Jan. 31, 1967 E. M. LAU 3,301,280

BAG FILLING MACHINES

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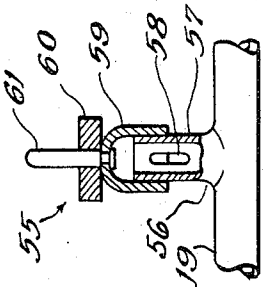


FIG 5

FIG. 1

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FIG. 2

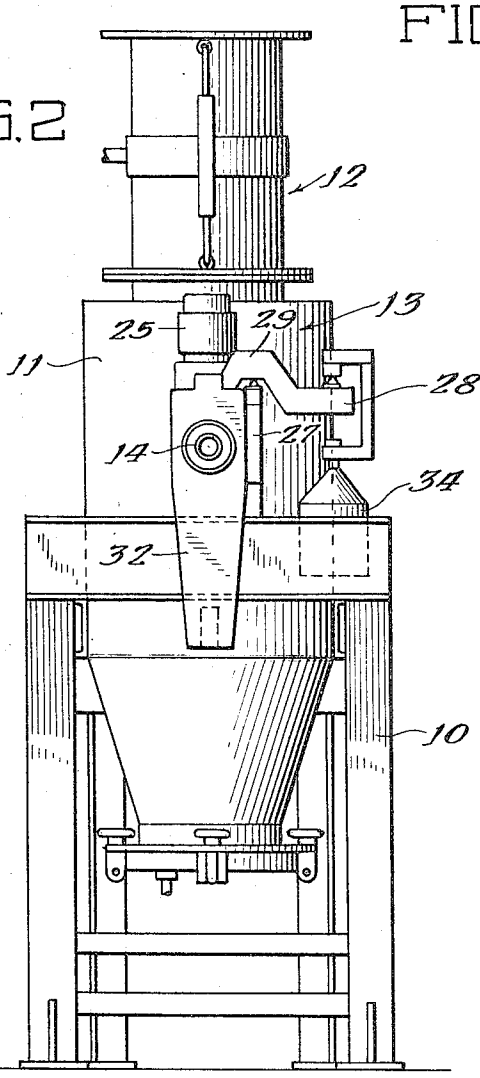
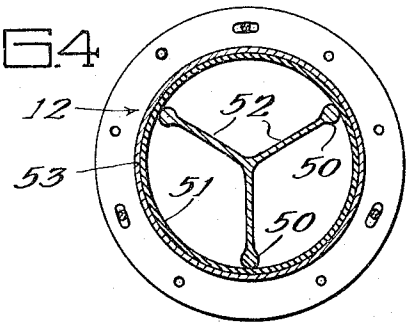


FIG. 4



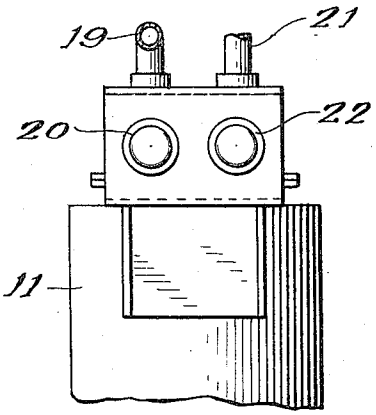
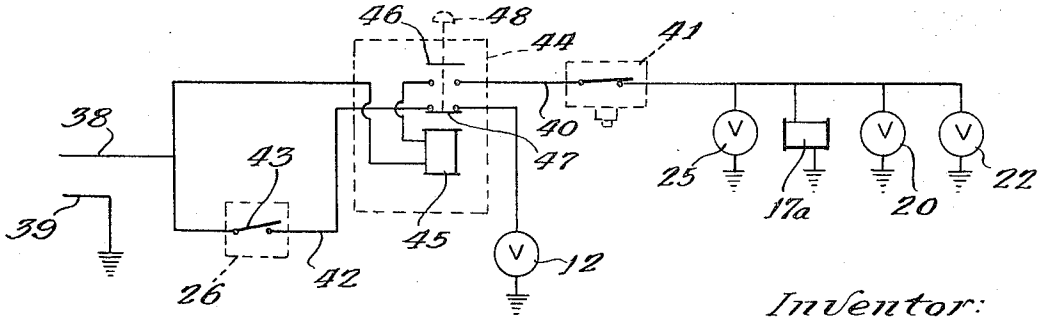


FIG. 3

FIG. 6



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BAG FILLING MACHINES

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6 Claims. (Cl. 141—68)

This invention relates to bag filling machines of the fluidizing type.

It is an object of the present invention to provide a machine which requires less head room that the usual fluidizing type bag filling machine.

In a bag filling machine such as that shown in my prior Patent No. 2,936,994, granted May 17, 1960, the spout of the machine stands about four feet above the floor, and since the spout communicates with the bottom of a conditioning chamber, which may be four feet high for example, the over all height of the bag filling machine will be approximately eight feet. The inlet valve for the conditioning chamber will add another foot and a half or more.

In accordance with the present invention, I locate the conditioning chamber at a lower level so as to reduce the over all height, and provide means for elevating the powdered or granular material from the bottom of the conditioning chamber up to the level of the spout.

It has been previously proposed to elevate powdered materials by a combination of fluidizing action and air jet means. However, this arrangement is not satisfactory for bag filling machines because of the difficulty in venting from the bag the large volume of air used in connection with the air jet means.

I have found that I can elevate the material by a combination of fluidizing means and auxiliary air supplied to the upper part of a closed chamber which increases the head of the material sufficiently as to cause the fluidizing material to move upwardly through the conduit, just as a liquid would. By virtue of this arrangement, there is no excess air passing into the bag over and above the fluidizing air, with the result that special bag venting means need not be used in the case of the usual porous wall or kraft paper bag.

Another object is to provide a low head room bag filling machine in which the conditioning chamber can be sealed against the loss of pressure through the inlet valve.

A further object is to provide in such a machine, an elevating conduit which will not materially slow up the bag filling rate, and which is not subject to clogging.

Still another object is to provide a machine of this type which will satisfactorily handle powdered and granular materials of widely differing specific gravities, and of widely differing fluidizing and flow characteristics. In the attainment of this objective I provide an arrangement in which the auxiliary air is supplied at a uniform and comparatively low pressure which can be regulated to a fine degree.

Other objects, features and advantages will become apparent as the description proceeds.

With reference now to the drawings in which like reference numerals designate like parts:

FIG. 1 is a side elevation showing a preferred embodiment of my invention, the conditioning chamber being partially broken away;

FIG. 2 is a front view thereof;

FIG. 3 is a fragmentary rear elevation taken along line 3—3 of FIG. 1;

FIG. 4 is a horizontal section of the inlet valve taken along the line 3—3 of FIG. 1;

FIG. 5 is a sectional view showing a suitable type of pressure relief valve; and

FIG. 6 is an electrical diagram illustrating the operation of the machine.

The bag filling machine comprises a framework **10** supporting a conditioning chamber **11** adapted for location

underneath a supply hopper, not shown. An inlet valve **12** is provided for the upper end of the conditioning chamber and is of an expanding sleeve type which will arrest falling particles and at the same time provide an air tight seal for the conditioning chamber **11**. This type of sleeve valve is characterized by a core having vertical members **50** located adjacent the inner surface of the sleeve **51** so as to divide the same into three or more separate expansible segments, as shown in FIG. 4, and as described in greater detail in my copending application, Serial No. 79,796, filed December 30, 1960, now Patent No. 3,103,300, granted September 10, 1963. The vertical members **50** are preferably connected to each other by radial webs **52**. A cylindrical casing **53** surrounds the sleeve **51**; air introduced between the housing **53** and sleeve **51** expands the sleeve segments to close the valve.

The machine also includes scale mechanism **13** which is located in front of the conditioning chamber **11**, and a bag supporting spout **14** which is supported by the scale mechanism.

The conditioning chamber **11** has a diffuser pad **15** located at the lower end, together with an air supply line **16** and a suitable control valve **17** which may be an electrically actuated valve.

When air is caused to flow through the supply line **16** and the diffuser pad **15**, the material adjacent to the pad within the conditioning chamber **11** is fluidized and will tend to flow like a liquid through an outlet which communicates with a point of lower pressure.

According to my invention I provide a conduit **18** which extends from a point immediately above the center of the diffuser pad **15** to the spout **14**, and I supply auxiliary air to the conditioning chamber when the inlet valve **12** is closed to create a pressure condition such that the conduit **18** provides an outlet leading from the pressurized conditioning chamber **11** to a point of atmospheric pressure, such as the end of the spout **14**. As a result, the pressure conditions cause the fluidized material to rise upwardly through the conduit and to flow through the spout and into the bag.

As shown in FIG. 3, an auxiliary air conduit **19** communicates with the upper end of the conditioning chamber **11** by means of pressurizing valve **20**, and a vent conduit **21** communicates with the upper end of the conditioning chamber **11** by means of vent valve **22**. Thus, during the bag filling step, the vent **21** is closed and the pressurizing valve **20** is open so that air can be supplied to the conditioning chamber **11** to cause material to flow upwardly through the conduit **18** and into the bag **23**.

The spout **14** communicates with the conduit **18** by a flexible rubber tube **24** which permits relative up and down movement of the spout and scale mechanism with respect to the remainder of the conduit **18**. A cut-off valve **25** is located between the flexible rubber tube **24** and the conduit **18** to shut off the flow of material at the conclusion of the bag filling operation.

The valves **20**, **22** and **25** are preferably air actuated pinch valves, of the general type shown in my aforesaid Patent No. 2,936,994.

When the weight of the bag and contents reaches a predetermined amount such as one hundred pounds the scale mechanism **13** is tripped, and the cut-off valve **25** is closed to cut off the flow of powdered or granular material through the spout **14** in order to terminate the bag filling step. The fluidizing air to the diffuser pad **15** is preferably cut off at this time also by the electrically actuated valve **17**.

The conditioning chamber **11** preferably has a capacity of from one and a quarter to two times the amount of material to be fed into the bag **23**, not including the free space above the paddle **26***a*, although the ratio may be as high as four to one or more, as when a one hundred

pound bag machine is set to fill a fifty pound bag. At any rate, the machine is designed so that the conditioning chamber **11** is filled after every bag filling operation. Thus, the inlet valve **12** is automatically opened at the conclusion of each bag filling operation for a short interval to permit the required charge of material to flow from the hopper (not shown) into the conditioning chamber. It is preferable to control the operation of the inlet valve **12** by a level responsive device **26** so that a free space is maintained in the upper portion of the conditioning chamber, as pointed out in Zenke Patent No. 3,073,401 granted January 15, 1963. A suitable type level responsive device is shown in my copending application filed November 2, 1962, Serial No. 234,991, now Patent No. 3,210,495, granted October 5, 1965. Thus, the inlet valve **12** may be automatically opened by the tripping of the scale mechanism, and can be closed by the operation of the level responsive device **26**.

The scaling mechanism **13** may be either of the type shown in my aforesaid Patent No. 2,963,994, or of the type shown in my copending application, Serial No. 171,200, filed February 5, 1962, now Patent No. 3,133,608, granted May 19, 1964. However the latter arrangement is preferred for this particular low head room type of bag filling machine for the reason that the pressure incident to the bag filling operation tends to produce a more dusty environment with the result that a construction having a minimum number of bearing points is preferred.

The scaling mechanism shown includes a vertically oriented U-shaped fulcrum member **27** mounted on the framework **10** and which supports a horizontally oriented U-shaped beam **28** having front and rear arms **29** and **30** which cooperate with the bearing points of the fulcrum member **27**. According to this arrangement, the fulcrum axis is parallel to the axis of the spout **14** with the result that variation in the longitudinal position of the bag **23** on the spout will not vary the length of the lever arm and hence affect the accuracy of the scale mechanism.

The scale mechanism also includes a suspended spout assembly **31** which is in the form of a cradle supported from the front and rear arms **29** and **30** of the beam **28**. The cradle **31** includes a front plate **32** in which the spout **14** is mounted, and preferably includes counterweights **33** located at the rear to prevent forward tipping of the cradle as the bag is being filled.

A counterbalance **34** is suspended from the longitudinal connecting member of the beam **28** by means of suitable bearing points in order to determine the point at which the scale mechanism **13** trips. This arrangement is described in greater detail in my aforesaid copending application, Serial No. 171,200.

It will be observed that the conduit **18** has a vertical span **35**, a horizontal span **36**, and a curved connecting portion **37**. According to my invention, the bend between the horizontal and vertical spans is preferably in the form of a curved portion **37** of relatively large radius. In the embodiment shown, the conduit has an inner diameter of two inches and the radius of curvature of the bend **37** is substantially nine inches. It has been found that where a sharp bend is introduced in the conduit **18**, that there is a tendency for the material flowing through the conduit to give up a part of its fluidizing air at the sharp bend, with the result that the material passing through the horizontal span **36** is less fluid. As a result the delivery rate is substantially reduced, and the conduit is subject to clogging. These objections are avoided by my improved design.

The auxiliary air supply as shown in FIG. 1 comprises a low pressure air pump **54**, preferably a constant delivery pump which is capable of supplying air at the rate of substantially 20 cubic feet per minute for the machine shown. The auxiliary air supply also is equiped with a relief valve **55** so that the pressure can be regulated from between one pound per square inch and three and one-

half pounds per square inch. Under this arrangement, and with a relatively large conduit **19**, such as two inches I.D., the pressure within the conditioning chamber will be brought up within about one second after the pressurizing valve **20** is opened.

A suitable pressure relief valve is shown in FIG. 5 and comprises a T-connection **56** formed in the conduit **19** and having a short vertical branch **57**. Slots **58** are formed in the wall of branch **57**. A slidable cap **59** is loosely mounted on the branch **57** so as to cover the slots **58**, but the air pressure within the conduit **19** elevates the cap so as to expose a portion of the slots **58**, thus providing an effective pressure control of the system. The degree of pressure can be regulated by adding weights **60** to the cap **59** by means of a spindle **61**. When the pressurizing valve **20** is closed, air from the pump **54** will bleed out through the slots **58**.

The bag filling operation is thus characterized by the flow of substantial volumes of air under small pressure differences and through relatively large conduits having low resistance. As a result, I have been able to use a low pressure system in which the pressure throughout the whole system can be regulated with a high degree of accuracy at the inlet end, so that powders and granular materials of widely different specific gravities can be elevated into the spout without increasing the amount of fluidizing air required to impart the desired flow characteristics to the particular material and without interfering with the conditioning action provided by escaping air.

The air supply for the air actuated sleeve valve **12** and the air actuated pinch valves **25**, **20** and **22** is controlled by solenoid valves V_{12}, V_{25}, V_{20}, and V_{22}, respectively, shown in FIG. 6. In FIG. 6 the reference numerals **38** and **39** designate the leads to a source of power, the lead **39** being shown as grounded for purposes of clarity. The operating circuit includes a bag filling control circuit **40** and a chamber replenishing control circuit **42** which are connected in parallel with each other across leads **38** and **39**, or **38** and ground, as shown. The bag filling control circuit **40** includes the solenoid valve **25** and a switch **41** which is actuated by the tripping of the scale mechanism **13**. When the switch **41** opens, the cutoff valve **25** closes.

The chamber replenishing control circuit **42** includes the solenoid valve V_{12} for controlling the inlet valve **12**, and a switch **43** which forms a part of the level responsive device **26**. When the switch **43** opens, the inlet valve **12** closes. In the arrangement shown, when the paddle **26***a* of the level responsive device **26** is stalled by an increase in material level, the switch **43** is opened, deenergizing and opening the solenoid valve V_{12} to supply air to the inlet valve **12**, thus closing same.

An interlocking relay **44** is provided so that only one valve, **12** or **25**, can be open at a time, thus providing alternate steps of bag filling and chamber replenishments. The relay **44** includes a relay coil **45**, a switch **46** in circuit **40**, and a switch **47** in circuit **42**. The switches **46** and **47** are spring biased into the chamber replenishing position shown in FIG. 6. When the relay coil **45** is energized, switch **46** is closed and switch **47** is opened, and vice versa when the coil is deenergized.

As shown in FIG. 6, the relay coil **45** is energized from circuit **40**, and the switch **46** serves as a starting switch, being initially closed by a start button **48** to initiate the bag filling step.

The bag filling control circuit **40** also includes the solenoid valves V_{20} and V_{22}.

To summarize the operation, manual closing of the switch **46** opens the pressurizing valve **20** at the same time as the cut off valve **25** is opened. The vent valve **22** closes at this time.

When the bag **23** is full, the scale mechanism **13** trips, breaking the bag filling circuit **40** which closes valves **20** and **25**, and opens the vent valve **22**. The breaking of circuit **40** closes relay switch **47** to establish circuit **42**. This, in turn, opens the inlet valve **12** to initiate the

chamber replenishing step. When the conditioning chamber has been filled up to a predetermined level, the switch **43** opens to break the circuit **42** and close the inlet valve **12**. The machine is now filled and ready for another cycle of operation.

The air supply for the fluidizing pad **15** is controlled by the electrically actuated valve **17**, of which the solenoid **17***a* is connected into the bag filling circuit **40**. Thus, when this circuit **40** is energized, air is supplied to the fluidizing pad; at other times the fluidizing air is cut off.

In the example shown, the conditioning chamber **11** is about three and one-half feet high and encloses a volume of about five cubic feet. The level responsive device **26** is located so that the lower edge of the paddle **26***a* is at an elevation of about twenty-four inches above the fluidizing pad **15**, representing a charge of 150 pounds of a granular material such as polyethylene pellets for the molding industry. The elevation of the horizontal span **36** is about thirty inches above the fluidizing pad **15**. The pellets are lifted through this thirty inch elevation by the pressure developed in the chamber, which in this instance called for a setting of the pressure relief valve **55** to a nominal value representing about two pounds per square inch. It took about fifteen seconds to fill a 100 pound bag.

The outlet conduit **18** and the auxiliary air conduit had an inner diameter of two inches which permitted the chamber to be brought up to pressure very rapidly. Within a second or two after the bag filling cycle was initiated, the pressure within the chamber was 2 pounds per square inch, and it gradually increased from 2 pounds up to 2¾ pounds per square inch at the end of the bag filling cycle, the gradual increase in pressure being due to the back pressure of the bag as it approaches the filled condition.

Since the pressure relief valve **55** is of the continuously bleeding type, the loading or setting thereof can best be expressed by nominal values, representing the initial pressure within the chamber after the material begins to flow through the spout, such as two pounds per square inch in the example given above.

In some instances, the lower end of the vertical span **35** may be flared. This regulates the proportion of escaping air to effective air, and hence the amount of conditioning of the material prior to fluidization, and the extent of flare, in this connection, cooperates with the taper **11'** at the lower end of the chamber **11**.

With such granular materials, the expanding sleeve type inlet valve **12** is effective to seal off the chamber **11** and cooperates with the large diameter of the auxiliary air conduit **19** to cause the rapid build up of pressure. The disclosure of my aforesaid copending application Serial No. 79,796 is incorporated herein by reference, insofar as consistent with the present disclosure.

The location of the level responsive device **26** would be somewhat higher for the packing of 100 pounds bags of light fluffy powder, and such a material calls for a nominal setting of the pressure relief valve **55** of from 1 to 1½ pounds.

The pressure need only be sufficient to offset a thirty inch head of fluidized material, and the fluidized head, of course, is considerably less than the unfluidized head.

Although only a preferred embodiment of my invention has been shown and described herein, it will be understood that various changes and modifications may be made in the construction shown without departing from the spirit of my invention as pointed out in the appended claims.

I claim:

1. A bag filling machine comprising a conditioning chamber, a bag supporting spout communicating with said chamber and adapted to project into a bag to be filled, a first conduit extending between said spout and said chamber, cut off means located in said first conduit for cutting off the flow of material therethrough, bag weight responsive means for causing operation of said cut off means when a predetermined amount of material has been fed into said bag to terminate the bag filling operation, an inlet valve located in the upper portion of said chamber for permitting material to flow into said conditioning chamber, means for closing off said inlet valve during the bag filling operation, said means including a level responsve device which also maintains a free space in the upper portion of said conditioning chamber, said conditioning chamber having a diffuser pad located at the bottom thereof, said spout being located above the level of said diffuser pad, the inner and lower end of said first conduit being located immediately above said diffuser pad, a second conduit communicating with said fill space, a constant delivery air pump connected to said second conduit, a pressurizing valve interposed in said second conduit for controlling the flow of air from said air pump to said chamber, and a pressure relief valve of the continuously bleeding type connected to said second conduit to maintain the air within said conduit at a substantially constant pressure.

2. A bag filling machine as claimed in claim **1** in which the inner diameter of said second conduit is at least as great as the inner diameter of said first conduit to permit the pressure within said chamber to be increased rapidly up to the pressure obtaining within said second conduit prior to the time that said pressurizing valve is opened.

3. A bag filling machine as claimed in claim **1** in which said pressurizing valve is controlled by said bag weight responsive means.

4. A bag filling machine as claimed in claim **1** which includes a vent connected to the upper portion of said conditioning chamber, a vent valve for said vent, and means for closing said vent valve when said pressurizing valve is open.

5. A bag filling machine as claimed in claim **1** in which the space enclosed by said conditioning chamber is substantially five cubic feet, and in which said constant delivery pump has a delivery rate of at least substantially twenty cubic feet per minute, and in which said continuously bleeding pressure relief valve is operable to bleed the pressure from said second conduit when said pressurizing valve is closed, and to maintain a pressure of from one to three and on-half pounds per square inch within said conditioning chamber when said pressurizing valve is open.

6. A bag filling machine as claimed in claim **5** in which said spout is located substantially two and one-half feet above the level of said diffuser pad.

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