APPARATUS FOR APPLYING VISCOS MASSES

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ABSTRACT

Apparatus for continuously applying a viscous mass to an object comprises a rigid tube and a flexible housing mounted axially within the tube and spaced radially from the wall thereof. The hose is provided with conveyor means for pneumatically feeding dry material to it. The hose is radially distendable into the annular space about it under action of the flowing material to mix the material and enhance its movement.

18 Claims, 7 Drawing Figures
APPARATUS FOR APPLYING VISCOS MASSES

BACKGROUND OF INVENTION

The present invention relates to apparatus for applying a viscous mass such as protective coating material, cement or the like on or in an object such as a wall, a mold, or building form.

Conventionally such apparatus comprises a pneumatic tubular conveyor for delivering a mixture of dry particulate, dust or pulverized material and sometimes water to the object. The apparatus includes a mixing chamber through which the dry material is caused to flow axially into which water is delivered to be mixed therewith. In the known systems great difficulty and considerable trouble resulted when the dry and highly adhesive material and water were mixed over long stretches of the conveyor. Under such conditions there was great risk of plugging or blocking the conveyor and its orifices, and consequently delivering an unregulated, non-uniform stream of mixed material.

It is an object of the present invention to provide apparatus for applying coating material which overcomes the prior art difficulties.

It is another object of the present invention to provide apparatus for applying coating material wherein dry pulverized material and water are efficiently mixed and do not create orifice plugging or blocking adhesive masses.

It is another object of the present invention to provide apparatus of the type described wherein the mixing of the dry material and water is done in the conveyor and where the means for mixing the material is replaceable.

These and other objects together with numerous advantages are set forth in the following disclosure.

SUMMARY OF THE INVENTION

According to the present invention a novel apparatus for continuously applying a viscous mass to an object comprises a rigid tube and a flexible housing mounted axially within the tube and spaced radially from the wall thereof. The hose is provided with conveyor means for pneumatically feeding dry material to it. The hose is radially distendable into the annular space about it under action of the flowing material to mix the material and enhance its movement.

Preferably the flexible hose is also somewhat elastic to enable the radial distension. It may also be provided with one or more annular radial inward grooves or collars to provide additional space for radial movement.

The tube and flexible hose are provided with a variety of nozzles which may be chosen to brake and deflect the flow of the mixture, and cause it to be extruded either at greater or lesser velocity with straight or rotary components of movement.

Full details of the present invention are contained in the following disclosure and in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an end view partially sectional of the apparatus of the present invention;

FIG. 2 is an axial cross section through one form of nozzle;

FIG. 3 is a view similar to that of FIG. 2 showing another form of nozzle;

FIG. 4 is a view of still another form of nozzle;

FIG. 5 is a view of a modified form of the apparatus seen in FIG. 1;

FIG. 6 is a view of a form of nozzle combining the features of FIGS. 3 and 4; and

FIG. 7 is a view of still another form of nozzle.

DESCRIPTION OF INVENTION

As seen in FIG. 1 there is shown a portion of a pneumatic tubular conveyor comprising a supply line 1 and a coupling member 3 to which a tubular pipe 5 is connected. The pipe 5 is surrounded with an integral ring-like water distributor jacket 7 which has an internal annular passage 8 for receiving water. The jacket 7 is formed with a plurality of uniformly spaced projections extending into the tubular pipe 5, each of which has a bore 9 communicating between the annular passage 8 and the interior of the tubular pipe 5, and a mouth forming jet head 11 through which the water may be caused to spray peripherally onto the material in the tubular pipe, in a direction perpendicular to the flow of material.

The supply line 1 may be an elongated flexible hose or may be rigid piping conduit. It is connected at its end to a source of dry material, a source of pneumatic media such as air or an inert gas, and means for propelling the media and material through it. Suitable pumps, compressors, etc. may be used. The material itself may be chosen from those most suitable for the intended purpose, cements, asbestoses, stuccos, heavy paints, and petroleum coating materials are some of those which may be used. They may be granulated, dust, fine or coarse particulate material. The water distributor inlet jacket may be integrally formed about the pipe or may be formed as a separate joint member. It is itself connected by conventional means to a source of water or other solvent media, the delivery rate of which may be varied in conformance with the mixture to be formed.

A flexible hose 13 made of rubber or natural or synthetic plastic materials, preferably having an elastic characteristic, is inserted within the tubular pipe 5 so that it is spaced from the inner wall of the pipe 5 to provide an annular space 16 which is so large that the flexible hose 13 can distend, radially, under action of the flowing mass of material. The flexible hose is connected by the coupling 3, to communicate with the supply line 1 and extends short of the forward end of the tubular pipe 5, so that the pipe 5 has a terminal end 17 extending over the foremost end of the hose. The terminal section of FIG. 1 may be used alone or with a nozzle of the type described hereinafter.

A rebound or baffle nozzle 19 of the type adapted to brake or slow the velocity of the flow while maintaining the flow in a direct or straight manner is seen in FIG. 2. (Such a nozzle bears the name "Pralldüse" in German, which according to De Vries and Herrmann, German-English, Technical and Engineering Dictionary, Second Edition, is translated at page 776 as "rebound nozzle"). The nozzle comprises a connecting sleeve 21 adapted to be inserted within the forward end 17 of pipe 5. The sleeve has a neck portion of smaller diameter fitting within the mouth of the end of the hose 13. The nozzle 19 has an enlarged cylindrical chamber 22 at its forward end in which a deflecting baffle disk 24 is mounted by a set screw 35. The disk 24 is of a diameter smaller than the cylindrical chamber and is fixed adjacent its outermost end. The disk 24 is shaped and is
arranged with its plane perpendicular to the flow to provide a ring-like or annular orifice through which the pneumatic media such as air can force the mixed viscous mass outwardly onto the object to be covered. The diameter of the deflecting disk 24 is chosen so as to define a predetermined size of the ring-like orifice. Various diameters or deflecting disks of different shapes may be provided to obtain any desired degree of opening. The use of the set screw permits its simple replacement and will also permit it to be swivelled to vary the opening.

In FIG. 3 there is shown another rebound type nozzle 29 designed to lead the mixture at an angle from pipe 5. This version also has a connecting sleeve 30 which is adapted to fit within the end 17 of the pipe 5. The sleeve has a tubular extension 32 from which a connecting channel 31 extends at an angle. The end of the extension 32 is closed by a funnel-shaped insert 33 against which the material is adapted to be propelled before being diverted into the angular channel 31. The funnel insert 33 is made of hardened metal, ceramic or other material suitable to withstand the pressure and harshness of the mixture, and has its central axis lying along the axis of the sleeve 30 and therefore in the direction of movement of the mixture. The angular channel 31 opens into an enlarged hollow cylindrical chamber 36, the axis of which lies parallel to the axis of the channel 31. A deflecting disk 34 which may be similar to that shown in FIG. 2, is secured within the mouth of the cylindrical chamber 36 by a set screw 35. The disk 34 may be varied as desired, in the same manner as the corresponding disk 24 seen in the straight form of nozzle of FIG. 2.

A so-called spin or cyclone nozzle 37 is seen in FIG. 4. (This nozzle is referred to in German as a "Draill-duese" which DeVries and Herrmann on page 263 translate as "swirl nozzle (rocket) turbulence nozzle (jet).") It is provided with an elbow sleeve connection 38 adapted to be inserted in the end 12 of pipe 5. The connection 38 has an opening 39 entering tangentially into a cylindrical chamber 40 which is closed at its rear end. A post 41 is integrally mounted on the closed end and extends along the central axis toward the open end. Mounted on the end of the post 41 is an exchangeable baffle disk 43 secured by a wing nut 45. The disk 43 may be replaced by a conical baffle body member 47 having vanes as seen in dash lines or by a convex dish-like member 48 (rather than a disk) seen in dot-dash lines, if desired. The annular spacing 49 between the periphery of the body 43 and the inner surface of the chamber 40 forms the exit opening from the housing, through which the mixed material may be extruded in practically a straight line. The inner chamber of the housing 40 may be formed in the shape of a truncated cone, opening symmetrically to the central axis in the direction of material flow. The cyclone nozzle causes the material to exit with a rotary spiral component.

FIG. 5 shows a variant of the terminal portion depicted in FIG. 1, comprising a feed pipe 50 and connected to a supply of dry material and source of pneumatic media for propelling the material in the direction of the arrow. A coupling 52 to which a cylindrical water distribution jacket 54 is integrally attached, is connected to the end of the pipe 50. Extending integrally from the jacket 54 is an inflexible rigid pipe 55 having a terminus 56 to which any one of the nozzles mentioned earlier may be secured. The water distribu-
tor jacket 54 is provided with an annular passage 58 on its inner surface which is straddled by a pair of O-ring seals 60 and 61 seated within suitably formed grooves. A hollow rigid sleeve 63 extending from the coupling 52 is inserted within jacket 54 in conventional manner to seal the passage 58 in conjunction with the O-rings 60 and 61. The hollow sleeve 63 carries a flexible hose 65 which for the major portion of its length is spaced from the surface of tube 55 such as is the hose 13 shown in FIG. 1. The rigid sleeve 63 and the flexible hose 65 are provided with aligned holes 66 and 68 respectively which provide inlet jets for the water which is to be mixed with the particulate, dust, or pulverized dry material fed from the supply pipe 50. The water connection to the jacket 54 is conventional. This embodiment does not have any projections into the interior of the tube 55 so that a change in flexible hose inserts can be easily and swiftly made.

The flexible hose insert 65 is provided with one or a plurality of annular collars 70 radially inwardly directed, which provide an enlarged space 72 between the wall of tube 55 and the hose 65. The annular collars 70 provides increased hollow areas for the radial flexing or distention of the hose, permitting the hose to increase its working of the mixture therein and providing increased self-cleaning capabilities.

The apparatus described heretofore operates in the following manner.

In known manner, the dry material, either in particulate, granular, pulverized, or dust form is pneumatically conveyed in the direction of the arrow through the supply line 1, which may be 10 or more meters long. The dry material passes through the coupling 3 into the flexible hose insert 13. At this point the water, in predetermined doses, is delivered to the jacket 7 and extruded as a spray through the bores 9 and jets 11 into the dry material. The free length of the flexible hose 13 serves as a mixing chamber wherein, because of the turbulence caused by the moving material and the water spray, the dry material and water is thoroughly mixed. The mixture then passes to the terminal end 17 where it may be exited onto the work object or into one of the nozzles depicted in FIGS. 2, 3, or 4.

The free end of the flexible hose and its elastic nature causes the dry material passing through it to mix thoroughly. The elastic hose flexes and dilates while the free end vibrates.

In case a rebound nozzle of the form seen in FIG. 2 is used, the mixture is propelled against the baffle disk 24, rebounding into the chamber 22 where it mixes still further and then exits with lessened velocity or speed through the annular orifice 27, on to the work object, which for example may be a wall.

When a further reduction in exit or extrusion speed is desired, the nozzle of FIG. 3 may be used. The angular deflection of the course of material flow through the channel 31 reduces the speed before the material hits the baffle disk 34. Consequently, the disk 34 can then reduce the speed considerably.

In FIG. 4 the depicted spin or cyclone nozzle permits the extrusion of a relatively stable stream, with the mass assuming a linear but rotating or spinning outward characteristic. In this manner the material may be propelled on to the wall without the normal rebound or back spray which occurs with the prior art devices. It reduces the possibility of the separation of the mixture components. Furthermore the rotational component
provided by the spin nozzles permits the coating material to be applied in a smoother and more uniform manner. It is possible through the use of one or more of the varying baffle bodies, such as depicted in FIG. 4, to provide an optimal extrusion stream and thereby prevent the formation of dust particles and clumps of wet material from forming in the nozzle. This provides a more efficient, secure application of the mixture on the object in a shorter time than heretofore.

The free end of the flexible hose insert is spaced from the wall of the surrounding rigid tube a distance great enough to permit the hose to vibrate or wag as if it were the "tail" of an animal. In this manner the mixing of the material is enhanced and the blocking of the conduit formed by the hose is prevented. The radial movement of the hose dislodges any clumps, or glued particles and in combination with the axial movement of the material creates a self-cleaning mixing conveyer. Although the hose insert 13 seen in FIG. 1 may be somewhat tiring to replace, it may be exchanged without difficulty by merely sliding the new elastic member into position over the projecting spray heads 11 of the water jacket. The heads align and hold the hose 13 in place.

In the embodiment shown in FIG. 5 the self-cleaning, and blockage preventive features of the insert hose are perhaps more easily attained. The insert hose 65 with its annular collars 70 provides an automatic radial working of the material. In this instance, the space 72 between the hose 65 and the wall of the rigid tube 55 is enlarged by the hollow portions formed by the collars 70, so that a greater radial action is possible. It is also possible to apply pressurized air, via the collars 70 into the space 72 so that from time to time the flexible hose may be pinched or pneumatically shoved to further provide the radial action. The air may be made through a not shown conduit from the source of pneumatic media. The collars 70 are necessary for a very practical advantage, for use with certain materials, particularly the very fine dust material, since without such collars there is insufficient self-cleaning power. Such material builds itself up at the rear of the conduit against the flow of the material and quickly blocks and interrupts the further flow. Coarse material, such as granular cement does not have this problem, but for fine material such an auxiliary means for radial working the hose is required.

In the building of tunnels it has been known to apply a relatively dry mixture to the wet tunnel walls. Generally spray concrete was used. The device seen in FIG. 5 can be used directly for this purpose, without any intermediate braking or nozzle element. In this manner the dry mixture of material can be delivered with a larger portion of quick-setting cement than otherwise and without fear of blocking the flow of the mixture or spray.

In FIG. 6 there is an embodiment combining the features of the particular nozzle of FIG. 4 with the connecting member of FIG. 3. A connecting member 32 having the conical insert 33 is provided with a bent arm or elbow connection to which a spin nozzle such as chamber 40 is attached. This embodiment combines the advantages of angular deflection of FIG. 3 with the spin effect of FIG. 4.

FIG. 7 shows an embodiment by which the spin nozzle 37 of FIG. 4 is connected directly to the mixing chamber of the form of terminal portion provided by the flexible hose shown in FIG. 5. The spin chamber 40 connected to the end of the conduit connection 31 is slightly elongated and formed with a necked down terminal portion on which a flexible hose 42 of a few meters long is secured. The spring action within the chamber 40 is translated by the cylindrical neck into an axial stream extruded outwardly of the mouth of the chamber 40.

The embodiments of FIGS. 6 and 7 function in a similar manner as those of FIGS. 2-4. For example the spin-spray device of FIG. 6 has the advantage that when the water mixture leaving the flexible hose (13) 65 to be propelled against the hardened impact insert 33, it is not only braked but also partly dewatered. The greatest part of this dewatered portion is normally separate from the solid material in the air stream. After the water and the mixture enter the chamber 40 they are remixed by the turbulent action created. This remixture of the two components produces a more uniformly homogeneous mixture than was previously obtained by the use of the flexible hose 65 (13) alone. For use in the "wet" spraying technique, i.e. when a dry coarse material such as spray cement is sprayed on tunnel or mine walls for example, then the embodiment shown in FIG. 7 may be used. With this apparatus, the mixture exiting from the flexible hose into the spin chamber 40 is further mixed by the turbulent action. The final hose portion 42 straightens out the flow of the mixture and with a translatory velocity, at least double that normally attained, leaves the mouth of the hose 42. Both the braking function and the mixing function of this apparatus will be clearly understood.

The present invention may take many forms and embodiments; changes and modifications may be easily made. The present disclosure therefore is to be understood as illustrative only and not limiting of the invention.

What is claimed:

1. Apparatus for continuously mixing and applying a viscous mass to an object, comprising a rigid tube, a flexible hose located co-axially within said tube, said flexible hose being secured to said tube at its rear end and extending substantially freely along the length of said tube radially spaced from the inner wall thereof, means for pneumatically feeding particulate material axially to the rear end of said flexible hose, said flexible hose being swingable and radially distendable under the flow of said material toward its forward end.

2. The apparatus according to claim 1 including means for delivering liquid radially through said pipe and said flexible hose to mix with said dry material.

3. The apparatus according to claim 2 wherein the means for delivering the liquid is arranged perpendicularly to the flow of material.

4. The apparatus according to claim 1 wherein said flexible hose is provided with at least one radially inwardly directed circumferential ring providing an enlarged annular space between said hose and the inner wall of the rigid tube.

5. The apparatus according to claim 1 including a braking element located at the forward end of said flexible hose, said braking element providing a translatory change in velocity to the mass.

6. The apparatus according to claim 5 wherein said braking element comprises a rebound nozzle.

7. The apparatus according to claim 6 wherein said rebound nozzle is provided with an adjustable baffle.
8. The arrangement according to claim 7 wherein said baffle member comprises a disk.

9. The arrangement according to claim 7 wherein the baffle member comprises a concave dish.

10. The arrangement according to claim 7 wherein the braking element comprises a spin chamber in which the mass is given a rotary component of movement.

11. The apparatus according to claim 11 wherein said chamber is provided with a replaceable baffle insert arranged at the exit mouth thereof to lead the mass to the peripheral edge thereof.

12. The apparatus according to claim 11 wherein the spin chamber is provided with a replaceable baffle insert arranged at the exit mouth thereof to lead the mass to the peripheral edge thereof.

13. The apparatus according to claim 11, wherein said chamber is provided with a neck of reduced diameter and a flexible hose secured thereto.

14. The apparatus according to claim 1 wherein the forward end of the flexible hose is radially free of said rigid tube.

15. The apparatus according to claim 1 including a coupling member secured at the rear end of said tube for connection to a supply line, and a sleeve secured in said coupling, said flexible hose being arranged within said sleeve and supported thereby.

16. The apparatus according to claim 1 including a flow directing cap arranged at the forward end of said flexible hose, said cap having an angular flow channel, and a conical impact insert arranged axially of the flow of said material.

17. The arrangement according to claim 16 wherein said insert is made of hardened metal.

18. The apparatus according to claim 1 wherein said flexible hose is of uniform cross section throughout its length.

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