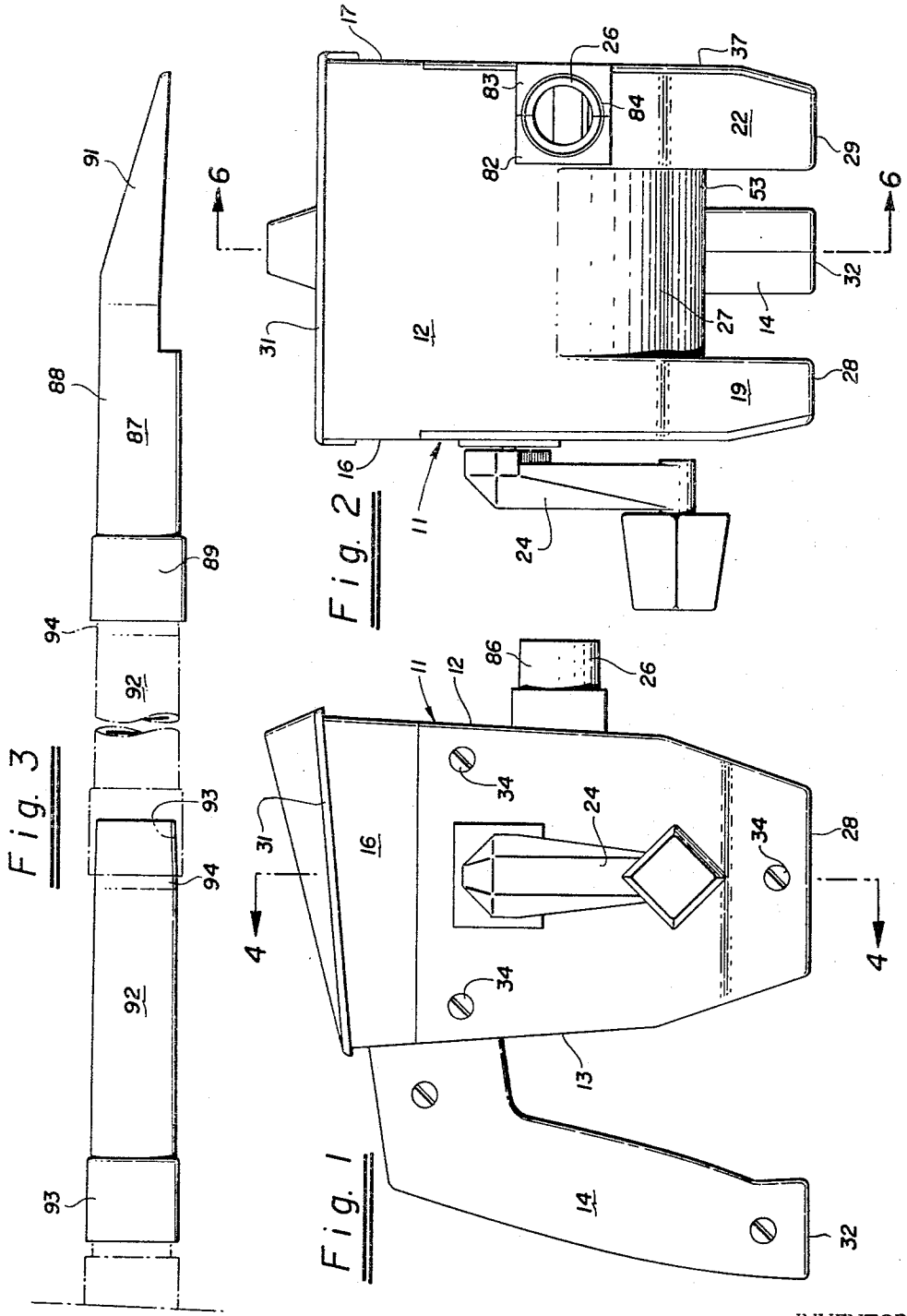
July 11, 1967 W. D. LOVE, JR 3,330,445

HAND DUSTER

Filed June 30, 1965 4 Sheets-Sheet 1



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HAND DUSTER

Filed June 30, 1965 4 Sheets-Sheet 2

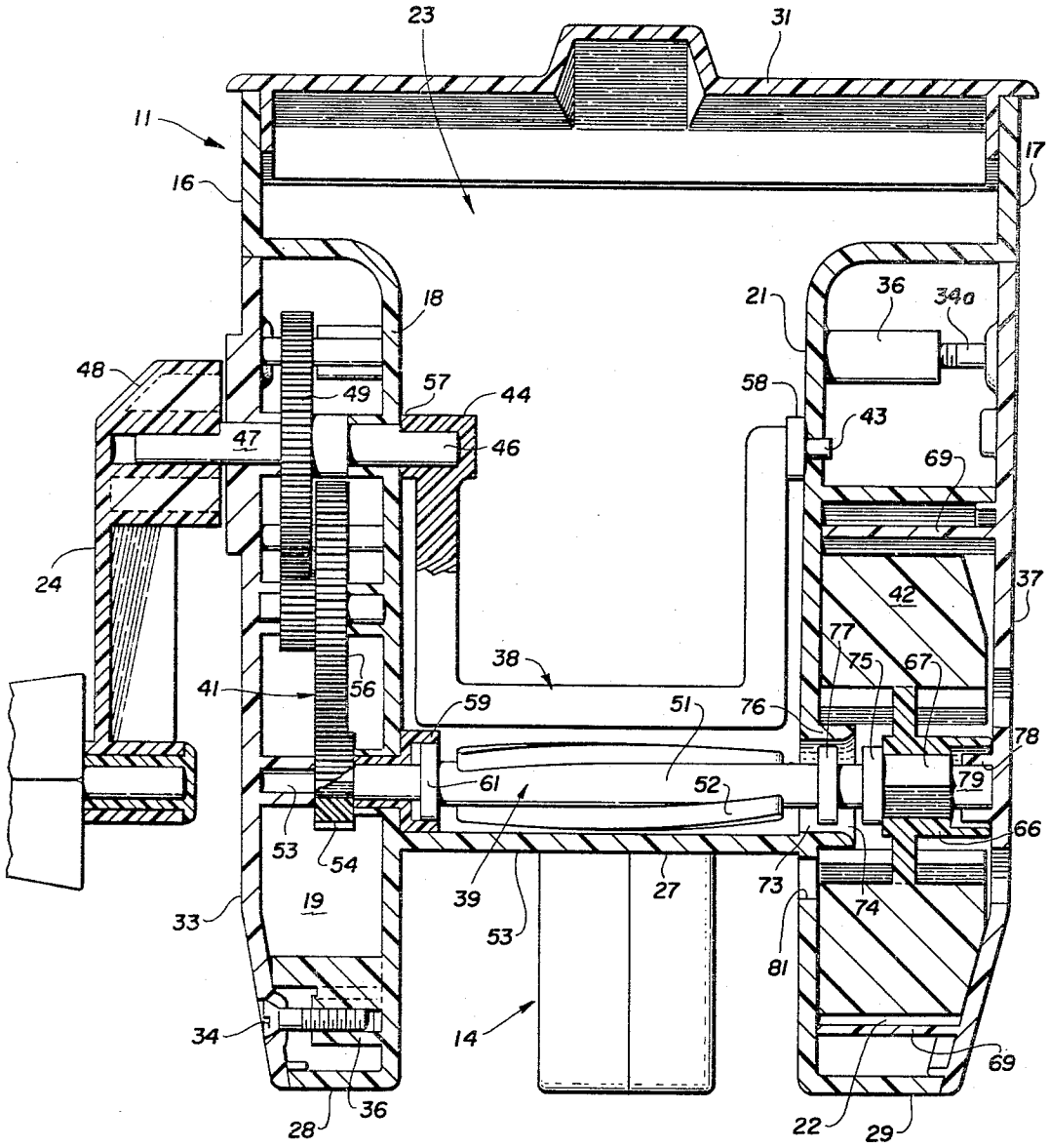

Fig. 4

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HAND DUSTER

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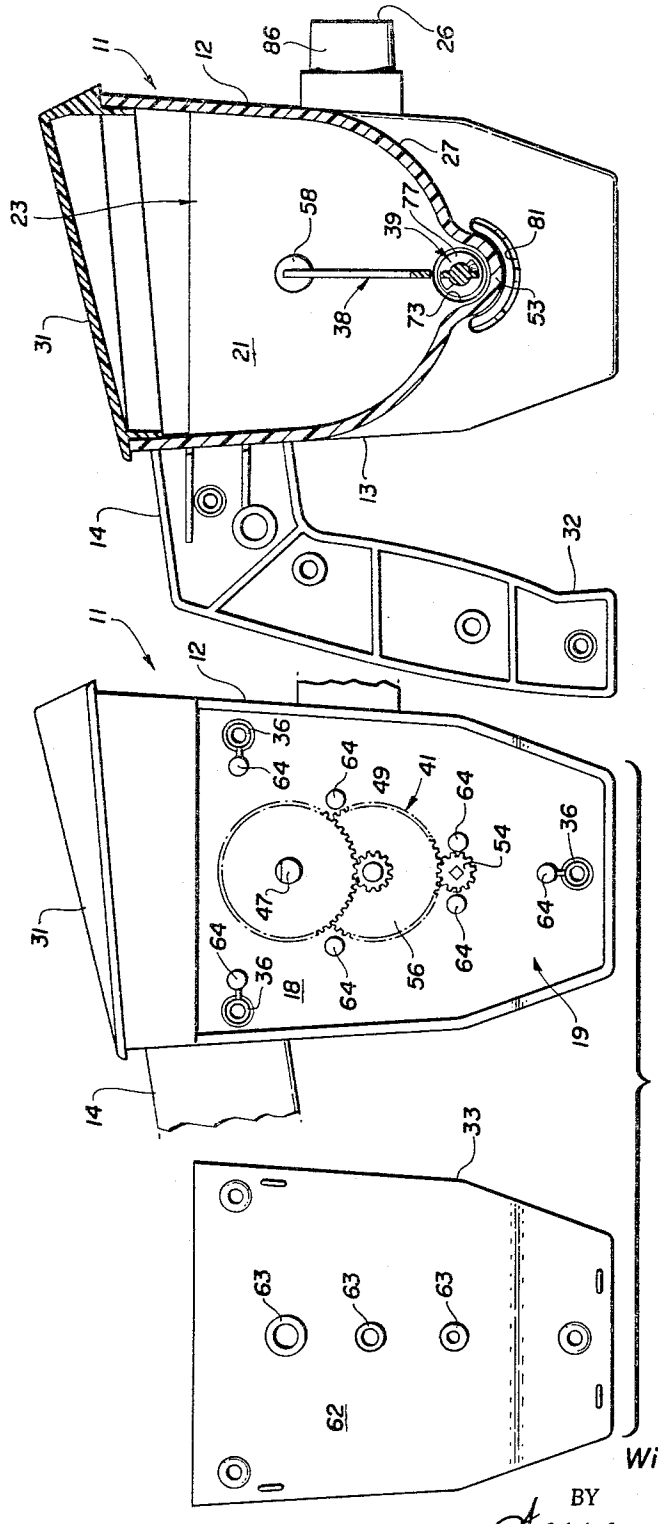

Fig. 6

Fig. 5

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Fig. 7

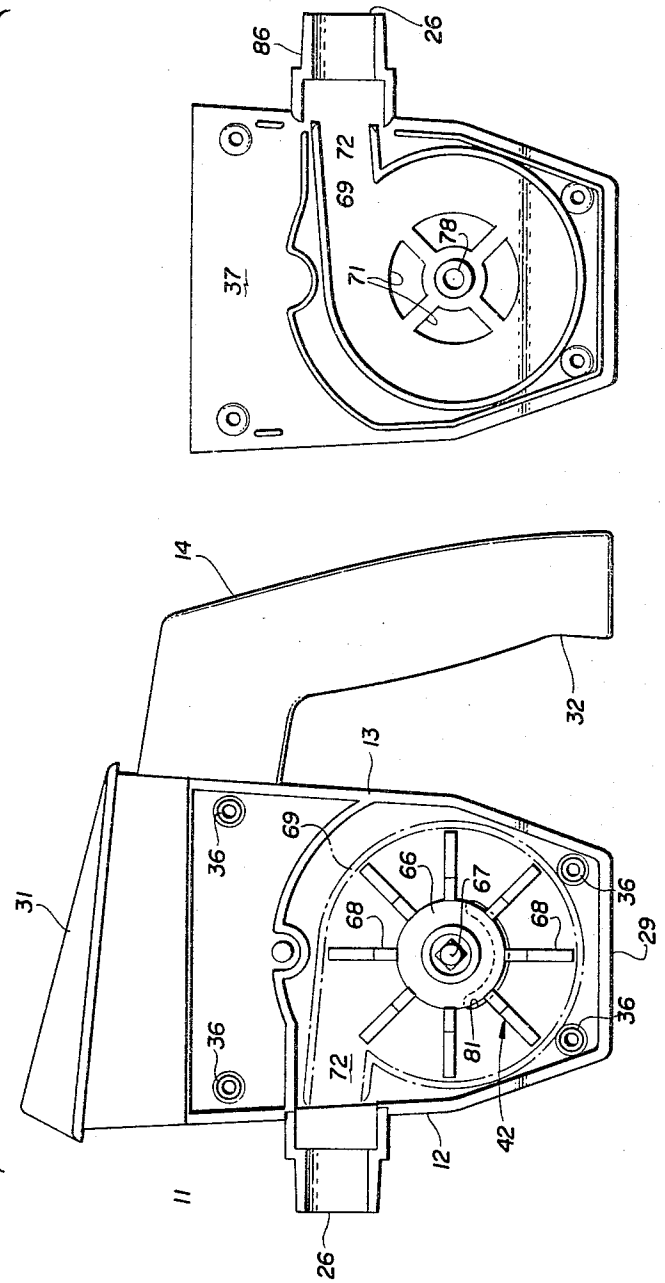
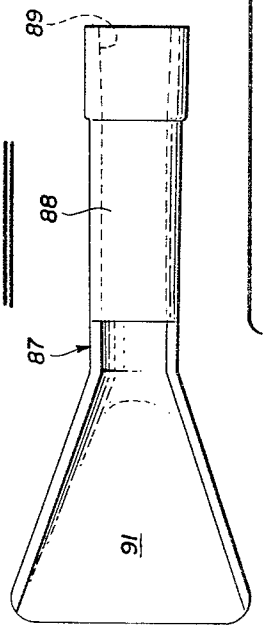


Fig. 8



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HAND DUSTER

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1 Claim. (Cl. 222—193)

The present invention relates to an applicator for projecting and disbursing fluids, more especially pulverulent or granular materials, and more particularly to a hand duster for the application through projection and disbursion of insecticidal or microbicidal powders upon growing plants, and especially for the application of rose dust insecticides to rose bushes and the like.

In the application of pulverulent or granular materials, generally comprising insecticides, pesticides, fungicides, or the like, to growing plants, both in agricultural and garden utilizations, the class of applicators have generally involved relatively large, cumbersome, and heavy equipment, not suitable for holding in the hand, and requiring various necessary supporting harnesses or positioning means. This type of applicator is completely unsuitable for use over extended periods of time without tiring of the operator, and is especially unsuitable for use by homeowners and non-professional gardeners.

A further complication has been the necessity of such applicators dealing with pulverulent substances often of a highly abrasive character, and in addition combining such problem characteristics as being corrosive and deliquescent. The above factors have in the past necessitated that applicators be constructed of abrasive resistant metals having corrosion resistance properties, making possible rigorous cleaning of the often deliquesced, solidified, or gummy material, as by washing in hot water.

It is accordingly an object of the present invention to provide a dust applicator for insecticide powders or the like which is light in weight, can be hand held by an inexperienced operator for extended periods of time, and is capable of being operated without undue exertion.

Another object of the present invention is to provide a hand duster which is formed of a material resistant to the abrasive and corrosive action of certain of the substances it may dispense, and which may safely and easily be cleaned of material residue through washing.

Another object of the present invention is to provide a hand duster which will permit placing of the duster in a secure upright position without tipping and loss or spilling of the material contents.

A still further object of the invention is to provide a duster which will be suitable for hand holding not only of light weight but formed of a material comfortable to the touch being neither excessively cold in inclement weather nor uncomfortably hot when exposed to the sun or higher ambient temperatures.

A yet further object of the present invention is to provide a hand duster formed of a minimum number of parts and adapted for fabrication in an economical and durable manner.

Another object of the present invention is to provide a hand duster which effectively retains the material being dispensed, and prevents contact of such material with its various operating parts, while providing convenient access to such parts for maintenance by the operator.

Again, an additional object of the present invention is to provide a hand duster the operating parts of which require minimum effort for operation through inherent low frictional characteristics and through elimination of the necessity of lubrication with its undesirable tendency to cause adherence of the contaminating granular or pulverulent material being dispensed by the duster.

The invention possesses other objects and features of advantage, some of which of the foregoing will be set forth

in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of this specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claim.

FIGURE 1 is a side elevational view of a preferred embodiment of my invention.

FIGURE 2 is a front elevational view of the embodiment of the invention shown in FIGURE 1.

FIGURE 3 is a side elevational view, partly broken away and in dotted lines, showing another portion of the invention shown in FIGURES 1 and 2,.

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 1.

FIGURE 5 is a side elevational view of the invention shown in FIGURE 1, but with a portion thereof removed and reversed.

FIGURE 6 is a cross-sectional view taken along the line 6—6 of FIGURE 2.

FIGURE 7 is a side elevational view of the invention shown in FIGURE 1, but as seen from the opposite side thereof, and with a portion removed and reversed.

FIGURE 8 is a plan view of a portion of the invention shown in FIGURE 3, but rotated 90 degrees.

The invention generally comprises a housing **11** having front and rear walls **12** and **13** respectively, a handle **14** provided on the rear wall, and side walls **16** and **17**. Housing **11** is divided into three chambers: by an inset side wall **18** defining in conjunction with side wall **16** and front and rear walls **12** and **13** a first chamber **19**; by a second inset side wall **21** defining with side wall **17** and the front and rear walls a second chamber **22**; and the central chamber **23** positioned between the first and second side chambers.

Central chamber **23**, being the considerably larger chamber of the three enclosed within housing **11**, serves as the material hopper for the pulverulent material to be dispensed, and side chambers **19** and **22** define the operating or "drive" and discharge chambers, respectively, of the present duster.

A crank handle **24** is provided at the exterior of chamber **19**, and a discharge nozzle **26** is provided at the front wall of discharge chamber **22**. Hopper chamber **23** is provided with an arcuate, recessed bottom **27** inset from the lower edges **28** and **29** of the operating chamber and discharge chamber respectively, and may desirably be provided with conveniently removable top **31**.

It will now be clear from the foregoing, together with a study of FIGURES 1 and 2 especially, that the present duster is designed to be held by the operator by gripping the handle with one hand while the other hand operates the crank, causing material from the hopper to be disbursed through outlet **26** at the front of the duster normally pointing away from and in full view of the operator.

As an important feature, the construction of the duster the subject of my invention permits it to rest upon a surface in an upright, stable position, and as shown in FIGURES 1 and 2 this stable position is achieved through the three-point contact with a surface provided by the butt **32** of handle **14** and the lower edges **28** and **29** of the side chambers of housing **11**. This stable, vertical, upright at-rest position of the duster is impotrant to the operator in preventing tipping and spilling of the hopper contents when the duster is set down, as well as affording convenient loading of the hopper when necessary, upon removal of cover **31**.

In order to ahieve the objective of a portable duster combining the necessary strength, abrasion resisting, anticorrosion qualities, light weight and relative immunity from temperature extremes, it is desirable as I have found

to fabricate the duster from one of a body of plastic materials capable of being injection molded. These materials include nylon, Cycolac (T.M.), polypropylene, and others having generally similar characteristics, and such materials have the additional desirable quality or property of having a relatively low coefficient of friction, whereby they are able to provide self-bearings and inherent lubricating qualities between moving parts.

The possibilities, however, of economical mass fabrication such as by utilizing injection molding techniques, impose severe requirements upon the preferred embodiment of the invention so as to conform to the necessity of avoiding undercut and confined members or cavities which would preclude die or mold withdrawal, and such limitations apply likewise to die casting proper utilizing a metallic alloy.

The adaptability of the embodiment of the present invention as shown, to economical fabrication as by injection molding, will be apparent, particularly from a study of FIGURES 4, 5, 6 and 7.

With reference to FIGURE 4, chamber **19**, already denoted the operating or "drive" chamber, is provided with a removable side plate **33**, secured as shown by means of a plurality of screws **34** threaded in bosses **36** provided in the chamber. Cover plate **33** in conjunction with fixed side wall **16** defines the outer side wall of housing **11** adjacent the "drive" chamber, and at the opposite side of housing **11** chamber **22**, denoted the "discharge" chamber, is provided with a similar cover plate **37** removably secured to chamber **22** and in conjunction with fixed side wall **17** defining the opposite outer side wall of housing **11**.

Provided within the hopper **23** of the duster housing is an agitator **38**, journalled for sweeping rotation within the hopper between inset side walls **18** and **21** respectively; likewise disposed within the hopper adjacent the apex of the arcuate bottom **27** is a material conveyer **39**, adapted for rotation and operatively extending between chambers **19** and **22**. Disposed within "drive" chamber **19** is a gear train **41** providing an operative connection between hand crank **24**, agitator **38**, and conveyer **39**.

Affixed to conveyer **39** within chamber **22** is an impeller **42** arranged in relation to discharge outlet **26** so as to direct a current of material-laden air from the discharge outlet. Rotation of hand crank **24** by the operator will thus cause the simultaneous movement of the agitator **38**, and the conveyer **39** together with impeller **42** to cause agitation and conveyance of material in the hopper to and adjacent impeller **42** for discharge by nozzle **26** at the exterior of the duster housing. While such movement of the associated parts is simultaneous it is not of an equal speed, a variation in peripheral speed between the agitator and the conveyer being accomplished by means of gear train **41**, as will be hereinafter described.

As shown in FIGURE 4, agitator **38** comprises a U-shaped stirring member having one leg terminating in a stub shaft **43** journalled for rotation in side wall **21**, and the other end providing a socket **44** for receiving a squared-end **46** of shaft **47** journalled for rotation between wall **18** and cover plate **33** of the "drive" chamber **19**. Shaft **47** is socketed and keyed in hub **48** of the hand crank **24** for rotation therewith and the shaft carries midway a fixed gear **49**. Rotation of hand crank **24** will thus cause simultaneous and equal rotation of agitator **38**, and the agitator is so positioned as to closely sweep the front and rear walls **12** and **13** and interconnecting arcuate bottom **27** of hopper **23** during its arc of rotation, thus effectively dislodging material within the hopper from adjacent the sides thereof and preventing packing or compacting of the pulverulent material.

Conveyer **39** as shown comprises a shaft **51** extending between chambers **19** and **22**, operatively connected in the first chamber to the gear train **41** for rotation therewith in a ratio to the speed of hand crank **24**, and terminating in chamber **22** in discharge impeller **42**. The conveyer includes a plurality of helix vanes or blades **52**, and as an important feature of the present invention conveyer **39** is, and as shown in FIGURE 6, disposed within an arcuate, semi-circular recessed portion **53** provided in arcuate bottom **27** of the hopper at its apex. Such a positioning of the conveyer, in conjunction with the sweeping arc of the agitator, combines to effect a gravity flow of material within the hopper to the conveyer vanes, whereby upon rotation of the conveyer, material of a pulverulent nature in contact therewith will be caused to move and flow axially of the conveyer into discharge chamber **22** and adjacent the vortex of impeller **42**, as will be more particularly described.

It will be clear from FIGURE 6 that agitator **38**, during that portion of its sweeping rotation immediately above conveyer **19**, will agitate and sweep aside a segment of material immediately superimposed over the conveyer affording unimpeded gravity flow into the conveyer of the balance of the material.

Affixed to a keyed end **53** of conveyer shaft **51**, extended within "drive" chamber **19**, is a gear **54**, and a double faced idler gear **56** meshes with gears **49** and **54** respectively to provide an operative connection therebetween. As shown, the gear train design, including gears **49**, **56** and **54** results in a speed ratio of approximately 20 to 1 whereby one revolution of hand crank **24** will effect one revolution of agitator **38** but approximately 20 revolutions of conveyer **39** and impeller **42**.

Because of the often highly abrasive nature of the pulverulent materials designed to be disbursed by the duster the subject of my invention, it is important to effectively seal the "drive" chamber from the hopper, and to this end it will be noted that effective seals are provided for both shafts **47** and **51** at their points of bearing in chamber wall **18**. Agitator **38** is desirably formed of somewhat resilient material, and this combined with the slightly compressed U-shape of the installed part causes side pressure to be exerted by agitator boss **57** upon chamber wall **18**, and boss **58** of the other leg upon the opposite wall **21** of the hopper, affording a tight seal at both of these bearing points. Conveyer shaft **51** is afforded a tight seal at the point of its journalling in wall **18** as here shown by means of a bushing **59** which provides a precise bearing for the conveyer shaft, and in conjunction with an annular ring **61** provided on shaft **51** affords a double seal against contamination of the "drive" chamber by the contents of the hopper.

As will be noted from a study of FIGURE 5, cover plate **33**, as shown in reverse position to that shown in FIGURE 1, carries on its inner surface **62** a plurality of shaft support bearings **63** for shaft **47**, idler gear **56**, and shaft **51** respectively. A plurality of support studs **64** are formed in chamber **19**, positioning cover plate **33** and limiting deflection of the cover plate against undue tightening of assembly screws **34**.

Impeller **42**, comprising hub **66** mounted upon a squared portion **67** of conveyer shaft **51**, is provided with a plurality of radial vanes **68**. As shown in FIGURE 7, impeller **42** is disposed within a volute **69**, as shown in dotted lines in FIGURE 7 in assembled position, the volute being formed as an integral inwardly extending wall of the discharge chamber cover plate **37**, and as shown in full in the reversed view. Primary air is admitted to the impeller adjacent its axis via a plurality of air admission ports **71** formed in the discharge chamber cover **37**. Primary air enters axially, is accelerated radially and tangentially by the rotating impeller vanes, trapped and directed by volute **69** at the high pressure and/or high velocity volute exit **72** positioned in alignment with discharge nozzle **26**.

Pulverulent material flow is accomplished axially along conveyer **39** through the medium of helix blades **52**, through discharge port **73** provided in wall **21** separating the hopper from discharge chamber **42**. As shown in FIGURE 4, material discharge port **73** terminates in a flared portion **74** adjacent the impeller, facilitating dis-

bursal of the material in the air stream generated by impeller-rotation within the volute construction.

As an important feature of the present invention, material discharge port **73** is formed with extended annular side walls **76**, while conveyer shaft **51** is provided with a relatively more narrow collar **77** disposed for rotation substantially at the transverse midpoint of discharge port **73**. Pulverulent material conveyed from the hopper must thus pass through the restricted annular opening defined by the constricting side walls **76** of the discharge port surrounding collar **77**. The material is thus effectively subjected to a rolling and crushing action immediately prior to its discharge into the impeller influence, promoting maximum degrading of material size and eliminating the possibility of lumps or compacted material being ineffectively dispensed by the impeller. The construction functions also as a flow metering control, restricting material flow to a rate within the impeller capacity and avoiding jamming or inoperability. The rolling and crushing action obtained with the present invention enables the control to function even though tightly packed with pulverulent material, as when initiating operation after an interval which has allowed the material to become gravity-packed.

It has been found further, that the relative relationships established by the discharge port and the collar rotating therein is an important one in attaining and controlling optimum effectiveness of pulverulent disbursal. As an aid in insuring precise assembly of the parts and maintenance of the clearance relationship of the impeller within the discharge chamber **22**, and of collar **77** within port **73**, conveyer shaft **51** is provided with a shoulder **75** against which hub **66** of the impeller, is designed to seat over the squared portion of the shaft. The conveyer shaft is provided with an outboard bearing for maintaining accurate rotational alignment, and as shown such bearing comprises a socket **78** provided in the discharge chamber cover plate **37** for receipt of the outboard end **79** of the conveyer shaft.

As a means of increasing the effectiveness of the material pickup by the impeller air stream, a secondary air admission port is provided adjacent the hub of the impeller in the relatively low pressure area of the impeller chamber. Such secondary air admission port comprises an arcuate slot **81** provided in the lower portion of inner wall **21** of the air discharge chamber, and the air flow through this latter port generates a material carrying current passing to the impeller vanes **68** in the immediate region of the flared outer lip **74** of the material discharge port. The discharge chamber cover plate **37** is assembled by means of a plurality of screws **34***a* threadably engaged in bosses **36** provided within the chamber, as shown disassembled in FIGURE 7.

Outlet nozzle **26** is positioned substantially at the midline of impeller **42** and is formed of cooperating half tube portions **82** and **83**, formed as parts of the front wall **12** of housing **11** and of discharge cover plate **37** respectively. A suitable ring **84** encircles the tapered portion **86** of the nozzle as an additional assembly means to the screws **34**, and maintains the parts in substantially air tight relationship against loss of pressure adjacent the nozzle.

As shown in FIGURE 8, a deflector **87** is provided for attachment to nozzle **26** as an aid in most effective disbursion and control of the discharged pulverulent material. Deflector **87** includes a tapered tube body **88** having a tapered internal bore portion **89** providing a tapered fit over outlet nozzle **26**. Deflector **87** terminates in a fan shaped discharge end **91**, and it will be clear that the pulverulent discharge may be directed upwardly, downwardly, or at any degree therebetween depending upon the angle at which the deflector is positioned over the tapered nozzle **26**.

As shown in FIGURE 3, optionally there may be provided a plurality of cooperating tapered tube extensions

92, each having an internally tapered socket **93** and an externally tapered plug end **94**, it being understood that plug ends **94** have an identical taper to that of nozzle **26** whereby any number of extensions may be joined together extending from the nozzle, and may be terminated in deflector **87**, positioned by means of the tapered joints to deflect the pulverulent material to the underside of foliage, or to whatever angle that may be desired.

As an aid in reducing unnecessary weight of the duster, the handle **14** may be formed with a hollow interior, and as shown in FIGURE 6 wherein the handle is split at the mid line, one section being formed integrally with the rear wall **13** of the housing, and such section provided with appropriate ribs and studs and cooperating with a similar detachable section to provide a light weight handle of comfortable size for gripping by the operator.

It will be clear that while I do not limit my invention to being formed in any particular material the design and structure shown lends itself to rapid assembly, which I accomplish as follows: Agitator **38** is positioned within the hopper, the one end **43** snapping into the appropriate opening in wall **21**, and the other end positioned to receive shaft **46** which is assembled from the free side of "drive" chamber **19** after idler gear **56** has been installed. Conveyer shaft **51** carrying bushing **59** is next inserted from the discharge chamber side, and gear **54** is positioned over the keyed shaft end meshing with idler gear **56**. "Drive" chamber cover plate **33** may now be installed, and hand crank **24** mounted on the outboard end of shaft **47**. Impeller **42** is next positioned over the squared end **67** of the conveyer shaft, bottoming against shoulder **75** for a predetermined fit; cover plate **37** may now be installed journalling the shaft and defining through half tubes **82** on housing **11** and **83** on the cover the discharge nozzle **26**. Tapered ring **84** may next be installed over the taper of the discharge nozzle and deflector **87** may either be mounted directly upon the discharge nozzle or at an extended distance therefrom by means of any desired number of tapered extension tubes **92**. The operator is thus afforded a light weight, conveniently arranged duster with which he may direct the pulverulent insecticide or other material upon foliage at any angle desired, and at any selected discharge height relative to the ground depending upon the number of tube extensions and the deflector setting selected.

I claim:

A hand duster of the character described, comprising:

a housing formed with front and rear walls and inset side walls defining a first side chamber and a second side chamber and a bottom wall extending between and connecting said side walls, at right angles thereto, and said front and rear walls, and defining a material hopper;

said bottom wall having an arcuate shape when reviewed on an axis perpendicular to said side walls;

side cover plates secured to said housing enclosing said chambers;

said front and rear walls and said cover plates presenting a substantially unobstructed outer surface and with said inset chambers providing maximum usable hopper volume for minimum overall dimensions;

an impeller mounted for rotation in said first side chamber;

a material discharge port in one of said inset side walls communicating with the input side of said impeller;

a front-mounted discharge nozzle communicating with the discharge side of said impeller;

an agitator means mounted for rotation in said hopper for movement adjacent said front, rear and bottom walls;

a conveyer means mounted in said hopper adjacent said bottom wall;

a hand crank mounted at the exterior of said second side chamber;

means including a gear train positioned in said second side chamber and operatively connecting said hand crank, agitator means, conveyor means and impeller for simultaneous movement;

a gripping handle provided at the rear wall of said housing and defining in conjunction with the lower portions of said first and said second side chambers a three-point mounting for maintaining said housing in a substantially erect at-rest position.

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