity 22, that is, below the spreader 2, yet somewhat above the level of the cavity's bottom, or of material segregated therein, and in the vicinity of the outlet 3. Air under pressure, entering past the valve 44, as controlled by the pressure regulator 42 and as indicated by the gauge 47, enters the cavity tangentially at

points angularly spaced, whirls thereabout, and since the localized supply of dry mixture within the cavity is limited in quantity, it picks up a portion of this mixture and carries it by way of the centrally disposed and upwardly directed outlet 3, which is the only outlet from the cavity, and thence by way of the passage 31, and the hose 81, to the nozzle 8. The portion so delivered is simultaneously replaced by material entering the cavity 22 from above through the restricted opening 21, assisted by air pressure above the main supply, hence the operation is continuous so long as any mixture remains in the hopper. The instantaneous amount of material in the cavity 22 remains quite constant, decrements being immediately replaced from the main supply above.

It is necessary, of course, that water be supplied in order to hydrate the dry mixture, which is delivered at the nozzle. While the manner of supplying this water might be any suitable arrangement, still the arrangement shown is particularly advantageous in conjunction with the present mechanism. Water from a convenient source is supplied at 5, and preferably is filtered at 50, in order to remove any sediment that might tend to block the very small needle apertures by which it is discharged at the nozzle. It passes thence, by the conduit 51 and hose 52, directly to the nozzle. A regulating valve 53 should be employed here, for here the amount of water supplied, in ratio to the rather constant rate of delivery of mixture, is controlled. A normally closed manual-pressure-released valve 54 controls its discharge at the nozzle, to mix with the emerging dry mixture, or its cut-off when delivery of mixture is cut off. It is important that a minimum quantity of water be supplied, just sufficient for chemical admixture with the cement, and in fact best results are obtained if the mixture, when it emerges, is dry enough that some cement dust is given off. It is also desired to point out that the arrangement affords very fine control of the ratio of cement mixture to the water, for the uniformity and continuity of the supply of mixture matches the uniformity of the continuous water supply, and the valve at 53 need only regulate the ratio, rather than to attempt there or at the valve 54 to attempt to match water supply to fluctuations in quantity of mixture supplied. In some operations it may be necessary to supply, for part of the job, a drier or a wetter mix than for other parts of the same job, and this is done simply by closing or opening the valve 53 more or less, knowing that the quantity of mixture supplied will remain constant at all times.

In order that the interior of the device may be maintained dry at all times, it may be cleaned by a blast of dry air. The air supply line beyond the pressure regulator 42 is branched, and a branch 60 carries air past a control valve 6 to a connection at 61 to the collar 17. There, by a bypass 62, clean-out air enters the connection at 31 just beyond the outlet 3. By admitting air past the valve 6 the entire hose line may be cleaned out. By closing off the outlet at 3 and opening the closure plate 14 the hopper itself may be cleaned.

After the day's work is done it is customary to discharge any remaining cement mixture from the hopper, to seal the same so that humid air may not enter and condensation collect, and to blow out the hose line and the nozzle by means of air entering through the by-pass 60.

It is desired to point out that the maintenance of a cavity at 22 is of great importance to the successful operation of this device, and for the carrying out of the process involved. Within this cavity is segregated a small localized supply of the mixture, in such form and so loosened from the main mass that it may readily be picked up by the air current entering tangentially at 46, and be carried thereby in uniform supply to the nozzle. As the material is thus carried out by the air current, new material continuously enters through the restricted gap at 21, to take its place. The operation is continuous so long as any mixture remains in the hopper, and, because the operation can be closely controlled to deliver small, uniform amounts, correctly hydrated, operation can continue over very appreciable periods, without wastage, before the hopper must be recharged. Moreover, the nature of the arrangement is such that the material which enters the hopper, though it may pile up around the outside walls initially, will not continue to cavitate through its axial core, but by reason of the peripheral arrangement of the gap at 21, and the conical nature of the spreader at 2, such cavitation is prevented, and thereby there is maintained, when the supply gets low, a substantially uniform thickness of material to prevent any blowing out of pressure from the cavity.

I claim as my invention:

1. In mechanism for continuously supplying a pulverulent mixture in a dry state and in regulated quantities through an outlet connected to a nozzle; a closed cylindrical hopper having a substantially cone-shaped bottom, an inverted conical spreader coaxially disposed in said hopper in vertically spaced relation to the lower extremity of said bottom, said spreader serving to support the central mass of material in said hopper and dividing said hopper into an upper main supply chamber and a lower feeding chamber, the outer edge of said spreader being inwardly spaced from the adjacent converging walls of said bottom to form a restricted annular throat, establishing limited communication between said chambers, a source of compressed air, a plurality of annularly spaced tangentially directed air inlets in the converging walls of said feeding chamber below said spreader, to deliver compressed air to said feeding chamber, a mixture outlet passageway leading from said feeding chamber below said spreader and adapted for connection to a remote nozzle, and valve means within said feeding chamber, for controlling the discharge of mixture at said feeding chamber outlet.

2. In a mechanism for continuously supplying a pulverulent cement mixture in a dry state and in regulated quanties through an outlet connected to a nozzle; a closed hopper having a substantially cone-shaped bottom, said hopper being divided into an upper main supply chamber and a lower feeding chamber, by an inverted cone centrally disposed at a point above the lower extremity of said bottom, the outer edges of said cone being arranged in spaced relation to the adjacent converging walls of said bottom to form a restricted annular passageway placing the two chambers in communication, a tangential inlet to deliver air under pressure to said feeding chamber, a mixture outlet conduit extending radially through the wall of said feeding chamber and terminating at its inner end, substantially centrally within the latter, in a downwardly directed mouth,

spaced above the lower extremity of said feeding chamber, said outlet conduit being adapted for connection to a nozzle, and valve means for closing said mouth.

3. In mechanism for continuously supplying a pulverulent mixture in a dry state and in regulated quantities through an outlet connected to a nozzle; a closed cylindrical hopper having a substantially cone-shaped bottom, an inverted conical spreader coaxially disposed in said hopper in vertically spaced relation to the lower extremity of said bottom, said spreader serving to support the central mass of material in said hopper and dividing said hopper into an upper main supply chamber and a lower feeding chamber, the outer edge of said spreader being inwardly spaced from the adjacent converging walls of said bottom to form a restricted annular throat, establishing limited communication between said chambers, a source of compressed air, a plurality of annularly spaced tangentially directed air inlets in the converging walls of said feeding chamber below said spreader, to deliver compressed air to said feeding chamber, a mixture outlet passageway extending radially through the converging walls of said feeding chamber below said spreader and adapted for connection to a remote nozzle, said outlet passageway terminating at its inner end, substantially within the central portion of said feeding chamber in a horizontally disposed mouth arranged at substantially right angles to the axis of said passageway and a vertically reciprocable valve within said feeding chamber for cooperation with said mouth to control the discharge of mixture therethrough.

4. In mechanism for continuously supplying a pulverulent mixture in a dry state and in regulated quantities through an outlet connected to a nozzle; a closed cylindrical hopper having a substantially cone-shaped bottom, an inverted conical spreader coaxially disposed in said hopper in vertically spaced relation to the lower extremity of said bottom, said spreader serving to support the central mass of material in said hopper and dividing said hopper into an upper main supply chamber and a lower feeding chamber, the outer edge of said spreader being inwardly spaced from the adjacent converging walls of said bottom to form a restricted annular throat, establishing limited communication between said chambers, a source of compressed air, a plurality of annularly spaced tangentially directed air inlets in the converging walls of said feeding chamber below said spreader, to deliver compressed air to said feeding chamber, pressure equalizing means to deliver air from said source to the upper portion of said main supply chamber, a mixture outlet passageway leading from said feeding chamber below said spreader and adapted for connection to a remote nozzle, valve means for controlling the admission of air to said feeding chamber and pressure equalizing means and valve means within said feeding chamber for controlling the discharge of mixture at said feeding chamber outlet.

5. Portable apparatus for continuously supplying a pulverulent cement mixture in a dry state and in regulated quantities through an outlet connected to a remote nozzle, comprising a vertically disposed cylindrical body terminating at its lower end in a depending annular apron, a transverse axle supported by said apron, wheels on said axle, a hopper in the upper portion of said body having a substantially cone-shaped bottom lying within the confines of said apron, an inverted conical spreader coaxially disposed in said hopper in vertically spaced relation to the lower extremity of said bottom, said spreader serving to support the central mass of the main supply of material in said hopper, and dividing said hopper into an upper main supply chamber and a lower feeding chamber, the outer edge of said spreader being inwardly spaced from the adjacent converging walls of said bottom, to form a restricted annular throat, establishing limited communication between said chambers, a source of compressed air, a plurality of annularly spaced tangentially directed air inlets in the converging walls of said feeding chamber below said spreader, an air conduit connecting said source of compressed air with said tangential inlets, said air conduit being located in relatively close proximity to the outer wall of said body and having valve means for controlling the passage of air therethrough, a mixture outlet passageway extending radially through the converging wall of the feeding chamber below said spreader, and adapted for connection to a remote nozzle, valve means within said feeding chamber for controlling the discharge of mixture at said feeding chamber outlet and control means for said last named valve located externally of said body in relatively close proximity to said air control valve.

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