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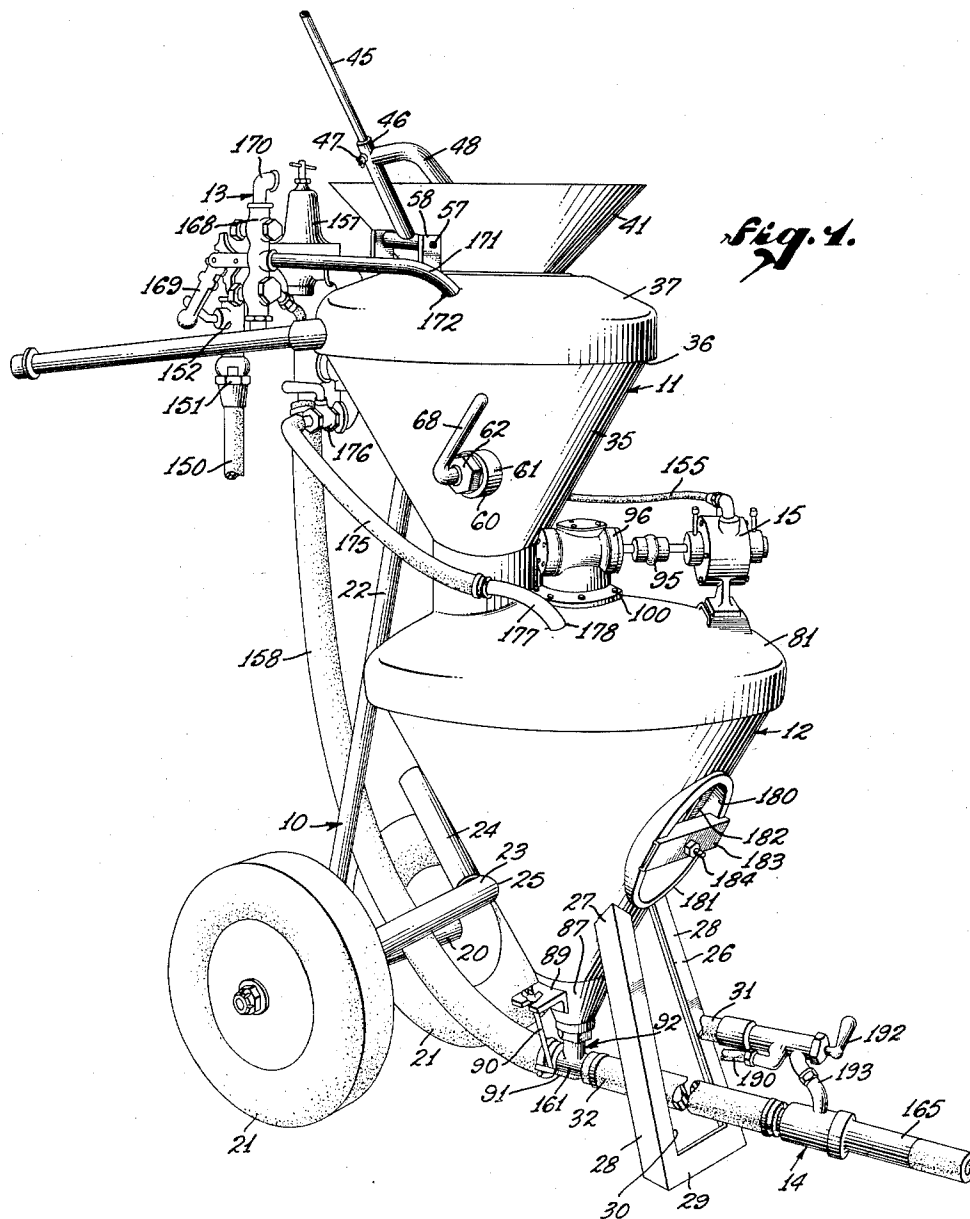
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2,594,072

HOPPER WITH BOTTOM DISCHARGE OPENING, AND MEANS
FOR METERING THE PASSAGE OF GRANULAR MATERIAL
THROUGH SAID OPENING INTO A DELIVERY CONDUIT

Filed March 29, 1949

4 Sheets-Sheet 1



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Fig. 3.

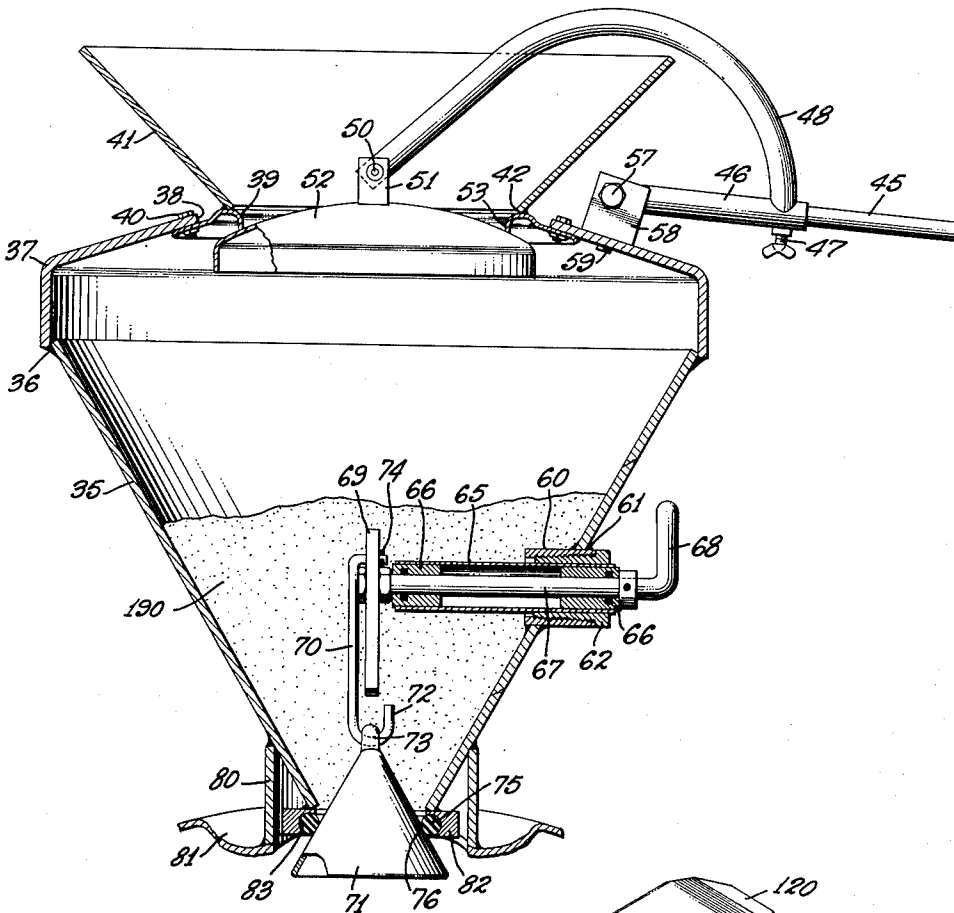
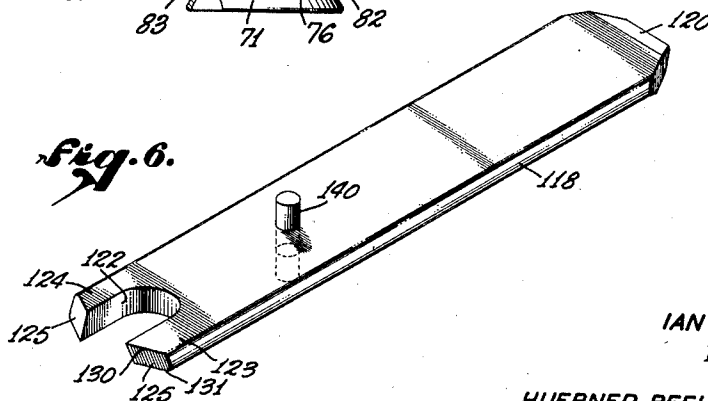


Fig. 6.



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Fig. 4.

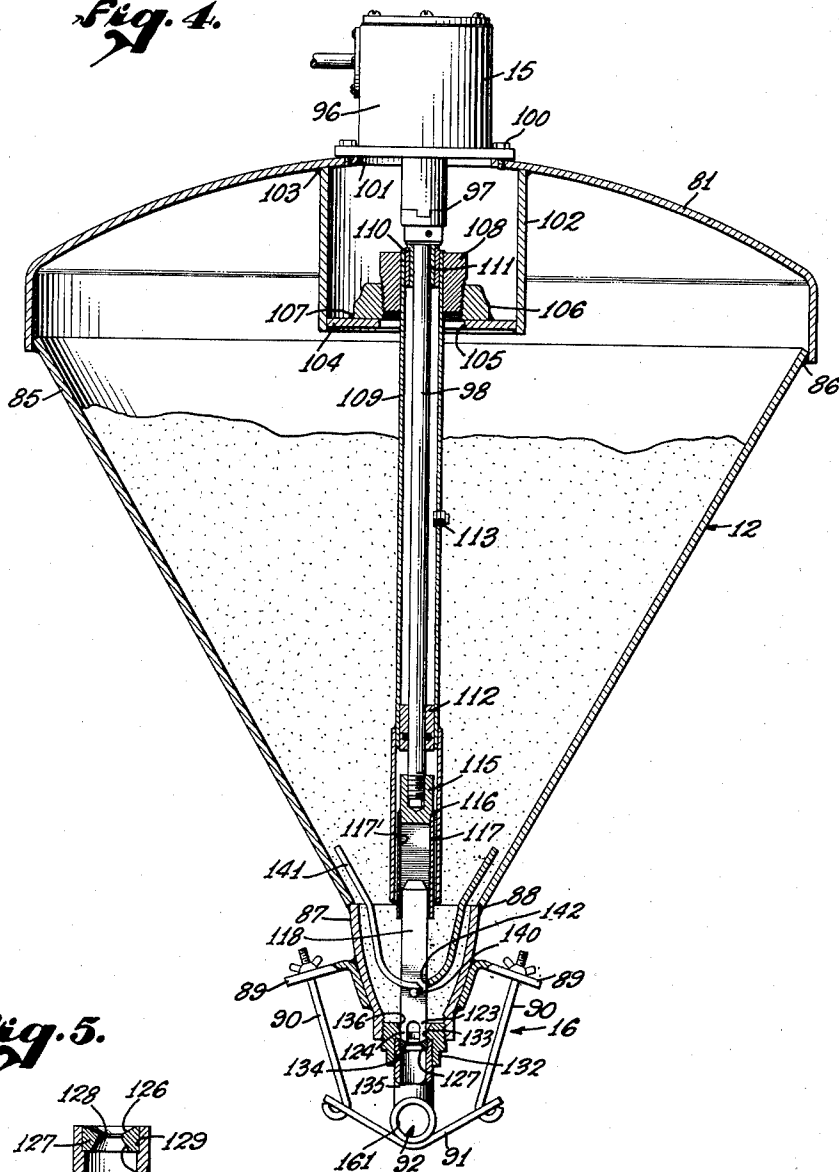
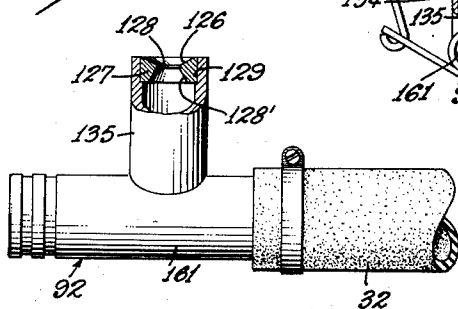


Fig. 5.



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UNITED STATES PATENT OFFICE

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HOPPER WITH BOTTOM DISCHARGE
OPENING AND MEANS FOR METERING
THE PASSAGE OF GRANULAR MATERIAL
THROUGH SAID OPENING INTO
A DELIVERY CONDUIT

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7 Claims. (Cl. 222-241)

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It is among the objects of this invention to provide in an apparatus of the described character an improved body and hopper arrangement.

Another object of the invention is the provision of an improved metering means.

Another object of the invention is the provision of a new and improved direct motor and drive arrangement with respect to the hopper structure, heretofore a source of manufacturing and operating inefficiency.

Another further object of the invention is the provision of a new and improved cement gun apparatus, the working parts of which are susceptible of ready disassembly for replaceability of parts or for repair.

Yet another object of the invention is the provision of a new and improved apparatus having improved accessibility and which is easy to manipulate and to transport from place to place, practical and trouble-free in operation, and commercially reproducible at relatively low cost.

Other objects of the invention include provision of a new and improved valve control construction and manipulative means therefor, improved quick release suspension for the metering apparatus and hose, and specific improvements over prior art devices intended to accomplish generally similar purposes.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of a cement gun apparatus made in accordance with this invention.

Figure 2 is a side elevational view thereof partially in section, other parts being cut away.

Figure 3 is a detailed sectional elevational view of an upper hopper and associated portions of the apparatus as on a line 3-3 of Figure 2.

Figure 4 is a detailed sectional elevational view of a lower hopper and associated portions of the apparatus taken as on a line 4-4 of Figure 2.

Figure 5 is a detailed enlarged elevational view of a portion of the metering orifice and discharge T, parts being cut away.

Figure 6 is a detailed perspective view of a metering blade.

Referring more particularly to the drawings, the apparatus generally designated by way of illustration, and not of limitation, in Figures 1

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and 2, comprises a frame 10, upper and lower feed hoppers 11 and 12, respectively, a valve assembly generally designated at 13, and a nozzle assembly generally designated at 14. A metering means may include a motor 15 and other parts to be described extending through and located at the bottom of the lowermost hopper where they are generally designated by the numeral 16.

The frame 10 may comprise an axle 20 supported as upon wheels 21 and carrying uprights 22, laterals 23 and cradle members 24, to which the remaining equipment may be secured as by welding at any convenient points 25. A yoke-type support 26 formed of angle iron or the like may be welded as at 27 to the lowermost hopper and may extend forwardly with its two legs 28 terminating in a cross-piece 29, thereby defining a loop 30 in which blast hoses as 31 and 32 leading to the nozzle assembly 14 of the machine may be carried.

The upper hopper 11 may comprise a funnel-shaped body 35 welded as at 36 to a bell-shaped top 37, the latter being formed with an opening 38 having a seat 39 formed therein and secured thereto as by a bolt 40. A funnel 41 may be welded along its bottom edge 42 as to the seat 39.

An extensible handle 45 may be slidably held within a sleeve 46 and secured in any desired position of extension therein as by a set screw 47. An arm 48 may be rigidly supported or welded upon the sleeve 46 and pivotally connected as at 50 to a lug 51 supporting a bell valve 52 designed to elevate or lower the same to seat it against the lip 53 closing or opening the inlet formed thereby. The sleeve 46 may be pivoted on a bolt 57 by means of a lug 58 secured to the hopper as by rivets 59.

An internally threaded sleeve 60 welded as at 61 to the hopper 11 may hold a male coupling member 62 preferably rigidly secured to a barrel 65 holding bearings 66 providing pivotal support for the shank 67 of a handle 68, keyed to an L-shaped link 69 pivotally supporting a link 70 by means of which a bell valve 71 may be manually controlled. A bent end 72 loosely held in a lug 73 facilitates removal of the valve 71 when a key 74 is also removed to free the link 70.

In its uppermost position the bell valve 71 seats against the preferably resilient ring 75 providing an opening 76 between the upper hopper 11 and the lower hopper 12. Said upper hopper is supported upon the lower hopper at one side thereof in vertical offset relationship as by a reinforcing

sleeve 80 welded to the top 81 of the lowermost hopper and to the bottom side portion of the upper hopper 11. The latter is likewise welded for reinforcement to a plate 82 which, in turn, is designed to carry the annular seat 75 in a recess 83 provided in the plate for such purpose.

The lower hopper 12 may likewise comprise a bell-shaped top 81 and a funnel-shaped body portion 85 welded together therearound in overlapping relationship in a similar manner to the upper hopper 11 as a line 86.

A cup-shaped lower end 87 is welded at 88 to the bottom edge of the body 85. Brackets 89 supporting tie bolts 90 releasably retain a yoke 91 in position against a T 92 comprising a portion of the metering mechanism hereinafter described.

At the top of the lowermost hopper 12, the motor 15 may be connected as by a coupling 93 with a gear box 96 secured as by a tongue and groove or spline connection 97 to a vertical shaft 98, both the gear box and said shaft 98 being preferably centrally disposed along the vertical axis of the lowermost hopper. Any bolts 100 may be employed to secure the motor and gear box, respectively, to the top 81 of the lowermost hopper which may be formed with a hole 101 to afford access to a box or cylinder 102 welded at its top edge 103 to the underside of the top 81, said box having a bottom 104 forming a central opening 105. A flange 106 may be welded as at 107 to said bottom and threadably receives a plug 108 carrying a sleeve 109 and a spacing ring 110 and bearing 111 in which the shaft 98 is rotatable.

At the lower end of the sleeve 109, any suitable bearing 112 may be provided. A radial port threaded for a plug 113 provides means for keeping the sleeve 109 loaded with a lubricant.

A plug 115 may be threadably secured to the lower end of the shaft 98 and welded as at 116 to a coupling 117 formed with an open lower end or slot 117' designed for the slidable vertical reception of a metering blade 118 adapted upon rotation of the shaft 98 to be rotated by means of said coupling.

The metering blade 118 may be chamfered at its upper end 120, as most clearly shown in Figure 6, to facilitate its insertion in the slot 117'. At its lower end, the same may be formed with a slot 122 defining legs 123 and 124 whose beveled ends 125 are designed to conform to the tapered surface 126 of hardened seat 127 formed around a metering orifice 128 and pressed, or otherwise firmly secured, in a recess 129 formed as in the discharge T 92. The ends 125 may form a flush sliding fit with the seat surface 126 but preferably are constructed for rotation in one direction, as clockwise, for which purpose a leading edge 130 may make line contact with the seat 127 while the edges 125 are relieved from said leading edge 130 to the opposite trailing edge 131 to facilitate rotation and prevent lifting and relative overriding of the blade 118 upon the granules of a mass metered through the orifice 128.

Threadably secured into the lower end of the cup-shaped member 87 is a plug 132 having a bore 133 and counterbored at 134 for the reception, whether by press fit, threadably, or optionally slidably, of the upturned leg 135 of the T 92, whereby the seat 127 is firmly held. The bore 133 is preferably countersunk or tapered at its upper end 136.

A pin 140 is press fit in the blade 118 and extends laterally upon either side thereof for the support of a U-shaped agitator 141 which is slot-

ted at 142 for slidable, non-rotatable securement upon the blade 118.

A hose section 150 is connected with a source of compressed air, not shown, and is secured as by a coupling 151 to a valve 152 which controls the air supply to the apparatus. The compressed air is tapped as at a T 153 by means of a valve 154 and hose 155 to operate, with unreduced pressure, the air motor 15.

By means of a pipe 156, some of the air is conducted through a pressure-regulating valve 157 from which it is conducted by a preferably flexible hose 158 via valve 160 through the run 161 of the T 92 whence it is carried by the delivery hose 32 to the discharge nozzle 165 for use in any desired manner.

A hose 166 conducts the compressed air as from another T 167 to a double-acting valve 168 controlled as by a handle 169 whereby the air may be released to the atmosphere through an elbow 170 or through a pipe 171 welded at 172 to the upper hopper 11 for discharge into the interior of said hopper. Another hose 175 may conduct air from the T 167 through a valve 176 to a pipe 177 similarly welded into the hopper at 178 for discharge into the interior of said lowermost hopper.

Both hoppers 11 and 12 are air-tight in construction. The lowermost 12 may be formed with an access hole 180 provided as with a collar 181 and fitted with a cover 182 normally held tightly closed by an arm and bolt assembly 183, 184.

In the operation of the above-described apparatus, a preferably dry feed of sand and/or cement in suitable proportions, usually pre-mixed if combined, is introduced into the upper hopper through the opening at 39, air from the pipe 171 having been previously shut off and the bell valve 52 lowered by means of the handle 45. Said mix, as indicated at 190, falls to the bottom of the hopper 11. Because of the normal closure of the bell valve 71 assured by continued air pressure in the lower hopper supplied by the pipe 177, said material does not drop into the lower hopper 12 until, upon manual closure of the valve 52 and equalization of pressure within the hoppers 11 and 12 occasioned by opening of the valve 168, air under equal pressure then enters the upper hopper through pipe 171. Due to such equalization of pressure in the two hoppers, the weight of the valve 71 plus the weight of the material 190 forces said valve 71 open, permitting the material to drop into the lower hopper 12 without interrupting the continued operation of the apparatus.

Thus, the apparatus may be continuously supplied with granular material by intermittent opening and closing of the valve 71 due to differentials in air pressure by relieving the pressure within the upper hopper 11 through the atmospheric exhaust 170 and opening of the inlet valve 52 which manually or optionally automatically, may occasion the closing of the valve 71, maintaining a desired air pressure within the lower hopper 12.

Said material, upon dropping within the lower hopper, is conducted, together with the entrapped air, under pressure, to the metering cup 87, thence to the metering orifice at 136, 133', 128 and 128', to the discharge T 92, where it is picked up and forcibly ejected through discharge nozzle 165 by compressed air from the hose 158.

During operation the motor 15 continually turns the shaft 98 as through the gear box 96 and hence continually rotates the metering blade 118 which, by its unique construction, effectively

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meters the granular material through the orifice 128 in a well-mixed continuous stream of constant volume. It may be noted that the blade 118, as well as the agitator 141 rotating therewith, are both floatingly mounted so that the blade 118 rests upon the seat 127 due to gravitational forces only and rotates freely and slidably within the port 133. It is free, however, to slide upwardly and downwardly within the slot 117 in the coupling 117. Similarly, the agitator 141 rests only gravitationally upon the pin 140 and is free to move slightly sidewise or slidably up or down during its rotation to obtain an effective mixing action.

The ideal depth of the slot 122 from the ends thereof as at the ends of the legs 123 and 124 to the top edge of said slot is approximately equal to the diameter of the orifice 128. Such proportioning of the parts results in optimum use and advantage of the slot 122 whereby metered material flows freely through said slot 122 and into said orifice 128. The width of the slot should also approximate the diameter of the orifice.

A lesser depth of the slot lessens the effectiveness of the same, together with the legs 123 and 124, as a metering device.

Air under pressure from a source not shown to a hose 190 may be fed together with water from the hose 31 in any desired amount as by a valve 192 and conduit 193 to the discharge nozzle 165, to wet the outgoing dry mixture 190 as may be required. Where the apparatus is used as a sand blaster, the mixture 190 will usually comprise only dry sand, and water from the hose 31 will not be required.

In order to disassemble the essential operating parts of the apparatus, particularly of the metering mechanism, it is only necessary to loosen the bolts 100 on top of the hopper 12 whereby the plug 108 and its associated parts, including the tube 109 and shaft 98 with its coupling 117 and sleeve 196, are readily accessible through the hole 101, and may be withdrawn therefrom by unthreading the member 108 from the flange 106 and pulling the assembly upwardly through the holes 105 and 103.

Similarly, the lower portion of the metering apparatus may be removed by loosening the bolts 90 at the bottom of the hopper 112, dropping the yoke 91, releasing the T 92, and permitting the retraction, as by unscrewing of the plug 132, of the blade 118. The freed agitator 141, as well as all other internal areas and parts of the lowermost hopper, may be reached through the hand hole 180.

The sleeve 109 and shaft 98 may be replaced as by a pipe secured at its upper end at the connection 97, which latter may, if desired, extend into the interior of the main body 85 below the box 102, the gear box drive and said connection 97 then extending downwardly below said box. The lower end of the pipe may be flattened to axially accommodate and drive the blade 118 to any desired floating or axially fixed extent relative to the seat 127.

In addition, the seat 127 may be integral with a cap slidable over the end of the leg 135 of the T 92 for ease of replacement thereover.

Sometimes it is feasible to increase the effective capacity of the upper hopper 11 by elimination of the bell valve 52 depending thereinto and substitution of a laterally, i. e., horizontally slidable and horizontally disposed plate-type closure normally seating under air pressure, from within the hopper 11, against the lip 53 or the like.

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Preferably said lip 53 should be provided with a rubber-like gasket.

This invention features an improved blast feed apparatus, improved metering mechanism, and an improved, more convenient and effective arrangement of the parts thereof, including its driving means.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent structures.

The invention having been herein described, what is claimed and sought to be secured by Letters Patent is:

1. In cement blowing apparatus comprising a funnel-shaped hopper outlet means including metering means at the lower end of the hopper and power means for operating said metering means, to regulate the downward flow of a feed material through said outlet means, said outlet means comprising a metering orifice having a tapered seat around the upper end thereof, said metering means comprising an elongate metering blade projecting longitudinally above the orifice and having a tapered lower end conforming to the taper of said seat normally bearing gravitationally thereagainst for rotative sliding movement, an axially disposed driven element having a slot-shaped recess adapted loosely to receive the upper end of said blade and hold the same upright in operative position relative to said orifice, a transverse pin projecting through the blade and a substantially U-shaped agitator having a bottom slot adapted to slidably receive the elongate blade, said agitator adapted to be carried on said transverse pin and rotated together with and by means of said elongate blade.

2. In a cement blowing apparatus of the character described, including a hopper for a dry cement mix, a downwardly directed annular discharge outlet at the bottom of said hopper and a substantially horizontal conduit below said outlet adapted to receive the dry mix therefrom, an improved metering means coaxial with said outlet comprising a vertical body portion and spaced leg portions below said body portion, said leg portions being separated horizontally a distance approximately equal to the diameter of the discharge outlet, the lower ends of said leg portions being adapted to rotate around the edge of said discharge outlet straddling the opening therein, said leg portions having an axial length approximately as great as the diameter of said outlet and power means for rotating said metering means on a vertical axis coincident with the axis of the opening.

3. In a cement blowing apparatus of the character described, including a hopper for a dry cement mix, a downwardly directed annular discharge outlet at the bottom of said hopper in communication with the interior of the hopper, and a substantially horizontal conduit below said outlet adapted to receive the dry mix therefrom, an improved metering means coaxial with said outlet comprising a vertical body portion and spaced leg portions below said body portion, said leg portions being separated horizontally a distance approximately equal to the diameter of the discharge outlet, the lower ends of said leg portions being adapted to slide over the edge of said

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discharge outlet straddling the opening therein, said leg portions having an axial length approximately as great as the diameter of said outlet; power means for rotating said metering means on a vertical axis coincident with the axis of the opening, said power means including a vertical longitudinally slotted drive shaft having an axial non-circular opening in the lower end thereof adapted to receive the upper end of the metering bar, said upper end of the metering bar being complementary to the opening in the drive shaft for free telescoping longitudinal movement and driving rotative association therewith.

4. In the apparatus of claim 2, said metering means further consisting of an elongate flat blade of greater width than said opening and formed with a longitudinal slot defining a bifurcate lower end straddling said opening and rotatable around the upper end of the outlet in gravitational frictional engagement therewith for stirring said cement mix adjacent said opening and slot, through said slot and into said opening.

5. In the apparatus of claim 2, said metering means further consisting of an elongate flat blade of greater width than said opening and formed with a longitudinal slot defining a bifurcate lower end straddling said opening and rotatable around the upper end of the outlet in gravitational frictional engagement therewith for stirring said cement mix adjacent said opening and slot, through said slot and into said opening, the upper end of said outlet and said bifurcate end being complementally tapered downwardly and inwardly relative to said opening.

6. In a cement blowing apparatus of the character described, including a hopper for a dry cement mix and a vertical discharge outlet in the bottom of the hopper: a metering device comprising a vertical shaft extending through said hopper, an inverted U-shaped metering member having the legs thereof disposed upon opposite sides of the discharge outlet, said legs being separated horizontally at their ends a distance equal to the diameter of the opening of the discharge

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outlet, said legs being approximately as long as said diameter of the opening in said discharge outlet; an axially slidable driving connection between said shaft and said port member whereby said port member rests gravitationally against the upper end of said discharge outlet, and power means for driving said shaft for axially rotating said port member.

7. A hopper and outlet means including metering means in the bottom of the hopper, for regulating the downward flow of a feed material through said outlet means, the improvement comprising: said outlet means comprising a metering orifice having a tapered seat around the upper end thereof, said metering means comprising a substantially flat elongate metering blade projecting longitudinally above the orifice and having a tapered lower end conforming to the taper of said seat normally rotating thereat, said flat elongate blade being bifurcate at its lower end forming opposite legs chamfered to provide clearance in a given direction of rotation whereby said legs make approximate line contact with said seat at diametrically opposite sides of the seat.

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