Dec. 18, 1956 C. H. WHITLOCK 2,774,636

HOPPER LOADERS

Filed Oct. 21. 1955 4 Sheets-Sheet 1

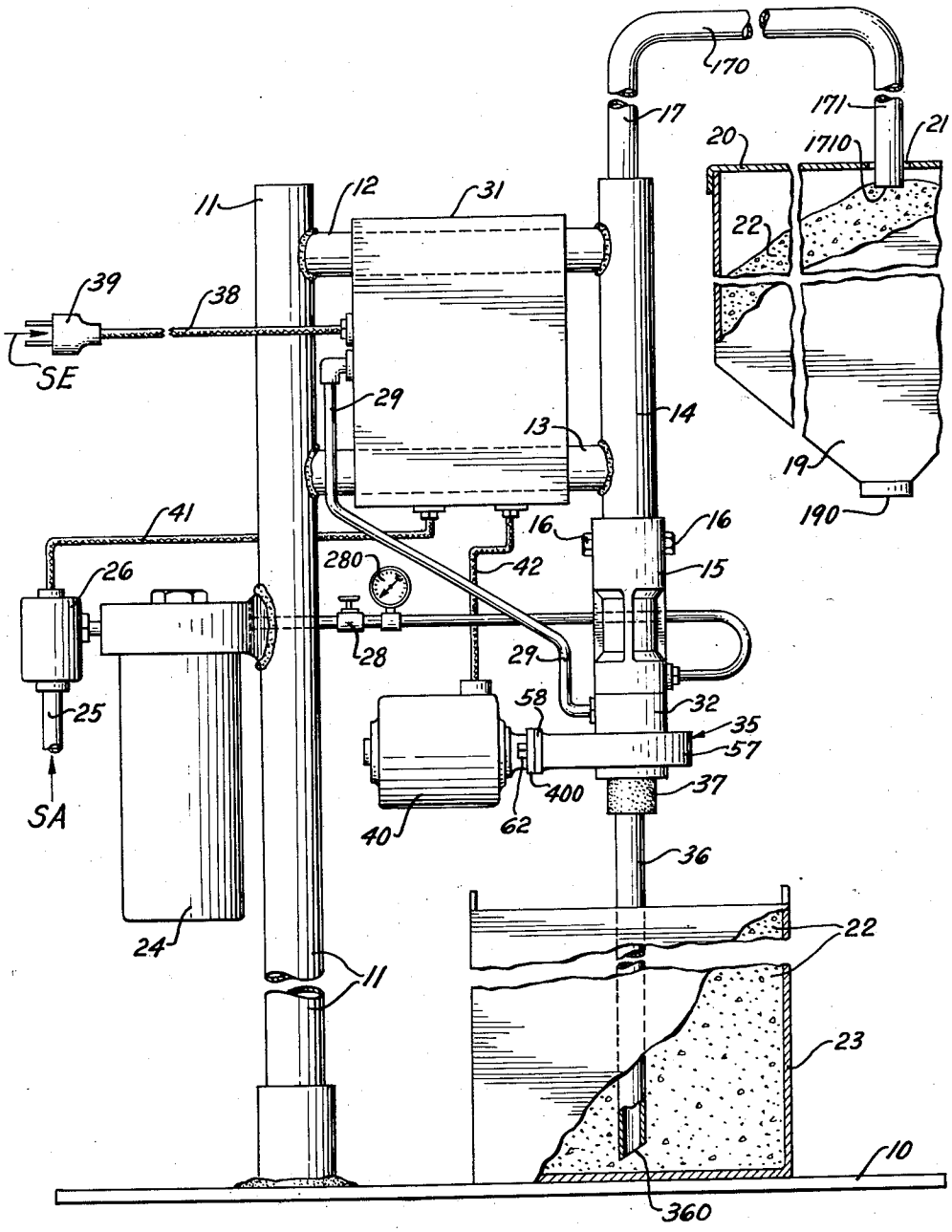


Fig. 1

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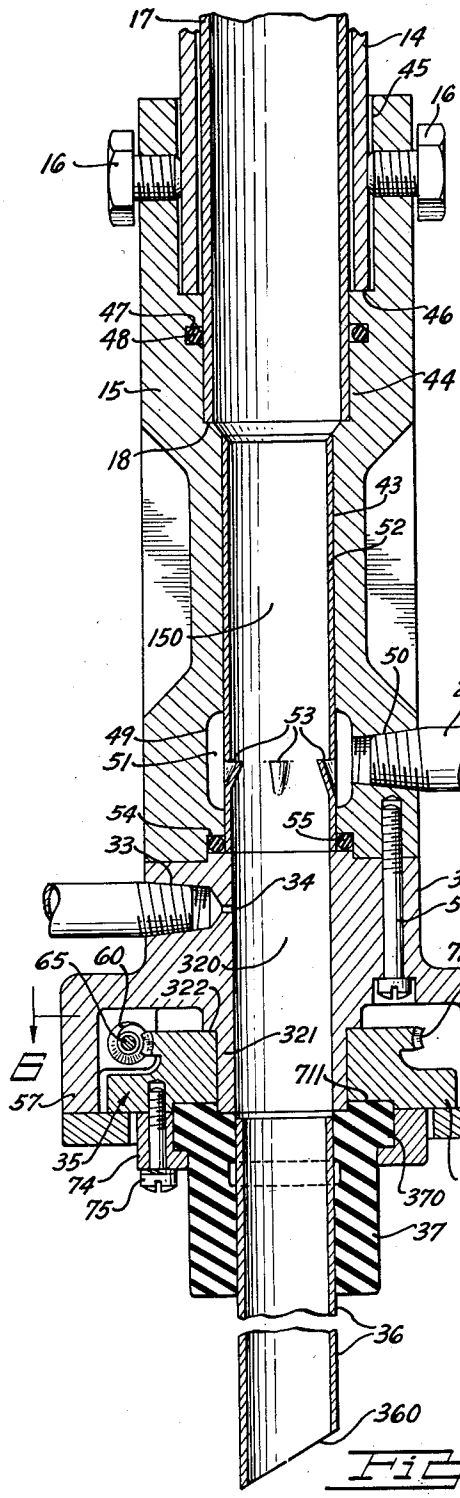


Fig. 2

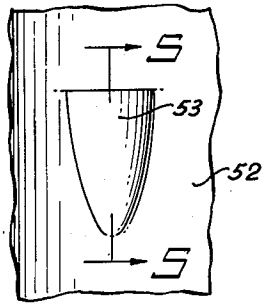


Fig. 4

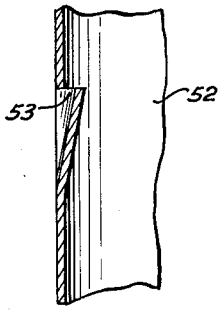


Fig. 5

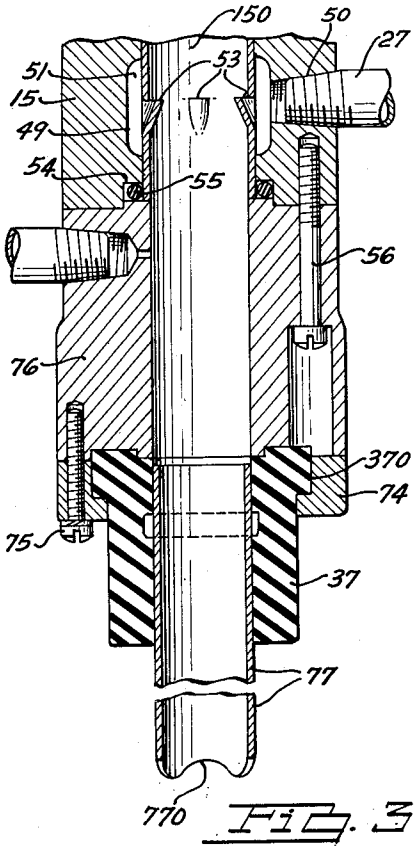


Fig. 3

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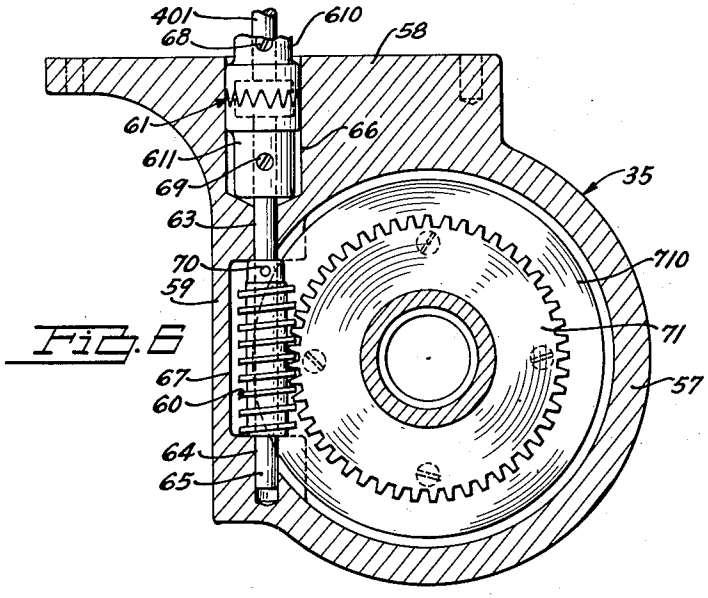


Fig. 6

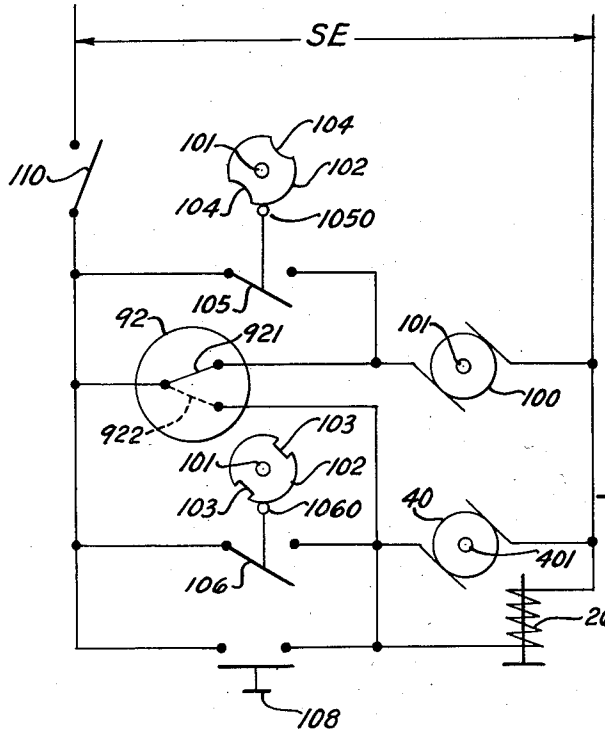


Fig. 7

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HOPPER LOADERS

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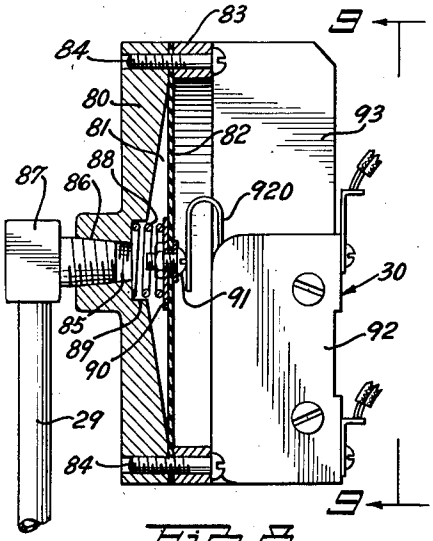


FIG. 8

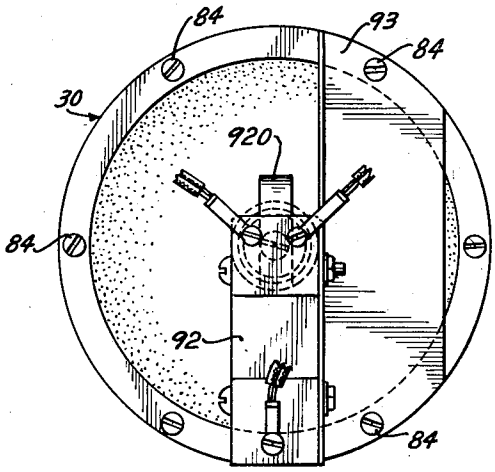


FIG. 9

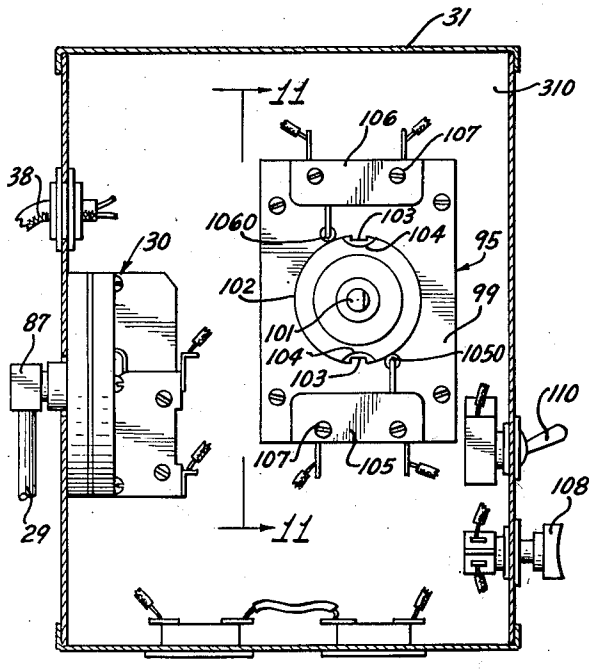


FIG. 10

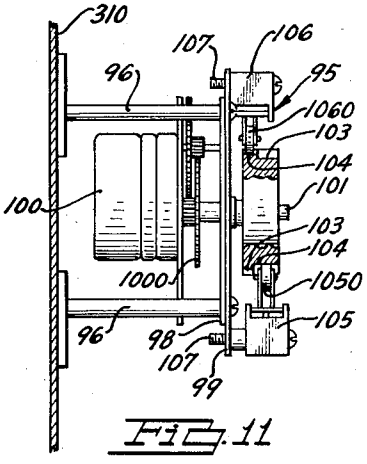


FIG. 11

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2,774,636

HOPPER LOADERS

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Application October 21, 1955, Serial No. 542,024

9 Claims. (Cl. 302—17)

This invention relates to hopper loaders of the type that transports and elevates coarse or finely ground granulated or pelletized material such as granules or pellets of plastic material or powdered material from bags, drums or other containers to the hoppers of molding machines or the like, which loaders automatically maintain the hoppers substantially filled at all times.

The primary object of the invention is to provide an inexpensive, simple, readily installed and easy to operate hopper loader which can handle free flowing granular or pelletized material directly from bags, drums or other containers located at floor level and deposit such material in an elevated hopper from which the material is fed by gravity to the point of use, the said hopper loader functioning responsive to improved compressed air and electrically operated mechanism under vacuum-electro controls to maintain the desired level of material in the hopper at all times.

Another object of the invention is to provide an improved hopper loader including a removable suction tube which permits rapid changeover from empty bags, drums or the like to full ones.

Another object of the invention is to provide an improved hopper loader including a rotating removable suction tube which prevents arching of granular or pelletized material in the shipping container from which it is drawn whereby to assure proper operation at all times without the necessity of constant attendance.

Another object of the invention is to provide a hopper loader which occupies substantially no more floor space than required to place a drum, bag or other container thereunder, and which requires no physical attachment to the hopper into which the material is fed from the container.

A further object of the invention is to provide an inexpensive trouble-free fully automatic hopper loader comprising a novel compressed air operated venturi loader mechanism including a rotating suction tube that lifts material from bags, drums or other containers to a hopper or the like and maintains material in the hopper at a predetermined level, the said loader mechanism including improved automatic vacuum operated means for shutting off the compressed air supply to the loader mechanism and means operable responsive to the said vacuum operated means for shutting off electric current to the means rotating the suction tube when the hopper is filled to the desired level, and including timer means for turning the said compressed air supply and electric current on again when the level of the material in the hopper drops below the normal "full" level established in the hopper by the location therein of the discharge tube from the hopper loader.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings in which:

Fig. 1 is a more or less diagrammatic elevational view showing a hopper loader mechanism embodying the invention.

Fig. 2 is an enlarged sectional view of the fixed venturi and the readily removable rotatable suction tube mechanism.

Fig. 3 is a sectional view similar to Fig. 2 except that a removable non-rotatable suction tube has been substituted for the removable rotatable suction tube mechanism.

Fig. 4 is a greatly enlarged elevational view of the venturi air jets shown in Figs. 2 and 3 taken from the inside of the fixed venturi.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is a horizontal sectional view taken on the line 6—6 of Fig. 2 showing the rotatable suction tube drive mechanism.

Fig. 7 is a diagram of the vacuum-electric control circuit preferably employed.

Fig. 8 is a vertical sectional view through the vacuum controlled switch mechanism.

Fig. 9 is a front elevational view taken on the line 9—9 of Fig. 8.

Fig. 10 is a front view, with the cover removed, of the control box in which the vacuum and timer cam operated circuits are housed showing both the vacuum controlled switch mechanism and the timer controlled switch mechanism preferably employed.

Fig. 11 is a view taken on the line 11—11 of Fig. 10 with parts broken away to show the construction of the timer controlled switch mechanism.

Referring now to the drawings wherein like reference numerals refer to like and corresponding parts throughout the several views, a hopper loader embodying the invention is shown more or less diagrammatically in Fig. 1 for illustrative purposes. The hopper loader preferably has a base **10** onto which is mounted an upright stanchion **11** from which the entire hopper loader mechanism is supported. Near the top of the stanchion **11** two vertically spaced laterally disposed cantilever arms **12** and **13** support a sleeve **14** which has a venturi **15** secured in telescopic depending relationship therefrom by such means as suitable studs **16**. The venturi **15** supports a discharge tube **17** which extends upwardly from a shoulder **18** therein through the sleeve **14**. The said discharge tube **17** has an upper horizontal portion **170** and a depending outer end portion **171** leading respectively laterally over and downwardly into a hopper **19**.

As an example, the hopper **19** may be the hopper of a plastic molding machine, not shown, arranged to discharge thereinto through a suitable bottom outlet **190**. The hopper **19** preferably has a cover **20** into the center of which is an aperture **21** through which the depending portion **171** of the discharge tube **17** is inserted into the said hopper **19** to a position where the bottom **1710** of the said depending portion **171** of the discharge tube **17** is located at the elevation to which the hopper **19** is to be filled and maintained filled with granular or peletized material **22** from a drum **23** or other container having granules or pelletized material **22** therein. The said drum **23** is positioned on the base **10** of the hopper loader, as shown in Fig. 1.

On the stanchion **11** is mounted an air filter **24** which is connected to a source of compressed air SA supplied by the compressed air supply line **25**. A spring closed electrically opened solenoid valve **26** interposed in the compressed air supply line **25** provides compressed air to the hopper loader venturi **15** when called for by the vacuum-electrically operated control mechanism as hereinafter described. The compressed air which passes through the solenoid valve **26** and the air filter **24** is supplied through a compressed air line **27** to the venturi **15**. A needle valve **28** is inserted in the compressed air line **27** for the purpose of regulating the amount of

compressed air supplied to the venturi 15 when the hopper loader is functioning. An air gage 280 is interposed in the compressed air line 27 between the needle valve 28 and the venturi 15 to permit visual checking of the operating back pressure when the hopper loader is functioning. A vacuum line 29 runs from a point below the venturi 15 to a vacuum controlled switch mechanism 30 located within the control box 31 which is mounted on the cantilever arms 12 and 13. Mounted in depending relationship from the venturi 15 is a collar 32 through which the vacuum line 29 is connected at 33 to a suction passage 34 in the said collar 32 aligned with the main venturi passage 150. In the collar 32 is incorporated suction tube rotating means 35 to which is removably connected a suction tube 36 by means of a friction connector 37 fixed to and rotatable with the said suction tube rotating means 35. With this friction type connector 37 the suction tube 36 may be readily connected to and removed from the said suction tube rotating means 35 to permit rapid change-over from an empty to a full drum or container 23. The lower end of the suction tube 36 is preferably cut on a diagonal as indicated at 360 which serves to prevent the granular or pelletized material 22 from arching in the drum or container 22 during the removal of the said material therefrom.

Within the control box 31 is vacuum and time controlled switch mechanism employed to operate the spring closed electrically opened solenoid valve 26 and to start and stop the suction tube rotating means 35. Electric current is supplied from a suitable source SE to the said control mechanism within the control box 31 by means of an electric cord 38 preferably having a suitable connector 39 on the free end thereof. Electric current is supplied from the said control mechanism within the control box 31 to the spring closed electrically opened solenoid valve 26 and to the electric motor 40 of the suction tube rotating means 35 by electric cords 41 and 42 respectively.

Referring now particularly to Fig. 2, the venturi 15 is bored at 43 and counterbored at its upper end at 44 and 45 to provide shoulders 46 and 18 respectively. The shoulder 46 abuts against the lower end of the sleeve 14 secured to the ends of the cantilever arms 12 and 13. The discharge tube 17 is supported in telescopic relationship in the counterbore 45 and abuts against the shoulder 18 as hereinbefore described. The venturi 15 is internally grooved at 47 to accommodate an O-ring 48 which provides an air tight seal between the discharge tube 17 and the counterbore 45.

The lower portion of the bore 43 of the venturi 15 is provided with an annular internal groove at 49, and is radially bored and threaded at 50 to accommodate the compressed air line 27 which communicates with the air distribution chamber 51 formed by a venturi liner 52 which is telescopingly positioned over the said internal groove 49 within the venturi 15. The venturi liner 52 has a plurality of upwardly discharging venturi jets 53 therein preferably formed as shown in Figs. 2, 4 and 5. The bottom of the venturi 15 is counterbored at 54 to form in cooperation with the lower end of the venturi liner 52 an annular groove which accommodates an O-ring 55 to provide an air seal between the lower end of the venturi 15 and the collar 32 depending therefrom when the said collar 32 is firmly secured to the said venturi by such means as the studs 56.

The upper wall of the collar 32 is radially bored and counterbored at 33 and 34 respectively. The bore 33 is suitably threaded to receive the vacuum line 29, and the counterbore 34 serves as a suction passage between the vacuum line 29 and the central passage 320 of the collar 32 which is aligned with the main venturi passage 150. The lower end of the collar 32 is bell shaped and has an annular depending flange 57. Two sides of the annular depending flange 57 of the collar 32 are extended as best shown in Fig. 6 to provide a motor mounting

flange 58 and a worm and coupling housing 59 to accommodate the motor 40 and the worm 60 and coupling 61 respectively of the suction tube rotating means generally designated by the numeral 35. The said motor 40 is secured to the motor mounting flange by such means as studs 62 extending through a suitable motor flange 400. The said worm and coupling housing 59 is bored at 63 and 64 to rotatably accommodate a stub shaft 65 onto which the driven coupling element 611 of the coupling 61 and the worm 60 are non-rotatably fixed. The said worm and coupling housing 59 is counterbored at 66 to accommodate the coupling 61 and is milled out at 67 to accommodate the worm 60. The drive coupling element 610 of the coupling 61 is fixed by a stud 68 to the shaft 401 of the motor 40 for rotation thereby. The said drive coupling element 610 meshes with the driven coupling element 611 to rotate the stub shaft 65 and the worm 60 mounted thereon. The driven coupling element 611 and the worm 60 are non-rotatably fixed to the stub shaft 65 by such means as the stud 69 and pin 70 respectively.

In mesh with the worm 60 is a worm gear 71 which is journaled on the central cylindrical lower end 321 of the collar 32 below a shoulder 322 formed thereon. The said worm gear 71 is provided with a lower annular flange 710 which rotates with the worm gear 71 on an annular bearing plate 72 secured by means of studs 73 to the bottom of the annular depending flange 57 of the collar 32. The said bearing plate 72 maintains the worm gear 71 in its proper axial position adjacent the shoulder 322 of the central cylindrical lower end 321 of the collar 32, and thereby properly aligns the said worm gear 71 in mesh with the worm 60. The friction type connector 37 which removably holds the upper end of the rotatable suction tube 36 to the worm gear 71 of the suction tube rotating means 35 is formed of relatively firm tubular rubber or neoprene and has an enlarged head 370. A flanged retaining ring 74 telescoped onto the connector 37 below the head 370 thereof is employed to fix the said connector 37 centrally onto the bottom of the lower annular flange 710 of the worm gear 71 and against the end face of the central cylindrical lower end 321 of the collar 32. The said flange 710 of the worm gear 71 is preferably counterbored at 711 as shown in Fig. 2 to receive the uppermost portion of the enlarged head 370 of the connector 37 and hold it centrally with respect to the said worm gear 71. Studs 75 secure the said flanged retaining ring 74 and the connector 37 to the worm gear 71.

Where the type of granules or pelletized material 22 to be handled by the hopper loader permits, the collar 76 shown in Fig. 3 is substituted for the collar 32 shown in Fig. 2, the said collar 76 and friction type connector 37 holding the suction tube 77 in non-rotatable readily removable relationship onto the lower end of the venturi 15. According to the material 22 to be handled, the lower end of the suction tube 77 may or may not be cut on a bevel or scalloped as indicated by the reference numeral 770 in Fig. 3.

The vacuum controlled switch mechanism 30 shown in Figs. 8 and 9 is operated by suction created in the central pasage 320 of the collar 32 disposed below and in communication with the main passage 150 of the venturi 15. Suction created in the said central passage 320 of the collar 32 communicates with the vacuum controlled switch mechanism generally designated by the numeral 30 through the suction passage 34 and the vacuum line 29 connected at 33 to the said suction passage 34. The said vacuum controlled switch mechanism 30 consists of a housing 80 formed to provide a vacuum chamber 81 over which is stretched a suitable diaphragm 82 which is anchored in place by an anchor ring 83 and studs 84. The housing 80 is centrally bored at 85 and threaded at 86 to accommodate a fitting 87 employed to connect the vacuum line 29 to the vacuum

chamber **81**. The diaphragm **82** is spring loaded by a suitable compression spring **88** to its neutral position shown in Fig. 8 assumed when no or not sufficient vacuum exists in the vacuum line **29** to depress the said diaphragm **82**. The spring **88** is maintained central with respect to the housing **80** and the diaphragm **82** by positioning the said spring **87** in a counterbore **89** within the housing **80**. The diaphragm **82** is provided with a central wear plate **90** fixed thereto by a suitable bolt **91**. The head of the bolt **91** serves as a contact between the diaphragm **82** of the vacuum controlled switch mechanism **30** and the actuating arm **920** of a double pole micro switch **92** suitably mounted on the housing **80** by a supporting angle **93** secured to the said housing **80** by two of the same studs **84** that secure the diaphragm anchor ring **83** in place.

Fig. 10 shows the control box **31** with the cover thereof removed, and with the vacuum controlled switch mechanism **30** mounted on one side thereof. Also shown in Fig. 10 and in Fig. 11 is the timer controlled switch mechanism **95** which is mounted within the control box **31** on a plurality of arms **96**, each fixed at its inner end to the back plate **310** thereof. The free outer ends of the arms **96** accommodate studs **97** which extend through and secure mounting plates **98** and **99** onto the said outer ends thereof. A synchronous timer motor **100** is fixed to the inner mounting plate **98** with its shaft connected through suitable reduction gearing **1000** to a slow speed shaft **101** which is connected in driving relationship to a cam wheel **102** rotatably mounted on the mounting plate **99**. Into the periphery of the said cam wheel **102** are cut pairs of inner and outer adjacent diametrically oppositely disposed cams **103** and **104**, respectively. Cam followers **1060** and **1050** extend respectively from the actuating arms of upper and lower switches **106** and **105** to operate the said switch **106** and **105** as hereinafter described. The cam follower **1060** of the upper switch **106** rides on the axially inner periphery of the cam wheel **102** and drops into the inner narrow rectangular cam grooves **103** therein when the cam wheel **102** is turned by the motor **100** to present a cam groove **103** in registry therewith. The cam follower **1050** of the lower switch **105** rides on the axially outer periphery of the cam wheel **102** and drops into the inner relatively wide arcuate cam grooves **104** therein when the cam wheel **102** is turned by the motor **100** to present a cam groove **104** in registry therewith. Because of the relative shape and extent of the cam grooves **103** and **104**, each cam groove **103** causes the switch **106** actuated thereby to open after and close before the opening and closing of the switch **105** as the cam wheel **102** rotates clockwise as viewed in Fig. 10. The said switches **105** and **106** are mounted on the outer mounting plate **99** by such suitable means as the studs **107**. The upper switch **106** operates the timer motor **100**, and the lower switch **105** operates the motor **40** which drives the rotatable suction tube **36**.

When in use, the hopper loader is placed alongside a hopper **19** and its discharge tube **17** is positioned in the hopper **19** with the bottom **1710** of the depending portion **171** of the said discharge tube **17** located at the elevation to which the hopper **19** is to be filled. The compressed air supply line **25** is connected to a suitable source of compressed air SA, and the electric connector **39** is connected to a suitable source of electric current SE. A drum or other container **23** filled with pelletized or either coarse or finely ground granular material **22** is placed on the base **10** of the hopper loader. The suction tube **36** is placed in the said container **23** and is connected to the venturi **15** through the connector **37**, the suction tube rotating means **35** and the collar **32**. The electric control circuit shown in Fig. 7 is closed by manually closing the off-on switch **110**. The double pole switch **92** is normally maintained by the compression spring **88** of the spring loaded diaphragm **82** of the vacuum controlled

micro switch mechanism **30** in its "non-load" position indicated by the full line **921** in Fig. 7, and is maintained in such position until sufficient vacuum is created within the vacuum chamber **81** of the said vacuum controlled switch mechanism **30** by compressed air passing through the venturi **15** to actuate the said double pole switch **92** to its "load" position indicated by the dotted line **922** in Fig. 7.

When the said double pole micro switch **92** is in its "load" position as indicated by the dotted line **922**, electric current is applied to the spring closed electrically opened solenoid valve **26** to open the same whereupon compressed air is supplied from the compressed air supply line **25** to the venturi **15**. The compressed air passes upwardly through the venturi jets **53** creating sufficient suction in the suction tube **36** to lift material **22** from the drum or container **23** to the venturi tube **15** from whence the said material **22** is carried by the airstream from the venturi jets **53** through the discharge tube **17** into the hopper **19**. Also, when the said two-way switch **92** is in its "load" position, electric current is applied to the electric motor **40** of the suction tube rotating means **35** to rotate the suction tube **36** whereby to prevent arching of the granular or pelletized material **22** across the end of the suction tube **36** and/or arching of the said material in the drum or other container **23**.

When the hopper **19** is filled with granules **22** up to the bottom **1710** of the depending portion **171** of the discharge tube **17** as shown in Fig. 1, the velocity of air passing through the venturi **15** drops and a corresponding drop occurs in the suction created below the venturi jets **53** whereupon material **22** ceases to be lifted from the drum or container **23**, and, at the same time, the vacuum in the vacuum chamber **81** of the vacuum controlled switch mechanism **30** drops. When the vacuum in the vacuum chamber **81** drops sufficiently, the compression spring **88** of the vacuum controlled switch mechanism **30** takes over, and the double pole switch **92** thereof is moved to its non-load position as indicated by the full line **921** in Fig. 7.

When the double pole switch **92** is in its "non-load" position indicated by the full line **921** in Fig. 7, electric current is supplied to the timer motor **100** which turns the cam wheel **102** slowly, for example, at a rate of six revolutions per hour. As seen as an arcuate cam **104** of the cam wheel **102** registers with the cam follower **1050** of the switch **105**, the said switch **105** closes a parallel timer motor circuit assuring the rotation of the cam wheel **102** even though current supplied to the clock motor **100** through the double pole switch **92** may be interrupted when the said switch **92** is moved to its "load" position by vacuum applied to the vacuum chamber **81** of the vacuum controlled switch mechanism **30** responsive to suction created in the central passage **320** of the collar **32** by compressed air passing from the jets **53** upwardly through the venturi **15**.

After an arcuate cam **104** of the cam wheel **102** closes the said parallel timer circuit through the switch **105**, an adjacent rectangular cam **103** of the cam wheel **102** registers with the cam follower **1060** of the switch **106**, and the said switch **106** closes a parallel solenoid circuit assuring that the solenoid valve **26** is actuated to supply compressed air to the jets **53** of the venturi **15** even though current supplied to the solenoid valve **26** through the double pole switch **92** is interrupted when the said switch **92** is moved to its "non-load" position by the dropping of the vacuum applied to the vacuum chamber **81** of the vacuum controlled switch mechanism sufficiently to permit the compression spring **88** thereof to take over, the said vacuum applied to the vacuum chamber **81** dropping responsive to the hopper **19** becoming loaded so that material **22** therein substantially closes off the depending end **1710** of the discharge tube **17** from the venturi **15**.

It will be noted that each rectangular cam **103** is sufficiently long to provide a 5 to 10 second dwell of the cam

follower 1060 to maintain the parallel solenoid circuit established by the closing of the switch 106 a sufficient length of time to cause the solenoid valve 26 to open and permit a sufficient vacuum to become established in the vacuum chamber 81 of the vacuum controlled switch mechanism 30 to move the double pole switch 92 to its "load" position; the foregoing occuring only in the event the level of material 22 in the hopper 19 has fallen below the level of the bottom 1710 of the depending end 170 of the discharge tube 17. In the event the said material 22 in the hopper 19 has not fallen below the level of the bottom 1710 of the discharge tube 17, and since no additional material is needed in the hopper 19, no vacuum can be created in the vacuum chamber 81, therefore, the said switch 92 remains in its "non-load" position. Obviously, when no material is needed in the hopper 19, the solenoid valve 26 is closed by the breaking of the solenoid circuit responsive to the opening of the switch 106 when the cam follower 1060 leaves the cam 103 as the timer mechanism continues in its cycle which, with the mechanism hereinbefore described, probes the hopper 19 intermittently to determine whether or not additional material 22 is required therein.

In other words, the arcuate cams 104 and rectangular cams 105 are so arranged with respect to each other and to the cam followers 1040 and 1050 respectively that current to operate the timer motor 100 and current to operate the solenoid valve 26 is always available regardless of the position assumed by the vacuum operated double pole switch 92. Thus, when the switch 106 controlled by a rectangular cam 105 passes through an "on" and "off" cycle with the double pole switch 92 positioned as indicated by the numeral 922 in Fig. 7, the availability of electric current to the timer motor 100 is assured whereby to prevent stalling of the fully automatic compressed air and electrically operated vacuum-electric controls employed to maintain the hopper 19 loaded to the desired level at all times.

To avoid waiting for the timer mechanism to open the solenoid valve 26 by closing the switch 106 when the hopper loader mechanism is first started, a starter circuit controlled by a starter switch 108 is employed to open the said solenoid valve 26. As soon as vacuum is created in the vacuum chamber 81, the double pole switch 92 is thrown from its "non-load" position indicated by full line 921 in Fig. 7 to its "load" position indicated by the dotted line 922, whereupon the normal automatic cycle of operation of the hopper loader begins to function.

Although but a single embodiment of the invention and one modification thereof has been disclosed and described herein, it is obvious that many changes may be made in the size, shape, arrangement and detail of the various elements of the invention without departing from the spirit and scope thereof as defined by the appended claims.

I claim:

1. In a hopper loader, venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a rigid suction tube positionable in a container of material to be loaded into a hopper, a flexible connector associated in rotatable sealed relationship with said venturi removably and flexibly connecting said rigid suction tube to said venturi in communication with the vacuum side thereof, the lower end of said suction tube being diagonally cut, and means operative responsive to the establishment and maintenance of a predetermined vacuum in said suction tube rotating said suction tube whereby to assure withdrawal of material from said container substantially uniformly around the lower end of said suction tube, and a discharge tube communicating between said venturi airstream and said hopper.

2. In a hopper loader, in combination venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a suctioin tube communicating from a container of material to be loaded into a hopper to said venturi below said jets, a discharge tube communicating from said venturi above said jets to said hopper and extending into said hopper to the elevation to which the hopper is to be filled and maintained filled with said material, a compressed air supply to said jets, and means shutting off the said compressed air supply actuated by a drop in vacuum in the suction line below said venturi air jets responsive to either the filling of said hopper with material up to the bottom of the discharge tube and/or the emptying of the said container, said shut-off means including means re-establishing the compressed air supply to said venturi responsive to material in said hopper falling below the said bottom of the discharge tube and/or replacement of the empty container with one containing material to be loaded in said hopper.

3. In a hopper loader, in combination venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a suction tube positionable in a container of material to be loaded into a hopper, a rotatable flexible connector associated with said venturi removably connecting said suction tube to said venturi in communication with the vacuum thereof, a discharge tube communicating between said venturi airstream and said hopper with the free end thereof depending into said hopper, a compressed air supply to said venturi jets loading said hopper from said container, vacuum operated vacuum-electro control means connected to the suction side of said venturi adapted to provide compressed air to said venturi when the level of material in said hopper falls below the bottom of the free end of said discharge tube and shut off said compressed air when material in said hopper becomes filled to the free end of said discharge tube, and means operable responsive to said vacuum-electric control means rotating said rotatable connector and said suction tube during the transfer of said material from said container to hopper.

4. In a hopper loader, venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a suction tube positionable in a container of material to be loaded into a hopper, a connector associated with said venturi removably connecting said suction tube to said venturi in communication with the vacuum thereof, a discharge tube communicating between said venturi airstream and said hopper with the free end thereof depending into said hopper, a compressed air supply to said jets, a spring loaded closed electrically opened solenoid valve in said compressed air supply, a timer means opening said solenoid valve intermittently to supply compressed air to said jets for short periods of time, and vacuum-electric control means connected to the suction side of said venturi operable when said solenoid valve has been opened by said timer means to maintain said solenoid valve open whenever the level of material in said hopper has fallen below the bottom of the free end of said discharge tube, the said vacuum-electric control means shutting off said compressed air supply when the said hopper becomes filled with material sufficiently to substantially close the bottom of the free end of the said discharge tube.

5. A hopper loader as claimed in claim 7 wherein the timer means comprises a cam wheel, a motor slowly rotating said cam wheel, a timer motor circuit normaliy closed by the said vacuum-electric control means, said cam wheel having axially adjacent long and short dwell cams in the periphery thereof, a timer controlled solenoid valve circuit including a cam wheel opened switch operated by said short dwell cam to close said circuit to said solenoid valve and open the said valve periodically for short intervals of time, a second timer motor circuit in parallel with said first mentioned timer motor circuit, said second timer circuit including a cam wheel opened switch operated by said long dwell cam closing said second timer circuit to assure continuous operation of the timer means whenever the said short dwell cam opens said solenoid valve at any time the said vacuum-electric control means closes or holds the first mentioned timer motor circuit closed.

6. A hopper loader as claimed in claim 7 wherein the vacuum-electric control means comprises a double pole switch element normally closing a timer motor circuit in said timer means, a normally open solenoid circuit, and spring loaded vacuum operated means operable responsive to sufficient vacuum being created in the suction side of said venturi to overcome the spring loading thereof actuating said double pole switch to open the said normally closed timer motor circuit and to close the said solenoid valve circuit to open said valve, the said double pole switch element opening the said solenoid circuit and closing the said timer circuit whenever sufficient vacuum ceases to be created in the suction side of said venturi to operate the said spring loaded vacuum operated means.

7. In a hopper loader, venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a suction tube positionable in a container of material to be loaded into a hopper, a connector associated in rotatable relationship with respect to said venturi removably connecting said suction tube to said venturi in communication with the vacuum thereof, a discharge tube communicating between said venturi airstream and said hopper with the free end thereof depending into said hopper, a compressed air supply to said venturi jets, a spring loaded normally closed electrically opened solenoid valve in said compressed air supply, timer means opening said solenoid valve intermittently to supply compressed air to said jets for short periods of time, vacuum-electric control means connected to the suction side of said venturi operable by suction created in said venturi after said solenoid valve has been opened by said timer means if and when the level of material in said hopper has fallen below the bottom of the free end of said discharge tube, the said vacuum-electric control means shutting off said compressed air supply when material in said hopper rises to the bottom of the free end of the said discharge tube and substantially closes the same, and means rotating said suction tube responsive to the operation of said vacuum electric control means to open said solenoid valve.

8. In a hopper loader for filling a hopper with material to a predetermined level and maintaining said hopper filled to said level, venturi means including air jets therein creating a vacuum therebelow and an airstream thereabove, a suction tube communicating from a container to said venturi below said jets, a discharge tube communicating from said venturi above said jets to said hopper having its free end extending therein to the elevation to which the hopper is to be filled and maintained filled, a compressed air supply to said jets, spring loaded valve means normally shutting off the compressed air supply to said venturi jets, time controlled means operating electro-magnetic means for opening said valve means to periodically supply air to said venturi jets, and vacuum-electric control means deriving its vacuum from suction created in the venturi below said venturi jets maintaining said electro-magnetic valve means open after having been opened by said time controlled means whereby to continue the compressed air supply to said venturi jets whenever the material in the hopper has fallen below the level of the bottom of the end of the discharge tube within said hopper, said vacuum-electric control means maintaining the said electro-magnetic valve means open until the hopper has been filled with material to the said level of the bottom of the discharge tube within said hopper.

9. A hopper loader as claimed in claim 8 including means rotating said suction tube during the period of time the said electro-magnetic valve means is opened and maintained open by said control means.

References Cited in the file of this patent

UNITED STATES PATENTS

228,206	Luckenbach	June 1, 1880
1,530,654	Daley	Mar. 24, 1925
2,148,501	Rasor	Feb. 28, 1939
2,544,011	Duvall	Mar. 6, 1951