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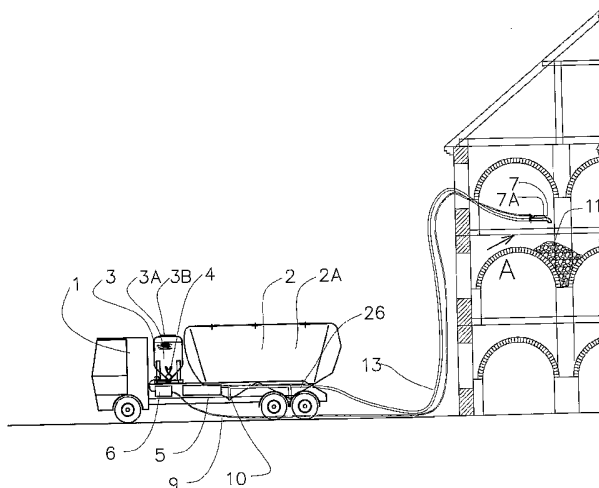
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(54) Title: APPLICATION OF FILLING OF GRANULATE STABILIZED WITH BONDING AGENT



(57) Abstract: Process of application of filling of granulate stabilized with bonding agent and equipment for the application by which are granulate and liquid bonding agent transported to the building site in separate reservoirs (2) and (3) but on one truck (1) or a set consisting of trailer or semi-trailer and tractor and on building site by laying of the filling to the place of deposition enters granulate continual from the reservoir (2) through the piping (13) to the mixing element (7), in which is the granulate mixed with liquid bonding agent, which is fed from the reservoir (3) by piping (9) and to intermixing comes by means of turbulence of granulate and bonding agent in flow of the air and after intermixing continues the granulate out off the mixing element (7) to the place of deposition (11). This process and equipment can be used by application of stabilized fillings mainly of light weight aggregate in floors and ceilings of buildings and in geotechnical constructions.

Application of filling of granulate stabilized with bonding agent

Technical field

In construction industry, extractive industry and other industries, plenty of fillings of granulates is used. To prevent settlement of these fillings, they are stabilized by mixing granulate with a bonding agent. Different processes and equipments are used for mixing of granulate with the bonding agent and for transportation and imposition of the stabilized filling.

Background of the invention

So far, constructional, geotechnical, fill-in and other kinds of fillings of the granulate stabilized with bonding agent are made in the way, that the granulate is coated by cement or by some other bonding agents in the mixing plant, then it is transported to the construction site in concrete mixer trucks and to the final place of destination, it is transported in containers. The disadvantage of this process is the fact that storage of granulate and manipulation with granulate in the mixing plant is necessary and that the transportation and imposition of granulate are inefficient.

Next process of the application of the filling of bonding agent-stabilized granulate is transportation of granulate and bonding agent separately. Granulate is transported in containers or by means of pneumatic transportation, then spread and washed down with the bonding agent. The disadvantage of this solution is its inefficiency and unevenness of granulate coating. Thicker layers of filling need to be done in more thin layers. It is necessary that at least 2 different vehicles transport the material to the construction site. And there need to be more mechanized equipments, which require more personal to operate them.

Summary of the invention

The problems mentioned above could be considerably eliminated by the solution according to this invention. Core of the invention is the process of application of filling of granulate stabilized with bonding agent, by which the granulate and the bonding agent are transported to the construction site or to the final destination in two separated reservoirs on one truck, or on a set of trailer or semi-trailer and tractor, on which also a compressor for generation of compressed air and bonding-agent-pump are placed. At the construction site the granulate continuously goes from the reservoir to the mixing element. The bonding agent is injected into the moving granulate, and they are mixed together due to the turbulence. Granulate intermixed with bonding agent then goes continuously into the place of deposition.

The significant trait of the equipment for the application of the filling according to this invention is that the equipment comprises a reservoir for the granulate and a reservoir for the bonding agent, which are placed on the same truck, or on a set of trailer or semi-trailer and tractor, a compressor for generation of compressed air, a pump for pumping a liquid bonding agent and a mixing element, connected by means of a piping to the reservoir for granulate at least at the time of laying of the granulate to the place of deposition. A turbulence is used for mixing the granulate with the bonding agent. The reservoir for

bonding agent can be connected with the truck, or the set of trailer or semi-trailer and tractor in such a way that it is easy exchangeable.

As a granulate can be used with advantage all known species of light weight aggregate for structural purposes which have grains resistant to crushing so much so as not happened to crushing during pneumatic transportation and which have closed surface with limited absorptivity so as not happened to quick soaking of the bonding agent to the grains. Suitable are expanded clays and slates with globular grain shape and narrow granularity fraction, also granulates of man-made matters like granulated polystyrene or granulate of recycled materials can be used.

As bonding agent can be used mineral bonding agents for structural purposes like cementing compound, water glass, lime hydrate, bonding agents on geopolymer basis, or also synthetic bonding agents. Granulate or the bonding agent can contain dispersed glass, synthetic or other reinforcing fibres.

Advantage of these procedure and equipment is, that the granulate, bonding agent, compressor for transportation of granulate and pumping device for transportation of bonding agent are on building site transported on one vehicle. Intermixing is done in mixing element, which contains minimum or none movable parts. One person is enough for operating the equipment. It is possible to supply large volumes of stabilized filling with one car. Right to the building site, without necessity of a buffer stock of granulate, it is possible this way with sole vehicle with capacity of 24 tons, operated by one person, without necessity of other devices, to supply as far as 70 m³ of stabilized filling, what with other known technology is not possible.

Brief description of the drawings

- FIG. 1 View on equipment during applying the process according to example 1 in phase of transportation to the building site.
- FIG. 2 Cut A-A of equipment during applying the process according to example 1 in phase of transportation to the building site.
- FIG. 3 View on equipment during applying the process according to example 1 in phase of laying of the granulate to the place of deposition.
- FIG. 4 View A, displaying mixing element of the equipment according to example 1.
- FIG. 5 View on equipment during applying the process according to example 2 in phase transportation to the building site.
- FIG. 6 Cut B-B of equipment during applying the procedure according to example 2 in phase of transportation to the building site.
- FIG. 7 View on equipment configuration during applying the process according to example 2 in phase of laying of the granulate to the place of deposition.
- FIG. 8 View B, displaying mixing element of the equipment according to example 2.
- FIG. 9 View on equipment configuration during applying the process according to example 3 in phase transportation to the building site.

- FIG. 10 Cut C-C of equipment configuration during applying the process according to example 3 in phase of transportation to the building site.
- FIG. 11 View on equipment configuration during applying the process according to example 3 in phase of laying of the granulate to the place of deposition.
- FIG. 12 View C, displaying mixing element of the equipment according to example 3.

Detailed description of the preferred embodiment of the invention

Example 1

Pictures FIG.1, 2, 3 and 4 display process of application of filling of granulate stabilized with bonding agent and equipment for the application. In this example the filling in spaces above vaults in reconstructed building is applied.

As granulate the light weight aggregate of expanded clay grain size 4 - 8 mm with loose density 350 kg/m³ is used and as bonding agent the highly fluid cementing compound with density 1700 kg/m³ and prolonged setting time is used. Granulate as well as bonding agent are transported to the building site on truck 1 in separate reservoirs 2 and 3 connected to the truck 1. The reservoir 2, for granulate, is firm, non tip-up tank 2A with capacity 22 m³, in which is possible to create overpressure. Tank 2A has two lower cone-shaped plug interconnected by piping 10 with output opening 26. The reservoir for liquid bonding agent are two easy exchangeable tanks 3A, 3B each with volume 1,5 m³. In tanks 3A, 3B there are agitators 4 for ruffle and agitation of bonding agent.

Also the compressor 5 for production of compressed air and pumping device 6 for pumping of bonding agent from tanks 3A, 3B are placed on the truck chassis.

On the building site is a mixing element 7A connected to the exit 26 from the tank 2A by means of piping 13 and to the pumping device 6 by means of piping 9. The tank 2A is pressurized by an air from the compressor 5. To the mixing element 7A then enters granulate together with compressed air and bonding agent. Granulate goes continual through mixing element, in which it is mixed with bonding agent and then flows out continual to the place of deposition 11.

The mixing element 7A is displayed in the picture FIG. 4. An opening 12 is connected by means of piping 13 to output opening 26 of the tank 2A. The granulate 21 enters through the opening 12 to the mixing element 7A by the help of overpressure of the air inside the tank 2A.

The liquid bonding agent 20 is fed into the opening 14 by means of piping 9 from the tanks 3A and 3B. On the input opening 14 connects tube 15, which goes to inner space 22 of the mixing element and is tipped with a jet 16, which has a slot 17 placed so, that the plane interlard by this slot is perpendicular to lengthwise axis of the mixing element or with her form an angle 60 as far as 90 degree. The granulate intermixed with the bonding agent flows out of the mixing element to the place of deposition through the output opening 27.

Example 2

Pictures FIG.5, 6, 7 and 8 display process of application of filling of granulate stabilized with bonding agent and equipment for the application. In this example the filling in spaces above vaults in reconstructed building is applied.

As granulate the light weight aggregate of expanded slate grain size 1 - 4 mm with loose bulk density 475 kg/m^3 is used and as bonding agent the highly fluid compound on geopolymer basis with density 1500 kg/m^3 is used. Briefly before starting the laying of the filling the setting agitator is added to the bonding agent.

Granulate as well as bonding agent are to the building site transported on one vehicle consisting of set of semi-trailer 24 and tractor 25, in separate reservoirs 2 and 3 connected to the vehicle. The reservoir 2, for granulate, is firm, non tip-up tank 2B with capacity 45 m^3 , in which is possible to create overpressure. Tank 2B has two lower cone-shaped plug connected by means of piping 10 to output opening 26. The reservoir 3 for liquid bonding agent is a tank 3C of cylindrical shape with volume 5 m^3 placed on the tractor 25. In tank 3C there is an agitator 4 for ruffle and agitation of bonding agent.

Also the compressor 5 for production of compressed air and pumping device 6 for pumping of bonding agent from tanks 3C are placed on the tractor chassis.

On the building site is a mixing element 7B connected to exit 26 from tank 2B by means of piping 13 and to pumping device 6 by means of piping 9. The tank 2B is pressurized by air from the compressor 5. To the mixing element 7B then enters granulate together with compressed air and bonding agent. Granulate goes continual through the mixing element, in which it is intermixed with bonding agent and then flows out continual to the place of deposition 11.

Mixing element 7B is displayed in the picture FIG. 8. The opening 12 is connected by means of piping 13 to the output opening 26 of the tank 2B. The granulate 21 enters through the opening 12 to the mixing element 7B by the help of overpressure of the air inside the tank 2B. The liquid bonding agent 20 is fed into an input port 14 by means of piping 9 from the tank 3C. On the input port 14 is connected a tube 15, which goes to inner space 22 of the mixing element and is tipped with a jet 16, which is turned against the flow of the granulate and air and in front of the jet is fixed a shield 19 with a conical inclination 23 and a reflexive sheet 28, which is a little concave. The bonding agent is dispersed by means of the reflexive sheet to the interior space of the mixing element, where comes to intermixing of the granulate with the bonding agent.

The granulate intermixed with bonding agent flows out of mixing element to the place of deposition through the output opening 27.

Example 3

Pictures FIG. 9, 10, 11 and 12 display process of application of filling of granulate stabilized with bonding agent and equipment for the application. In this example the filling in attic spaces of building is applied.

As the granulate the polystyrene granulate grain size 4 - 8 mm with loose bulk density 40 kg/m³ is used and as bonding agent the highly fluent cement-gypsum compound with density 1400 kg/m³ and prolonged setting time is used.

The granulate as well as the bonding agent are to the building site transported on one vehicle consisting of set of semi-trailer 24 and tractor 25 in separate reservoirs 2 and 3 connected to vehicle.

The reservoir 2 for granulate is tip-up tank 2C with capacity 65 m³, in which is possible to create overpressure. The reservoir 3 for liquid bonding agent are two tip-up tanks 3D, 3E each with volume 2,5 m³. The tanks 3D a 3E are placed on sides of tank 2C. In tanks 3D, 3E there are an agitators 4 for ruffle and agitation of bonding agent.

Also the compressor 5 for production of compressed air and pumping device 6 for pumping of bonding agent from tanks 3D, 3E are placed on the tractor chassis.

On the building site is a mixing element 7C connected on exit 26 from the tank 2C by means of piping 13 and on pumping device 6 by means of piping 9. The tank 2C is pressurized by an air from the compressor 5. To the mixing element 7C then enters the granulate together with compressed air and with the bonding agent from tanks 3D, 3E by means of piping 9.

Granulate goes continual through the mixing element, in which it is mixed with bonding agent and then flows out continual to the place of deposition 11.

Mixing element 7C is displayed in the picture FIG.12. An opening 12 is connected by means of piping 13 to output opening 26 of the tank 2C.

The granulate 21 enters through the opening 12 to the mixing element 7C by the help of overpressure of the air inside the tank 2C. The liquid bonding agent 20 is fed into an opening 14 by means of piping 9 from the tank 3D and 3E.

On the input opening 14 is connected a tube 15, which goes into inner space 22 of the mixing element 7C and is placed crossways to lengthwise axis of the mixing element so, that it forms an angle 5 as far as 45 degree with the lengthwise axis of the mixing element and is tipped with a jet 16. In front of the jet is fixed a reflexive sheet 28, which is convex. The bonding agent is dispersed by means of the reflexive sheet to the interior space of the mixing element, where comes to intermixing of granulate with bonding agent. Granulate intermixed with bonding agent flows out of the mixing element to the place of deposition through the output opening 27.

Industrial exploitation

This process of application and equipment for the application will be used by applying of filling mainly of light weight aggregate or other granulates stabilized with bonding agent in floors, ceilings, roofs, walls, around buildings, in geotechnical constructions by foundation of buildings, roads, railways and other structures and by applying the various fillings as filling of mined out spaces.

List of used signs

- | | |
|----|--------------------------------------|
| 1 | truck |
| 2 | reservoir for granulate |
| 2A | tipping tank for granulate |
| 2B | tipping tank for granulate |
| 2C | non-tipping tank for granulate |
| 3 | reservoir for bonding agent |
| 3A | tank for bonding agent |
| 3B | tipping tank for bonding agent |
| 3C | tipping tank for bonding agent |
| 4 | agitator |
| 5 | compressor |
| 6 | pumping device |
| 7 | mixing element |
| 7A | mixing element |
| 7B | mixing element |
| 7C | mixing element |
| 8 | air piping |
| 9 | bonding agent piping |
| 10 | interconnection piping |
| 11 | place of deposition |
| 12 | input opening for granulate |
| 13 | piping for granulate |
| 14 | input opening for bonding agent |
| 15 | tube |
| 16 | jet |
| 17 | slot |
| 19 | shield |
| 20 | bonding agent |
| 21 | granulate |
| 22 | interior space of the mixing element |
| 23 | conical inclination |
| 24 | tractor |
| 25 | trailer or semi-trailer |
| 26 | output opening of tank for granulate |
| 27 | output opening of mixing element |
| 28 | reflexive sheet |

Claims

1. A process of application of filling of granulate stabilized with bonding agent, **wherein** the granulate and the liquid bonding agent are on a building site transported together on one vehicle, which is a truck (1) or a set consisting of trailer or semi-trailer (24) and tractor (25), but in separate reservoirs (2) and (3) and on the vehicle is placed, at least in the time of transportation to the building site, also a compressor (5) for production of compressed air and a pumping device (6) for pumping of liquid bonding agent and on the building site, during laying of the filling to the place of deposition, is in the reservoir with granulate (2) by the help of the compressor (5) created overpressure of the air and eventually is the reservoir inclined and the granulate then enters continually from the reservoir (2) with air pressure through a piping (13) to a mixing element (7), in which is the granulate mixed with the liquid bonding agent, which is fed to the mixing element (7) from the reservoir (3) by means of a piping (9) and to intermixing comes by means of turbulence of the granulate and bonding agent in the flow of air and after intermixing flows the granulate out off the mixing element (7) to the place of deposition (11).
2. An equipment for application of the filling of granulate stabilized with bonding agent, **wherein** it is placed on one vehicle, which is a truck (1) or a set consisting of a trailer or semi-trailer (24) and a tractor (25) and contains at least in the time of transportation to the building site at least one reservoir for the granulate (2) and at least one reservoir for the liquid bonding agent (3) and at least one compressor (5) for generating of compressed air and at least one pump (6) for pumping of the liquid bonding agent and also contains at least one mixing element (7), which is, at least in the time of laying of the filling to the place of deposition, connected to the piping (13) leading from the reservoir (2).
3. The equipment for application of the filling of granulate stabilized with bonding agent according to claim 2, **wherein** the reservoir (2) for granulate is formed by one tank, in which is possible to create an overpressure of the air and the reservoir (3) for the bonding agent is formed by at least one tank placed on the truck (1) or tractor (25) or semi-trailer (24) among the cabin and reservoir (2) for granulate.
4. The equipment for application of the filling of granulate stabilized with bonding agent according to claim 2, **wherein** the reservoir (2) for granulate is formed by one tank, in which it is possible to create an overpressure of the air and the reservoir (3) for the liquid bonding agent is formed by at least one exchangeable tank, that is placed on the car (1) or tractor (25) or semi-trailer (24) among the cabin and reservoir (2) for granulate.
5. The equipment for application of the filling of granulate stabilized with bonding agent according to claim 2, **wherein** the reservoir (2) for granulate is formed by one tank (2C), in which it is possible to create an overpressure of the air and the reservoir (3) for the liquid bonding agent is formed by two tanks (3D), (3E), which are placed each of one side of the tank (2C) that way that longitudinal axis of the tank (2C) finds oneself among lengthwise axis tanks (3D) and (3E).
6. The equipment for application of the filling of granulate stabilized with bonding agent according to any of claims 2 to 5, **wherein** the mixing element (7) has except an input opening (12) and an output

opening (27) even at least one next input opening (14), on which is at least at the time of laying of the filling connected the piping (9) with bonding agent from the reservoir (3).

7. The equipment for application of the filling of granulate stabilized with bonding agent according to any of claims 2 to 6, **wherein** on the input opening (14) of the mixing element (7A) connects a tube (15), which leads to the inner space (22) of the mixing element (7A) and is tipped with a jet (16), which has a slot (17) placed so, that the plane interleaved by this one slot is perpendicular to lengthwise axis of mixing element or forms with her an angle 60 as far as 90 degree.

8. The equipment for application of the filling of granulate stabilized with bonding agent according to any of claims 2 to 6, **wherein** on the input opening (14) of the mixing element (7B) connects a tube (15), which leads to the inner space (22) of the mixing element (7B) and is tipped with a jet (16) turned against the flow of the granulate and air and in front of the jet is fixed a shield (19) with a conical inclination (23) and a reflective sheet (28), which is planar or concave or convex.

9. The equipment for application of the filling of granulate stabilized with bonding agent according to any of claims 2 to 6, **wherein** on the input opening (14) of the mixing element (7C) connects tube (15), which leads to the inner space (22) of the mixing element (7C) and is placed aslope toward the lengthwise axis of the mixing element so, that the it forms an angle of 5 as far as 45 degree and is tipped with a jet (16) and in front of the jet is fixed sheet (28), which is planar or concave or convex.

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FIG.1

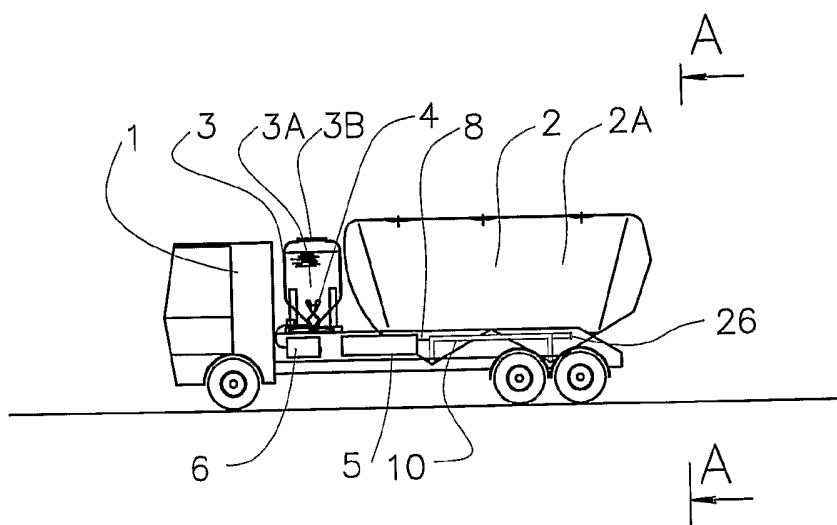


FIG.2 A-A

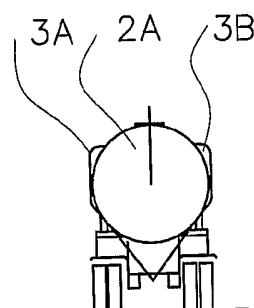


FIG.3

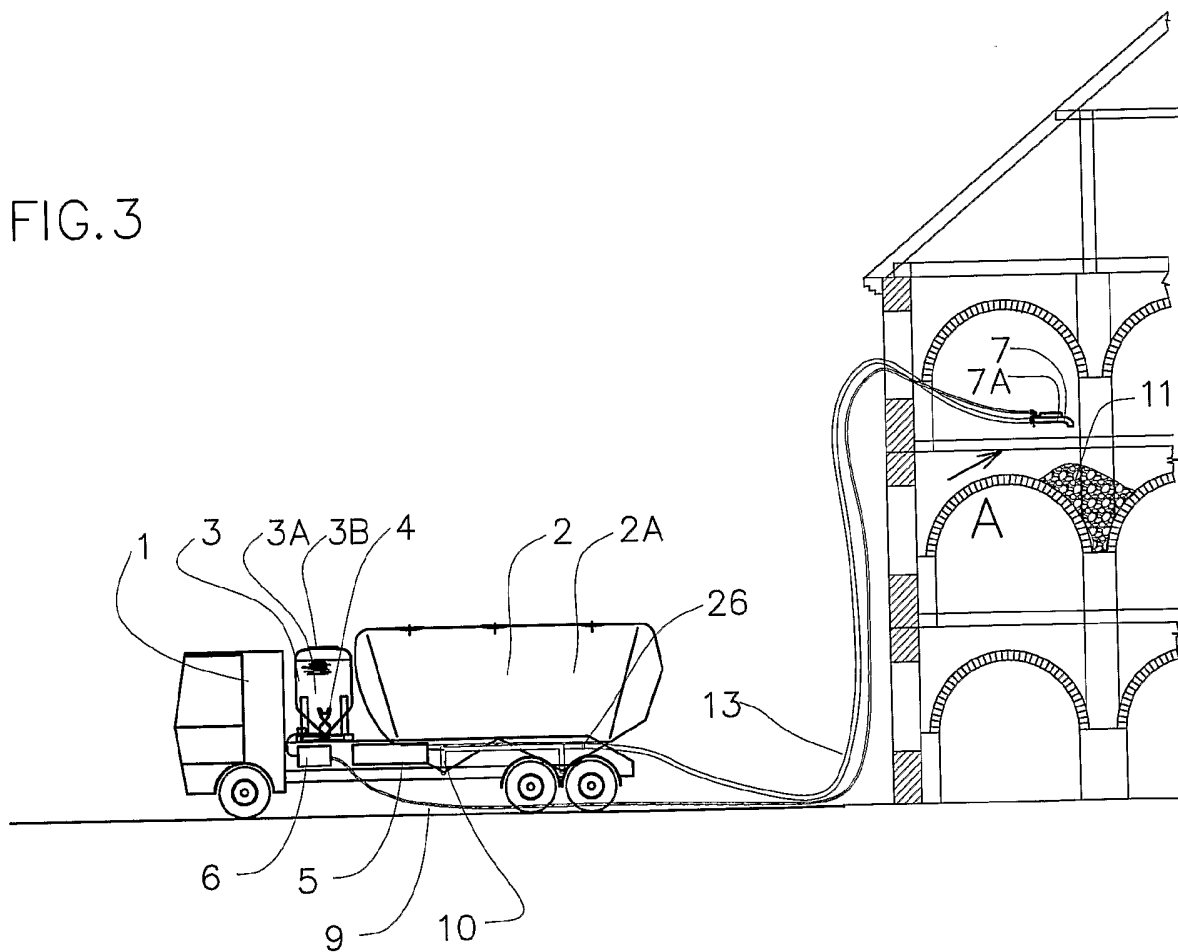


FIG.5

FIG.6 B-B

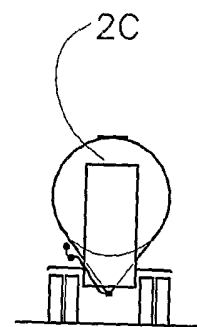
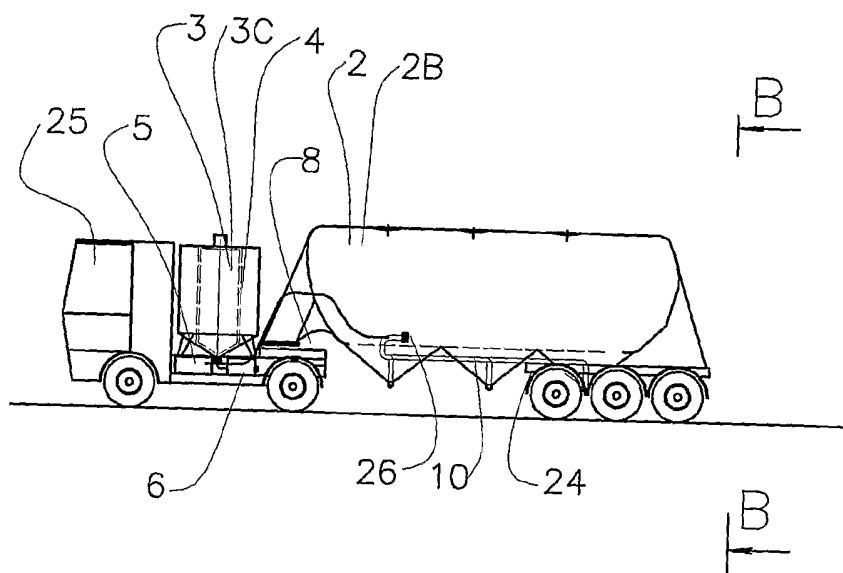


FIG.7

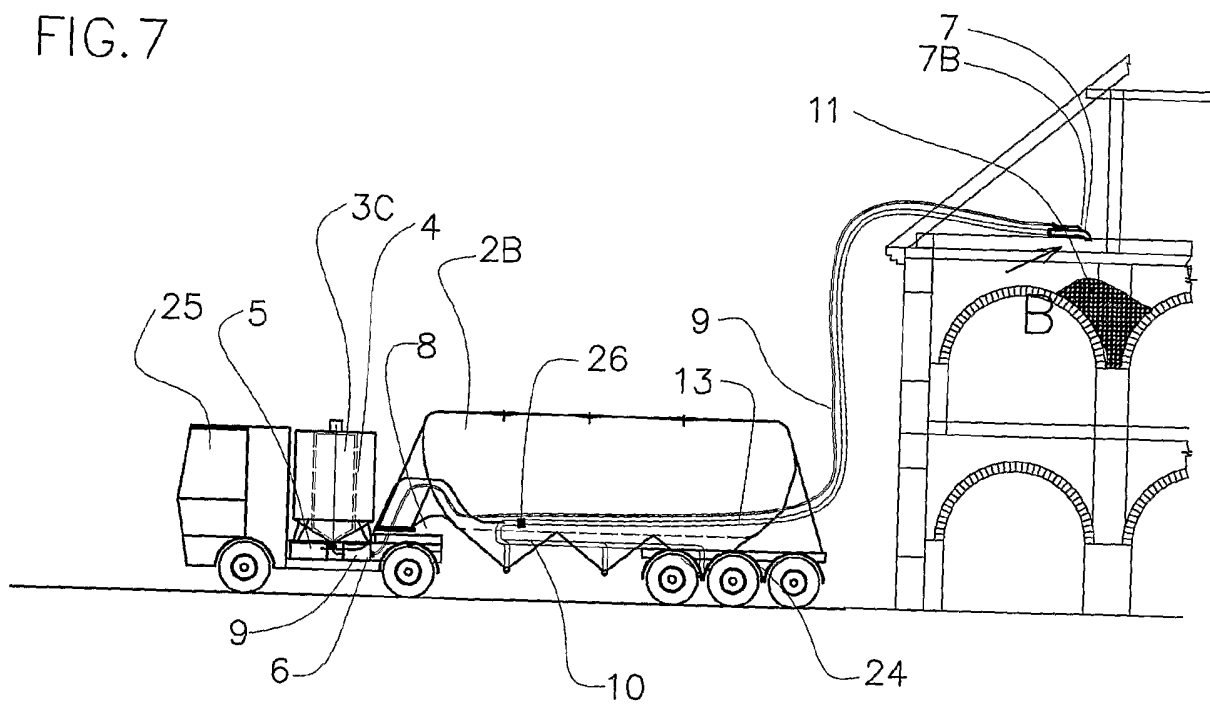


FIG. 9

FIG.10 C-C

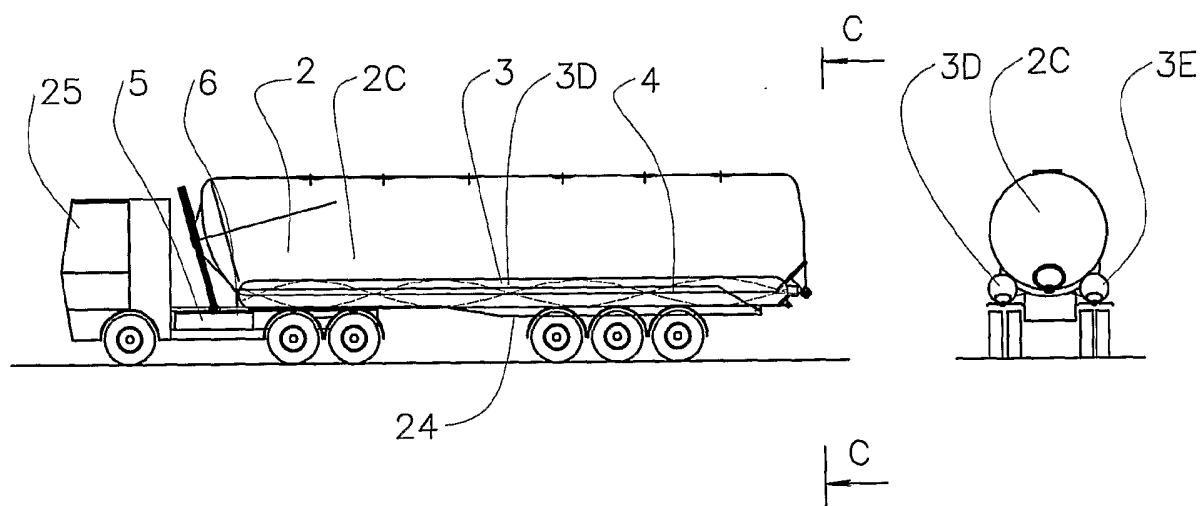


FIG.11

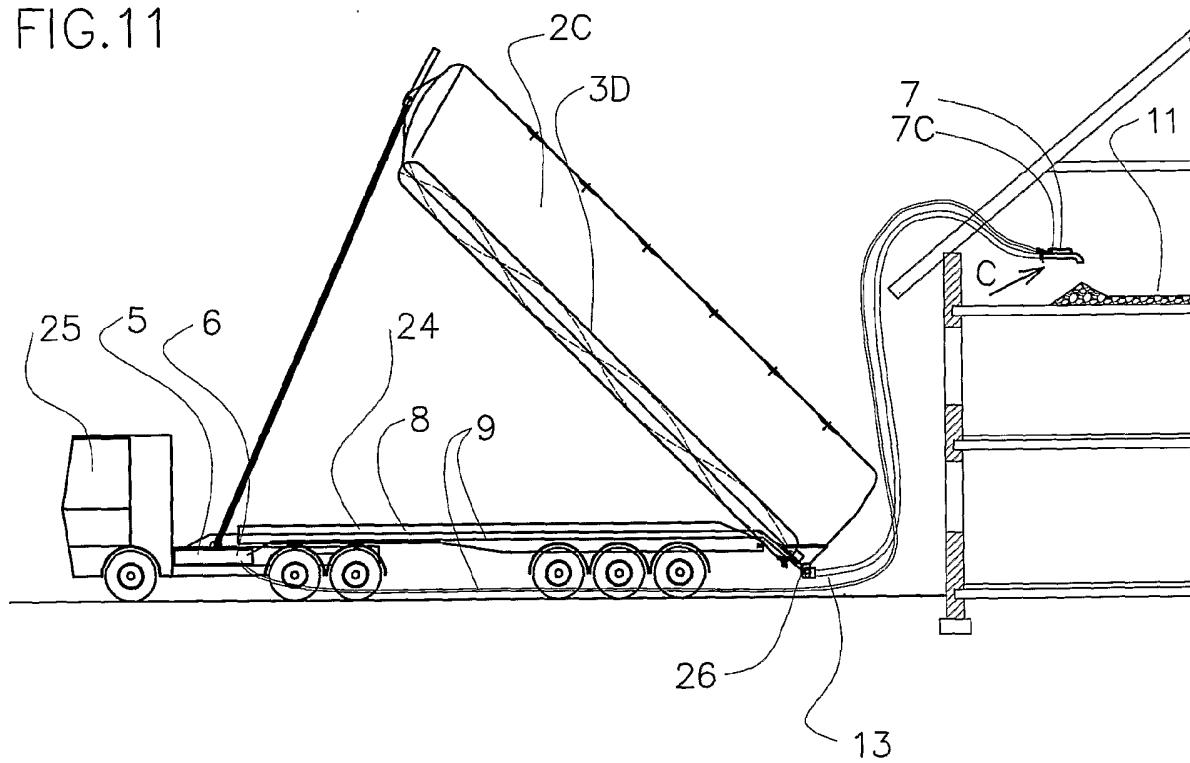


FIG.4 → A

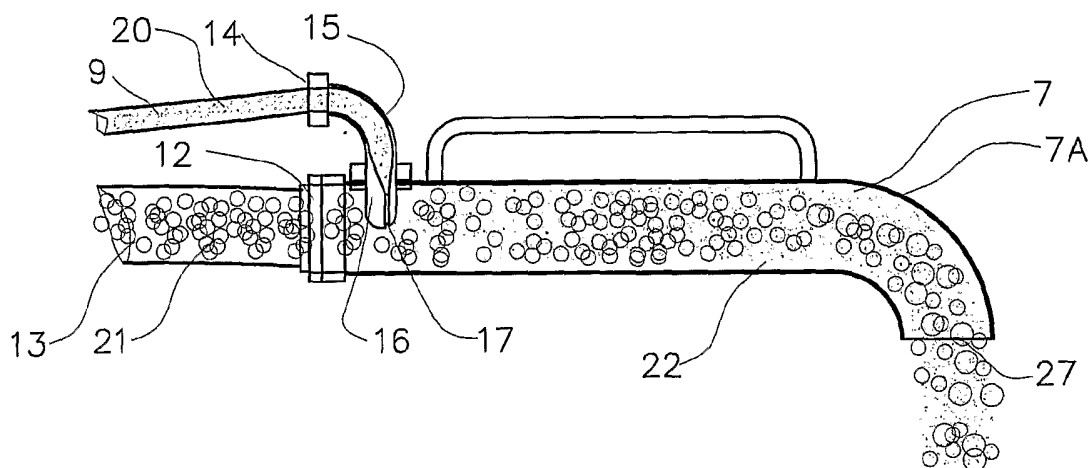


FIG. 8 → B

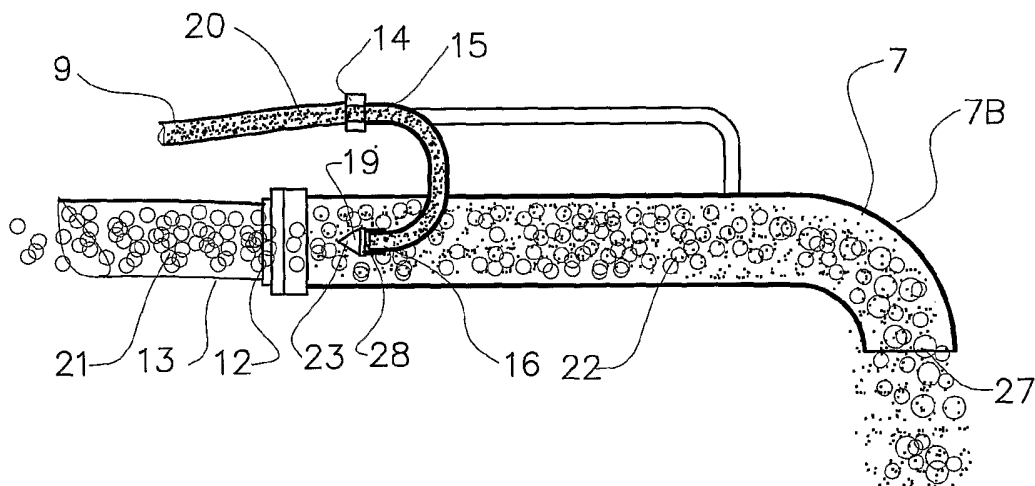


FIG.12 → C

