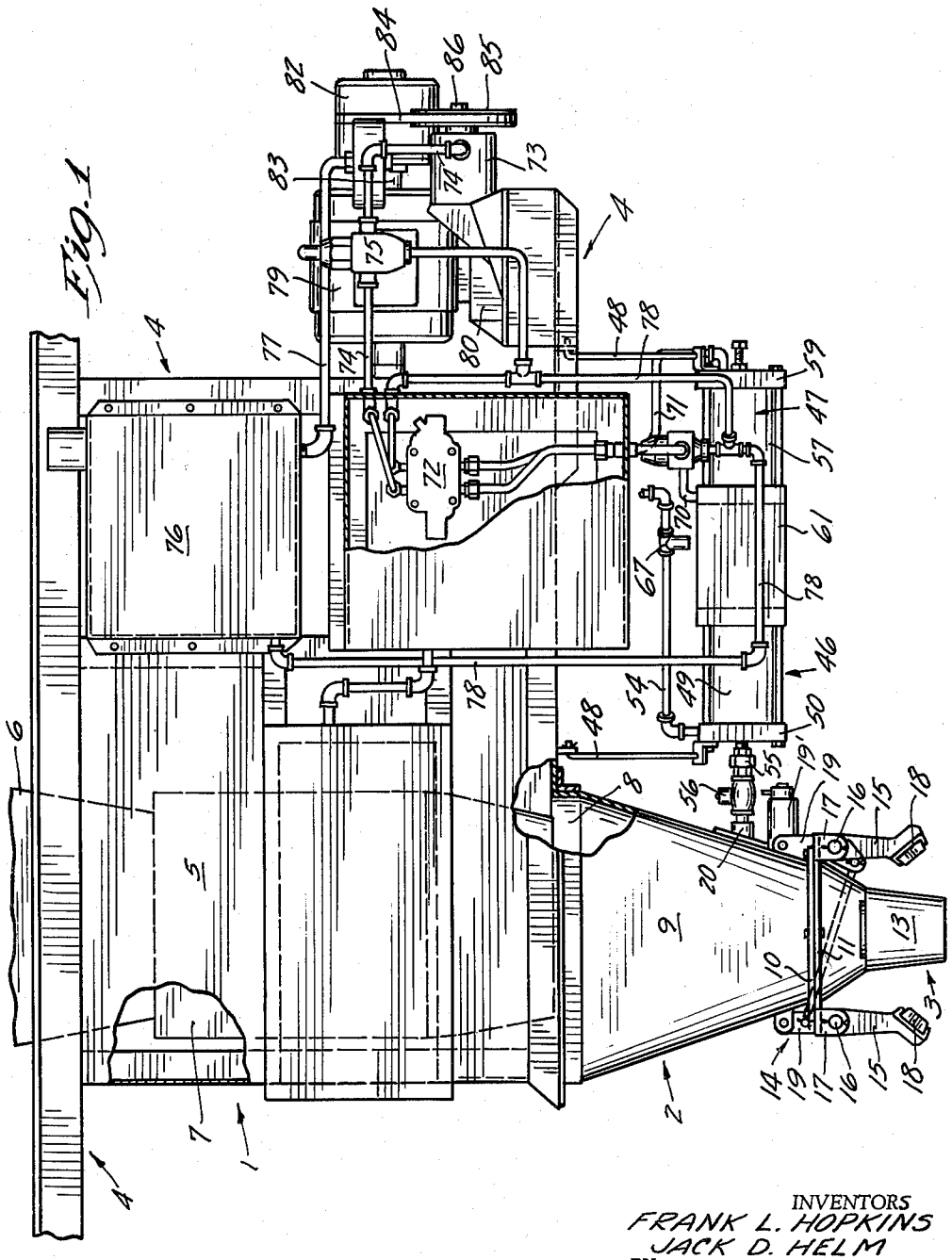
March 7, 1961 F. L. HOPKINS ET AL 2,973,740

APPARATUS FOR SPRAYING LOOSE BULK MATERIAL

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Fig. 1



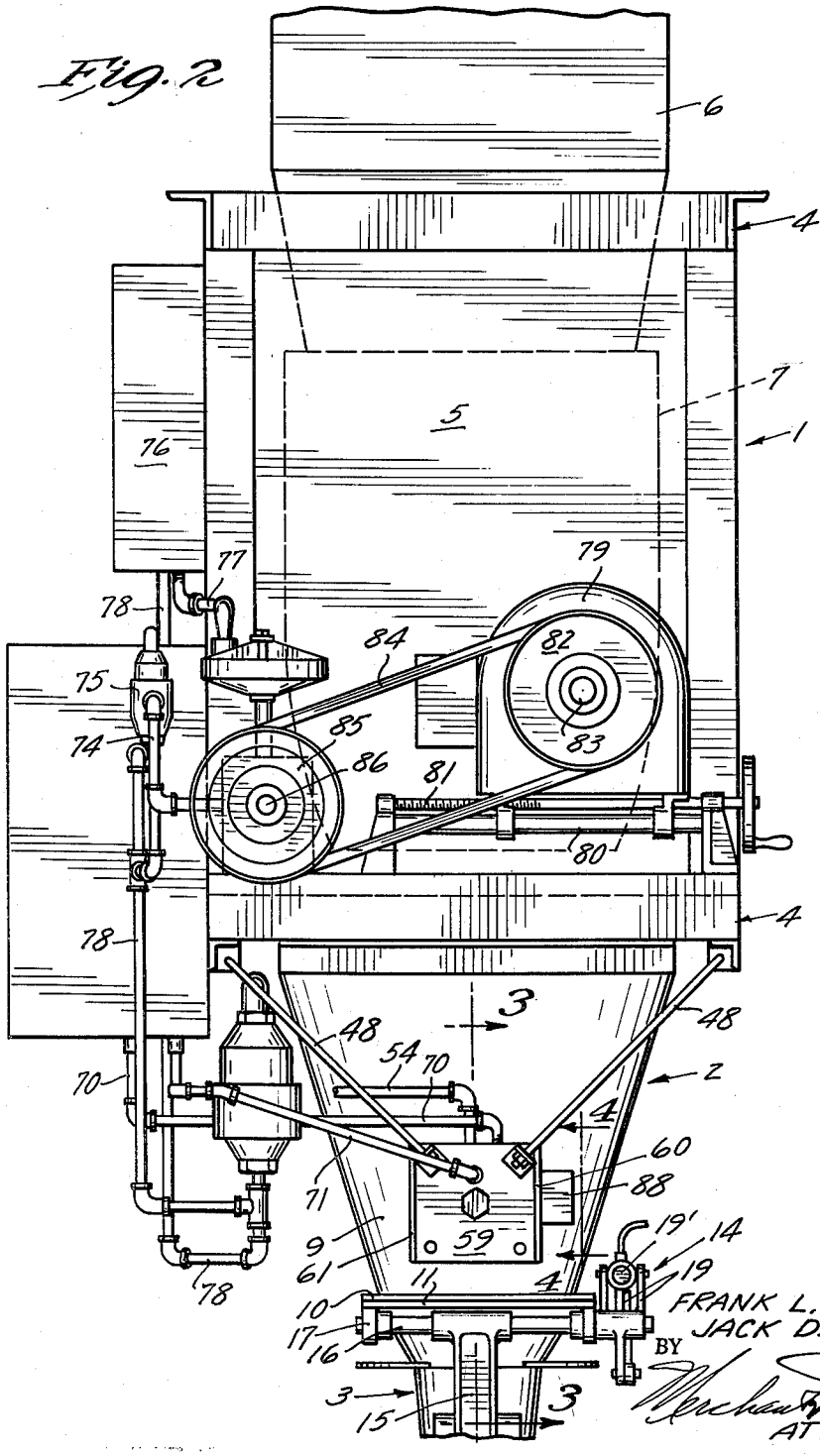
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APPARATUS FOR SPRAYING LOOSE BULK MATERIAL

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Fig. 2



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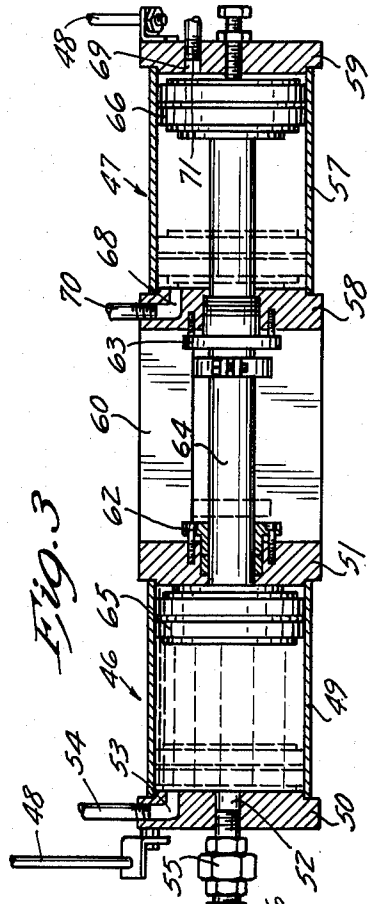


Fig. 3

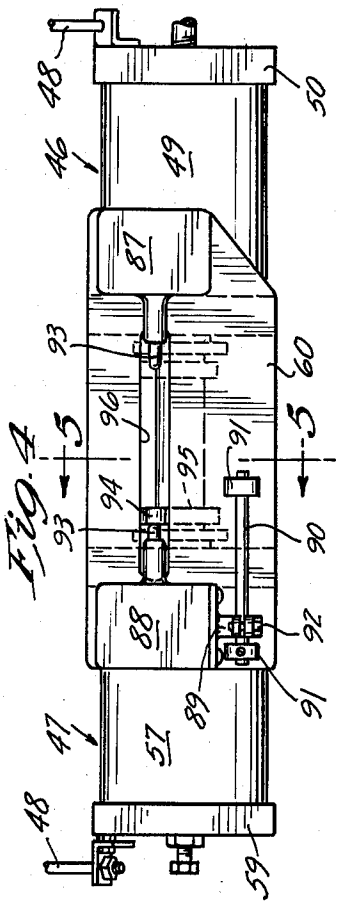


Fig. 4

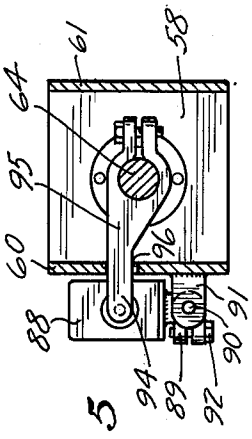
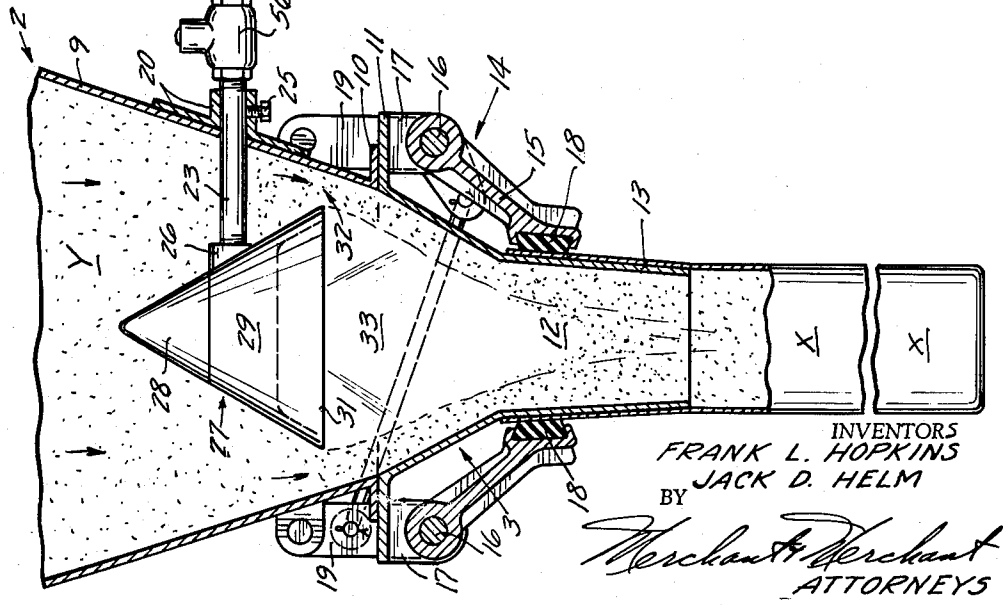


Fig. 5



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APPARATUS FOR SPRAYING LOOSE BULK MATERIAL

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Fig. 6

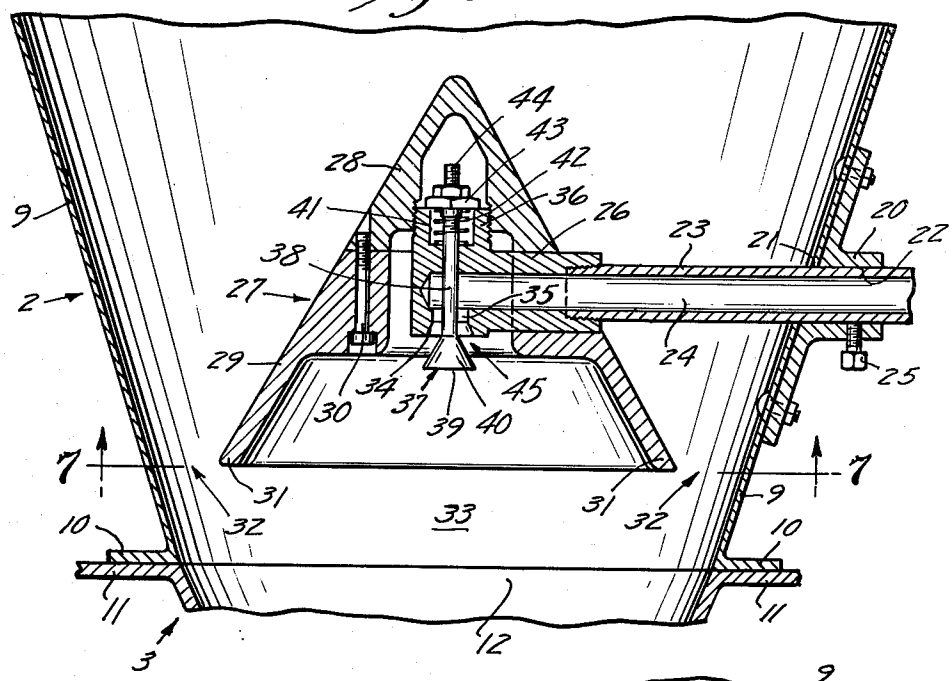
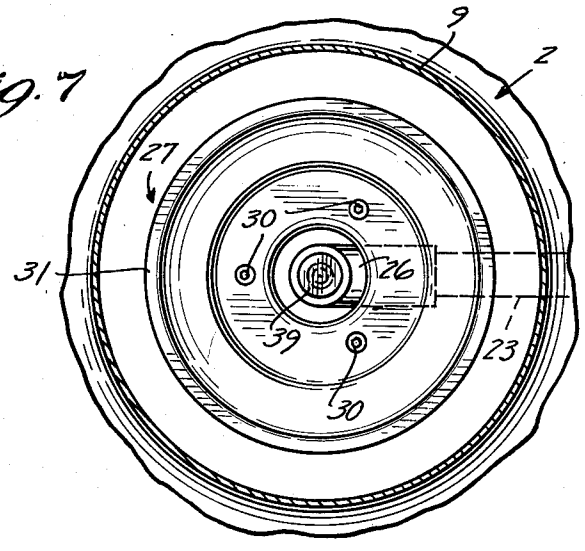


Fig. 7



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2,973,740

APPARATUS FOR SPRAYING LOOSE BULK MATERIAL

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Filed Dec. 26, 1957, Ser. No. 705,300

3 Claims. (Cl. 118—303)

Our invention relates generally to the spraying of dry bulk material with liquids, and more particularly to novel means for spraying of such material, in granular or powdered form, during the packaging thereof in predetermined quantities.

In the application of liquid additives to dry bulk material, it is desired that the additives be sprayed or otherwise fed to the material in predetermined quantities after the weighing of said material, and just prior to the packaging thereof, so as to prevent moistening of the weighing and any following parts or the packaging equipment and consequent adhesion of the material to such parts. Hence the moistening of such parts or equipment would result in a build-up of the material on the equipment and consequent loss of accuracy in the dispensing thereof, as well as necessitating frequent cleaning of the packaging equipment. The important object of our invention is therefore the provision of means so constructed and arranged as to cause dry granular or powdered bulk material to be constantly and uniformly fed in a cross sectionally annular stream without build-up and resulting obstruction for insuring spraying only the inner portion of said stream with liquid additives as it passes through the succeeding packaging equipment. To this end, we provide housing means defining a chamber having an inlet at its top portion and an outlet at its lower end, an upwardly tapering hollow conical baffle mounted in the chamber in axially aligned overlying spaced relation to th outlet for directing downwardly moving dry bulk material in the chamber in a cross sectionally annular stream which defines an open space within and below the hollow baffle. We further provide conduit means including a valve at the discharge end thereof disposed substantially on the axis of the hollow conical baffle below the upper end thereof but well within and above the lower end thereof, said valve comprising an annular valve seat and a cooperating valve element which cooperate to define a nozzle opening directing the fluid fed therethrough outwardly from the axis of said valve within the hollow cone in directions to cause the fluid to strike the inner surface portion of the stream of dry material defining said open space below the lower marginal edge of said hollow cone baffle.

Another important object of our invention is the provision of an open bottom cone protected nozzle combination spray nozzle and automatic valve which, when closed, effectively seals the liquid conduit to insure against dripping of the liquid additive from the nozzle when the apparatus is in an inoperative condition.

Another object of our invention is the position of a novel combination valve and spray nozzle having means for maintaining the valve in a closed position until the liquid additive therein reaches a predetermined pressure, and which, when said pressure is reduced will automatically close.

Another object of our invention is the provision of a combination nozzle and discharge valve as set forth having means whereby the nozzle opening may be quickly

and easily adjusted to regulate the velocity of flow of liquid through said nozzle opening and the spray pattern thereof.

The above, and still further highly important objects and advantages of our invention, will become apparent from the following detailed specification, appended claims, and attached drawings.

Referring to the drawings, which illustrate the invention, and in which like reference numerals indicate like parts throughout the several views:

Fig. 1 is a fragmentary view in side elevation of a weighing and dispensing apparatus for dry powdered or granular bulk material, incorporating our invention, some parts being broken away and some parts shown in section;

Fig. 2 is a view in end elevation, on an enlarged scale, as seen from the right to the left with respect to Fig. 1;

Fig. 3 is an enlarged fragmentary detail in section taken substantially on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged fragmentary view in side elevation as seen from the line 4—4 of Fig. 2;

Fig. 5 is a transverse section taken on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmentary view corresponding to a portion of Fig. 3 but showing the conical baffle and valve of our invention in axial section; and

Fig. 7 is a view partly in horizontal section and partly in bottom plan, taken on the line 7—7 of Fig. 6.

Referring with greater detail to the drawings, and particularly to Figs. 1 and 2, a bulk material weighing and container filling machine is shown as including an upper housing section **1**, an intermediate housing section **2** immediately below the section **1**, and a container holding and material discharge section **3** secured to the lower end of the housing section **2**. The upper section **1** involves a generally rectangular frame **4** and generally flat walls **5**, the upper end of the housing section **1** being open to receive a conduit or chute **6** which may be assumed to be connected to a source of supply of granular powdered dry material to be treated and dispensed. Suitably mounted within the upper housing section **1** is a measuring device **7** which receives material from the chute **6** and dispenses the same in measured quantities to the discharge section **3** through the intermediate housing section **2**. The measuring device **7** may be any one of several well known types which measure the granular or powdered bulk material by weight or volume and in itself, does not comprise the instant invention hence, for the sake of brevity detailed showing and description thereof is omitted.

The open upper end **8** of the intermediate housing section **2** underlies the measuring device **7**, the side walls **9** of the intermediate housing section **2** tapering downwardly and being provided at their lower ends with an outwardly projecting peripheral flange **10** to which is bolted or otherwise secured a peripheral mounting flange **11** projecting laterally outwardly from the upper end of the lower or discharge section **3**. Said discharge section **3** is generally tubular in form, defining a discharge outlet **12** for the granular bulk material dispensed from the measuring device **7**. The discharge section **3** includes a downwardly tapering lower end portion **13** that is adapted to receive a bag or like container, indicated at X, see Fig. 3, for reception of material sent downwardly through the sections **2** and **3**, said material being indicated by the reference character Y. The discharge section **3** further carries power-operated bag holding mechanism indicated generally at **14**, said bag holding mechanism including a pair of arms **15** mounted on shafts **16** at opposite sides of the discharge section **3**, said shafts **16** being journalled in bearings **17**. At their outer ends, the arms **15** are provided with rubber-like bag engaging

pads 18 that are adapted to engage opposite sides of the mouth of the bag X and clamp the same securely to the wall portion 13 of the discharge section 3. Means for imparting rocking movements to the shafts 16 to swing the arms 15 toward and away from operative engagement with the mouth of the bag X includes rock arms 19 secured to the shafts 16 and operatively coupled to a fluid pressure cylinder 19' and the piston-equipped plunger rod thereof, not shown. The bag holding mechanism 14 is fully disclosed in our prior United States Letters Patent 2,808,858, entitled "Machine for Weighing and Dispensing Bulk Material and Having Means for Impregnating said Material with Liquid."

A flange fitting 20 is bolted or otherwise rigidly secured to a portion of the side wall 9 of the section 2, said side wall portion and fitting defining aligned openngs 21 and 22 respectively through which extends a horizontally disposed rigid conduit 23 which defines a fluid passage 24. The conduit 23 is releasably locked against movement relative to the fitting 20 by a set screw or the like 25, the inner end of the conduit 23 is screw-threaded into one end of a valve body 26 in an upwardly tapering conical baffle 27 comprising upper and lower baffle sections 28 and 29 that are rigidly but detachably secured together by machine screws or the like 30. As shown in Figs. 3 and 6, the baffle 27 is disposed in upwardly spaced axially aligned relation to the outlet 12, the lower marginal edge portions 31 of the baffle 27 cooperating with adjacent side walls 9 of the housing section 2 to define a generally annular passage 32. As the dry granular material Y is discharged from the measuring and dispensing device 7, the same is directed by the conical baffle 27 into a cross sectionally annular stream which defines a hollow space 33 below the baffle 27, see Fig. 3.

The fluid passage 24 extends through the valve body 26, said valve body defining a downwardly diverging conical valve seating face 34 at the outlet end 35 of the passage 24, said passage end portion 35 being axially aligned with the baffle 27 and discharge outlet 12. The inner end portion of the valve body 26 is formed to provide an upwardly extending threaded neck 36 having screw threaded engagement with the screw threaded inner surface portion of the upper baffle section 28, said inner end portion of the valve body 26 providing a mounting and guiding means for a valve element 37 which comprises an elongated valve stem 38 which extends axially through the passage end portion 35, and a head portion 39 which defines a downwardly diverging conical surface 40 that is adapted to have seating engagement with the conical seating face 34. The neck 36 of the valve body 26 defines an upwardly opening recess 41 through which the valve stem 38 axially extends, and in which is disposed a coil compression spring 42 that engages a lock nut equipped stop flange or nut 43 that is screw threaded on the threaded upper end 44 of the valve stem 38. The valve element 37 is movable between an open position, as shown in Fig. 6, and a closed position wherein the conical surface 40 of the head 39 is in seating engagement with the conical seating face 34, the spring 42 yieldingly urging the valve element 37 toward its valve closed position. Movement of the valve element 37 toward its valve open position is limited by engagement of the stop flange or nut 43 with the upper end of the neck 36, the conical surface 40 and seating face 34 cooperating to define an annular nozzle opening 45, the side of which is determined by the position of the stop flange 43 on the valve stem 38. It will be noted that the valve seating face 34 and the head 39 of the valve element 37 are disposed at a level above that of the marginal edge 31 of the lower baffle section 29, to prevent the dry granular bulk material Y from coming into contact with the cooperating faces 34 and 40 in the event that material below the baffle piles up due to failure thereof to move outwardly through the outlet 12. The angle of the cooperating faces 34 and 40 is such that fluid passing through the nozzle opening 45 is directed in a downwardly diverging conical stream against the inner surface portion of the stream of dry material which defines the open space 33 below the lower marginal edge 31 of the baffle 27. When it is desired to adjust the nozzle opening 45, it is only necessary to remove the screws 30, unscrew the upper baffle section 28 from the neck 36 of the valve body 26, and set the lock nut equipped adjustment flange or nut 43 in the desired direction on the valve stem 38. Thereafter, it is an easy matter to replace the upper baffle section 28 and block the same in place with the screws 30.

A pair of axially aligned pumping and driving cylinders 46 and 47 respectively are suspended from the frame 4 in axial alignment with the conduit 23, by means of a plurality of hanger rods 48. The pumping cylinder 46 comprises a cylindrical wall element 49 and inner and outer end walls 50 and 51 respectively, the inner wall 50 having a central discharge opening 52 and an inlet opening 53 therein, to the latter of which is connected a fluid or liquid conduit 54 that is connected to a source of liquid supply, such as a tank, not shown. A conventional pipe fitting in the nature of a union 55 is screw threaded into the central discharge opening 52 and is connected to the rigid conduit 23 through the medium of a conventional check valve 56. The driving cylinder 47 comprises a cylindrical wall 57 and inner and outer end walls 58 and 59 respectively. The cylinders 46 and 47 are secured together in axially spaced aligned relationship by a pair of rigid stretcher plates 60 and 61 bolted or otherwise rigidly secured to opposite sides of the end walls 51 and 58 of the cylinder. Said end walls 51 and 58 are provided with axially aligned central packing glands 62 and 63 respectively through which extends a piston rod 64 having a pumping piston 65 secured to its inner end within the pumping cylinder 46, and a driving piston 66 secured to its outer end within the driving cylinder 47, see Fig. 3. It will be noted that movement of the piston rod 64 and pistons 65 and 66 from their dotted line positions of Fig. 3 to their full line positions thereof, will cause liquid to be drawn into the inner end of the pumping cylinder 46 through the conduit 54 and inlet 53, such movement of the piston rod and pistons being a suction stroke. Thereafter, movement of the piston rod 64 and pistons 65 and 66 in the opposite directions toward their dotted line positions of Fig. 3 causes liquid in the cylinder 46 to be delivered under pressure through the valve 56 and the passage 24 of the conduit 23 to move the valve element 37 to its open position against bias of the spring 42 and spray the liquid outwardly through the nozzle opening 45. During inward movement or pumping stroke of the piston 65, the fluid within the pumping cylinder 46 is prevented from being moved outwardly through the inlet 53 by a conventional check valve in the conduit 54, said check valve being shown in Fig. 1 and indicated by the reference numeral 67.

The inner and outer end walls 58 and 59 respectively of the driving cylinder 47 are provided with fluid openings or passages 68 and 69 respectively to which are connected conduits 70 and 71 respectively which lead to an electrically controlled reversing valve 72 that is connected to the output side of a fluid pump 73 by a conduit 74 in which is interposed a conventional pressure regulator valve 75. The pump 73 is conventional in nature and is connected to a fluid reservoir 76 by a conduit 77. The reversing valve 72 is further connected to the reservoir 76 by a conduit 78 whereby fluid in the driving cylinder 47 at opposite sides of the driving piston 66 thereof is returned to the reservoir 76. The fluid pump 73 is driven by an electric motor 79 that is slidably mounted on a base 80 and moved thereon by means of a hand-wheel equipped screw 81. A conventional variable pitch pulley 82 is mounted on the drive shaft 83 of the motor 79, and has entrained thereover a drive belt 84 which runs over a driven pulley 85 rigidly mounted on the shaft 86 of the pump 73.

Means for controlling the reversing valve 72 includes a pair of switches 87 and 88, the former of which is rigidly mounted on one end of the stretcher plate 60 and the latter of which is mounted on a bracket 89 that is adjustably slidable on a mounting rod or bar 90 which in turn is supported from the stretcher plate 60 by spaced lugs 91, see Figs. 4 and 5. The switch mounting bracket 89 is releasably locked in a desired set position on the rod 90, against movement longitudinally of the cylinders 46 and 47, by a clamping bolt or the like 92. Both switches 87 and 88 are provided with opposed switch operating buttons 93 that are disposed in the path of travel of the outer end 94 of an actuator element 95 that is rigidly secured to the piston rod 64 between the packing glands 62 and 63 of their respective cylinders 46 and 47. With reference to Figs. 4 and 5, it will be seen that the end portion 94 of the switch actuator element 95 projects outwardly through an elongated slot 96 in the stretcher plate 60 which guides the actuator element 95 during reciprocatory movement therewith common to the piston rod 64. The switches 87 and 88, which are interposed in a suitable electrical control circuit, operate to control the movements of reversing valve 72 and to reset the machine for each operating cycle. The control circuit, in itself not comprising the instant invention, is not shown in the interest of brevity.

The fluid used in the driving system including the driving cylinder 47 is preferably a substantially non-compressible liquid such as oil or the like, so that the piston rod 64 and its cooperating pistons 65 and 66 are positively driven in the desired directions. Hence, during flow of the granular material Y downwardly over the baffle 27, inward movement of the piston rod 64 causes pressure within the passage 24 to be built up immediately to a point where the valve element 37 is moved to its open position against bias of the spring 42 and the liquid is discharged outwardly through the nozzle 45 to the inner surface of the annular stream of material Y in the hollow space 33 below the baffle 27. When the liquid has been discharged from the pumping cylinder 46, the resultant decrease in pressure permits the spring 42 to immediately close the nozzle opening 45, and subsequent outward or return movement of the piston rod 64 causes the pumping cylinder 46 to be recharged with liquid as above indicated. Seating engagement between the seating face 34 and the conical surface 40 of the valve head 39 effectively prevents any undesired dripping of liquid downwardly through the discharge opening 12. The check valve 56 is used only as a safeguard to prevent air from being drawn inwardly to the pumping cylinder 46 on the return stroke of the piston rod 64 in the event that dust or other foreign material becomes deposited on the surface 40 of the valve head 39 to prevent complete closing of the valve.

With the exception of the switches 87 and 88 and actuator 95 therefor, the control circuit for the above described machine may be considered to be similar to that shown in our prior United States patent above identified, the arrangement being such that liquid is sprayed from the valve only when the granular material Y is being discharged downwardly over the baffle 27. Inasmuch as only the inner surface of the stream of material Y is sprayed with the liquid, the material Y is discharged into the bag X before the liquid has penetrated to the outer portions thereof, and the inner surfaces of the discharge section 3 remain dry, thus precluding a build up of material on said inner surfaces and reducing the necessity of cleaning of said surfaces to a minimum.

The above described device is capable of use with a wide variety of dry granular materials and liquids to be mixed therewith. For example, the device may be used to add fuel oil to dry powdered or granular ammonium nitrate while delivering the same to the bag X to provide

an explosive mixture for blasting purposes. The instant device is equally adapted for use in adding liquid insecticide to commercial fertilizer in dry granular or powdered form. In fact, almost any liquid additive may be applied to granular or powdered material of a desired type while the same is being packaged by means of our novel structure provided the spray valve nozzle means is protected from contact with rising or other uncontrolled supply of powdered material to and through the weighing and delivery throat of the discharge section 13. Further, the use of a single nozzle so disposed and protected enables the operator to quickly and easily control the ratio of liquid to dry material without the need for further adjusting for a balance between nozzles where a plurality thereof are used. The rapid opening and closing of the valve element 37 enables a very accurate control to be had over the uniformity of discharge of liquid to the dry material.

While we have shown and described a commercial embodiment of our novel device, it will be understood that the same is capable of modification without departure from the spirit and scope of the invention, as defined in the claims.

What we claim is:

1. In an apparatus for spray impregnating dry pulverulent material with a liquid, housing means defining a chamber having an inlet in its top portion and an outlet at its lower end, an open base hollow conical baffle in said chamber near the outlet thereof, with the open base of said baffle facing said outlet, a normally closed valved nozzle positioned within said conical baffle above the lower edge thereof, fluid passage means for delivery of liquid under pressure to said valved nozzle and including a rigid conduit also disposed within and wholly above the level of the open base of said baffle for supporting the baffle in overlying spaced relationship to said outlet, said conical baffle causing said pulverulent material to flow downwardly thereover toward said outlet in a hollow stream and defining and maintaining an open space below said valved nozzle and intermediate said baffle and the underlying chamber outlet, the valve of said nozzle being yieldingly urged toward a closed position and adapted to be opened by liquid under pressure in said passage means, said valve in its open position defining an annular opening in said nozzle directing liquid angularly outwardly and downwardly from its axis toward the inner surface portion only of said stream of pulverulent material below the level of the lower end of said baffle.

2. The structure as defined in claim 1, wherein said conical baffle comprises upper and lower sections removably secured together, and wherein said valved nozzle depends from said upper section for discharge of fluids through said open bottom of said lower section.

3. The structure as defined in claim 2, wherein said rigid conduit extends laterally from said valved nozzle between said upper and lower sections.

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