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M. W. JONES

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PNEUMATIC CONVEYER

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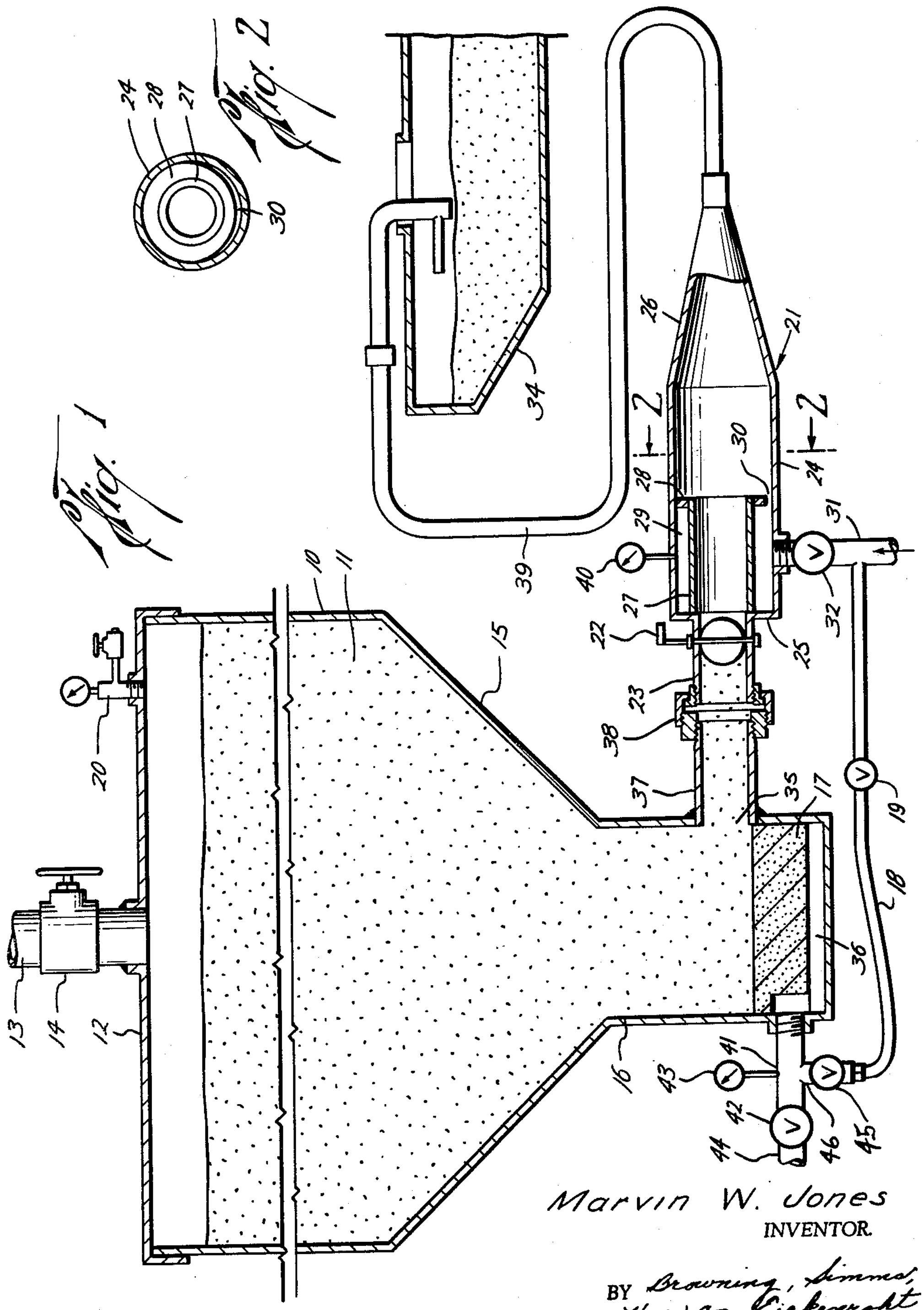

Marvin W. Jones
INVENTOR.

BY Browning, Simms, Hyer & Eickenroht

ATTORNEYS

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PNEUMATIC CONVEYER

Marvin W. Jones, Beeville, Tex., assignor to Magnet Cove Barium Corporation, Houston, Tex., a corporation of Arkansas

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This invention relates to air conveyers in general and, in particular, to air conveyers for moving dry, powdered solids.

This invention can be employed to convey any finely divided solid material; however, it finds particular utility where rapid transfer is desired as, for example, in the drilling industry where large supplies of drilling mud additives, such as barium sulfate, bentonite, etc., are stored in a central location and transferred to trucks to be hauled when needed to various drilling locations. In the case of barium sulfate, which is commonly used to add weight to drilling mud, the need for this material is sometimes urgent and the sooner the trucks can be filled at the central bulk stations, the less danger there may be of an oil well blowout. Heretofore, this material had been commonly transferred to the trucks by use of screw-type conveyers. Screw-type conveyers are capable of delivering only a given amount of material since the speed of rotation of the screw is limited plus the fact that it is prohibitively expensive to use a screw-type conveyer which is large enough to deliver the material at the desired rate. Not only would it be prohibitively expensive, but a conveyer system of this size would be bulky and hard to handle.

It is therefore one of the principal objects of this invention to provide an air conveyer system whereby dry, granulated material can be rapidly transferred from one container to another.

It is a further object of this invention to provide an air conveyer which is simply constructed and of relatively light weight.

It is a specific object of this invention to provide a conveyer system for finely divided solids which employs air to move the material through the eductor tube.

These and other objects will be apparent upon a reading of the detailed description which appears below.

Briefly, the invention comprises an eductor tube through which the material travels which is equipped with an enlarged section adjacent the point where the eductor tube is connected into the storage tank. A short section of tube of smaller diameter extends from the storage tank into this enlarged section to form an annular space between the smaller tube and the enlarged section of the eductor tube. The annular space is only partially closed and the means closing the tube is arranged so that air injected into the annular space will pass into the enlarged section of the eductor tube through a crescent-shaped opening along the bottom of the enlarged section of the eductor tube.

The invention will now be described in detail in connection with the accompanying drawings in which:

FIG. 1 is a view, partially in vertical section and partially in elevation, of the air conveyer showing in section the storage tank and the enlarged end of the eductor tube and the tank to which the material is being transferred; and

FIG. 2 is a vertical section taken along the line 2—2 of FIG. 1 showing the crescent-shaped opening through which the air enters the eductor tube.

Bulk granulated material is usually stored in rectangular or circular storage tanks shaped generally like the tank **10** of FIG. 1. At the lower end of tank **10**, the walls **15** slope inward to form a section **16** of relatively small cross-sectional area and it is from this section of the tank

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that the material is removed. The sloping walls **15** and the section **16** are provided to insure that most of the material in the tank will eventually be transferred out of the tank to the eductor tube and will not collect in a far corner and remain in the tank indefinitely as would be the case with a straight sided storage tank.

Connected to the top **12** of the tank is line **13** and valve **14** through which additional material may be placed in the tank. Also connected into the top of the tank is a pressure relief valve **20**. Located in the bottom section **16** of the tank at a point just below the opening **35** where the material is removed from the tank is a block **17** of porous material. An air line **18** is connected in the bottom of the tank adjacent this porous block so that air can be forced into the space **36** below the block and distributed evenly by the block across the total cross section of the lower end of the storage tank. This block may be made of any material having sufficient structural strength to withstand the weight of the material in the tank and also enough porosity to pass a sufficient amount of air into the material to keep it from bridging as it travels into the lower section of the tank. By porosity is meant a large number of interconnected, relatively small diameter passageways extending throughout the block.

Extending out from the opening **35** in the side of the section **16** of the tank **10** is a nipple **37** which supports at its outer end one-half of a coupling **38**. The other half of this coupling is carried by the nipple **23** which forms the lower end of the eductor tube **21**. The coupling **38** should preferably be of this "quick make and break" type to allow the eductor tube to be rapidly connected and disconnected from the tank. Also connected to the end of the nipple **37** but not shown in the drawings is a "molasses" type valve which can be swung into position to close the end of the nipple when the eductor tube is disconnected.

It is contemplated that these air type eductor tubes will be carried by the trucks and not be permanently connected to the tanks. For this reason, they must be light and easily handled. Most of the eductor tube **21** consists of an elongated section **39** of equal diameter, which is preferably a flexible hose of light weight and easily handled, but with sufficient rigidity to resist collapsing or kinking in use, as this would greatly restrict the flow of material through it.

The lower end of the eductor tube consists of the nipple **23** in which is located the flapper valve **22** which is closed when the eductor tube is not in operation to hold the air pressure in the tank and to prevent the material in the tank from filling up the end of the eductor tube when there is no air passing into the tube. Immediately downstream of the flapper valve, the eductor tube is equipped with a section **24** of enlarged diameter. This section is connected into the eductor tube by means of the flange **25** at one end and the swedge nipple **26** at the other, the swedge nipple being tapered from the large diameter of the section **24** down to the diameter of the elongate section **39**.

Extending into this enlarged section **24** is a nipple **27** which is located concentrically with the enlarged section and is actually a continuation of the short nipple **23** which is preferably of the same diameter as the eductor tube itself. The nipple **27** extends approximately half way into the enlarged section and is supported therein by means of the annular flange **28**. This creates an annular space **29** between the nipple **27** and the inside of the enlarged section **24** into which air may be introduced by means of the air line **31**. A valve **32** is provided in the air line to control the flow of air into the annular space. Pressure gage **40** is also provided to measure the air pressure in the annular space **29**.

Air is also introduced into the space 36 in the bottom of the tank by means of the hose 18 which is connected from the line 31 to the line 41. Valve 19 is provided to control the flow of air into the tank. Pressure gage 43 is used to indicate the pressure in the space 36 in the tank.

Line 41 is usually permanently connected to the tank as there is a need for air to be introduced into the tank even when the eduction tube is not in operation. For example, the tank may be located at a drilling rig to supply the daily requirements of drilling mud additives. This is done by placing a mud hopper below the outlet nipple 37, opening the molasses valve (not shown) and allowing the material in the tank to flow into the hopper. The purpose of introducing air into the material through the porous block is to prevent the material from bridging as it moves down the tank. This can happen whether the material is being removed rapidly by the eductor tube or slowly by gravity and, therefore, the air line 41 is arranged to allow air to be introduced either through the hose 18 when the eductor tube is operating or through the valve 42 and the line 44 when the eductor is not being used. The line 44 is usually permanently connected to the drilling rig air supply, whereas the eductor tube usually uses air obtained from the truck. A valve 45 is provided to close the line 46 when the hose 18 is disconnected.

It is one of the features of this invention that the air forced into the annular space 29 passes therefrom into the enlarged section 24 along only the bottom half of this section. In fact, it has been found that for the most efficient operation of the air conveyer system, the air should be introduced into this section of the eductor tube in diminishing amounts as it moves from the very bottom of the tube up toward the middle of each side. This is accomplished by providing a crescent-shaped opening 30 between the flange 28 and the enlarged section 24. The crescent-shaped opening 30 is obtained by providing the lower half of the flange 28 with the same radius of curvature as the enlarged section 24 but with its center of curvature moved upward. This produces a gap between the flange and the lower half of the inside diameter of the tube which will gradually diminish as you move in either direction away from the very bottom of the tube, i.e., a crescent-shaped opening. The radius need not be held equal to that of the enlarged section, of course, as it can be increased and a crescent-shaped opening will still be produced.

Operation

When truck bed 34 is in position to receive its load of material, flapper valve 22 is opened and air is concomitantly forced through air lines 31 and 18 into the annular space 29 and the porous block 17. With the opening of the flapper valve 22 and the introduction of air into the storage tank through the air line 18 and porous block 17, the material will begin to flow from the storage tank into the enlarged section 24 of the eductor tube. As this material is discharged into the enlarged section 24, air is passing simultaneously into the eductor tube from the annular space 29 along the bottom portion of the enlarged section 24. By properly regulating the flow of air through the air line 31 by means of the valve 32 and the pressure gage 40, the air will tend to form a moving layer along the bottom of the tube and carry the granulated solid material along with it as it moves through the eductor tube.

Once the flow of air is properly adjusted in accordance with the flow of material as it enters the eductor tube so that the maximum velocity of material can be attained, it is important that no bridging occur in the material as it is fed into the eductor tube from the storage tank. This is accomplished by the air which is introduced into the bottom of the tank through the line 18 and porous block 17. This air passes upward through the material, continually fluffing it, which prevents any bridges from forming.

The air passing into the tank accomplishes another purpose. By maintaining a positive pressure of about 1 p.s.i. on the surface of the material, it will feed more evenly into the eductor tube. Without this air pressure, as the tank empties, the volume of material being moved by the eductor tube decreases simply because the force moving the material into the tube decreases. This problem is partly overcome by maintaining this slight pressure above the material in the tank.

Since these storage tanks are not designed to withstand internal pressure, a safety relief valve 20 is provided to insure that the internal pressure never exceeds a maximum of from 2 to 3 p.s.i. so that the tank will not inadvertently be damaged.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein contained or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A pneumatic conveyor for finely divided solids comprising in combination an eductor tube assembly, including an elongate section of relatively smaller diameter, a swaged section having a smaller end connected to an end of the elongate section, a short horizontal section of larger diameter, connected to a larger end of said swaged section opposite the elongate section, said horizontal section having a closed end opposite the swaged section, and an inlet pipe extending through said closed end into said horizontal section; a vertical partition in said horizontal section surrounding said inlet pipe adjacent the inner end thereof providing a vertically narrow crescent opening between a lower edge of the partition and the bottom of the horizontal section, and a line connected to introduce compressed air into a space between said closed end of the horizontal section and said partition.

2. The apparatus of claim 1 wherein the inlet tube is concentric with the horizontal section; and the partition is substantially annular, the upper half of said partition having a radius equal to the radius of the horizontal section, the lower half of said partition having a radius at least as great as the radius of the horizontal section and having its center of curvature offset vertically above the center of the inlet pipe providing a vertically narrow crescent shaped passageway along the lower half of the horizontal section.

3. A pneumatic conveyer system comprising in combination a substantially air-tight container for finely divided solid material to be conveyed; and an eductor tube assembly attachable thereto, said assembly including an elongate section of relatively smaller diameter, a swaged section having a smaller end connected to an end of the elongate section, a short horizontal section of larger diameter, connected to a larger end of said swaged section opposite the elongate section, said horizontal section having a closed end opposite the swaged section, and an inlet pipe communicating with a lower part of said container and extending through said closed end into said horizontal section, a vertical partition surrounding said inlet pipe adjacent its inner end within the horizontal section, the upper half of said partition having a radius equal to the radius of the inside of the horizontal section and the lower half of said partition having a radius at least equal to the radius of the inside of the horizontal section but having its center of curvature offset vertically

above the center of the pipe to provide a crescent-shaped passageway into the horizontal section; and means for introducing a controlled stream of compressed air into a space between said closed end and said partition; and means for introducing a controlled stream of compressed air into said container at a level below said inlet tube.

4. The system of claim 3 wherein a lower part of the container is tapered inward, and the means for introducing compressed air into the container includes a porous plate extending across the container below at least some of said tapered part and a valved line connected to introduce compressed air into the container below said porous plate.

References Cited in the file of this patent

UNITED STATES PATENTS

1,160,283 Hay ---------- Nov. 16, 1915
2,924,489 Beckinann ---------- Feb. 9, 1960