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(54) Title: A MOBILE LOADING SYSTEM FOR CONCRETE MIXERS

(57) Abstract: A mobile loading system for concrete mixers comprises a storage silo (2) of the cement having a loading inlet (3) and a discharge outlet (4), first means of loading (5) the cement into the storage silo (2) through the loading inlet (3), dosing means (6) of the concrete at the discharge outlet (4), second means of loading (7) the concrete mixer adapted to draw the concrete from the dosing means (6) and to lift it to a predetermined height so as to bring it at the loading inlet of the mixer, a base frame (8) positioned on the ground, the mobile storage silo (2) hinged to the base frame (8) to be lifted from the horizontal transport position to the operative vertical position.

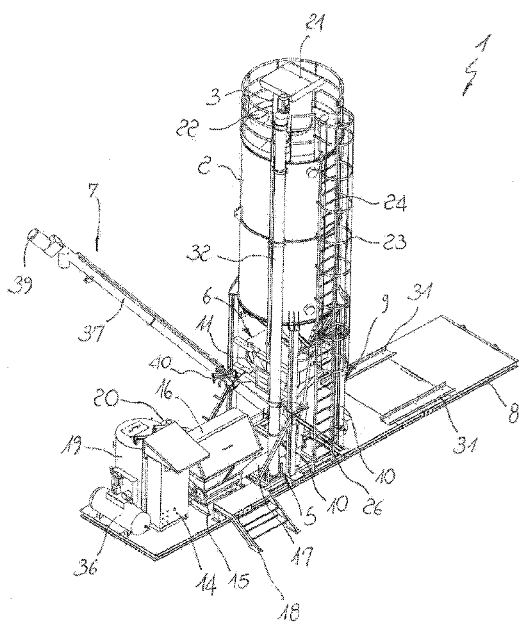

FIG. 1

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A MOBILE LOADING SYSTEM FOR CONCRETE MIXERS

Description

Technical Field

The invention can be technically applied for industrial plants used to process concrete and similar materials. In particular, it concerns a mobile loading system for concrete mixers which is primarily used for loading concrete dumpers or self-loading concrete mixers.

State of the art

As known, within small and medium construction sites, where the activities of compact dimensions are generally carried out, it seems to be cheaper to set up mobile installations rather than fixed installations for the production of concrete.

In other words, a mobile plant allows obtaining concrete with less obstructions and lower costs, compared to a fixed installation.

Moreover, mobile units can be sized depending on the needs of the construction site in order to produce the correct amount of concrete, ensuring at the same time the quality of the final product.

The first type of widely employed mobile plants contains self-loading concrete mixers whose use is traditionally limited to the construction site, where it is not convenient to install aggregate loading equipment - both for economic reasons and the available space - though keeping the dosing unvaried.

The disadvantage of such systems is associated with the necessity to load certain quantity of cement, aggregates, additives and water from different storage places on the construction site. Moreover, these operations are usually performed manually.

The mixer has, thus, to be moved within the construction site in order to load aggregates and cement, and subsequently adjust the dosage of water and additives. Once all the substances are added, they can be mixed.

A further limitation is, therefore, constituted by the fact that the quality of the finished product strictly depends both on the way various loading phases are carried out and on the waiting time.

In addition, when cement is available in bags, one or more operators will have to empty them directly on the blade, which can have a toothed plate to enable breaking the bag.

Cement dosage is slow, it may leave dust residue, and furthermore requires for the operator to wait until the mixer discharges the contents before proceeding with a new load.

Another type of system involves the use of a horizontal cement storage silo to load the mixer, designed to be transported by a 40-foot container and positioned in the construction site by means of a support structure.

The horizontal silo does have neither water tanks nor tanks for additives, so these must be positioned on site, requiring further transportation. Furthermore, in order to be filled, the silo must be coupled with a bag breaker, which represents an additional module.

All in all, such a solution does not enable the plant to be immediately ready for use, still requiring assembly. Examples of similar applications are described in US3820762, US3029958 and US3313435.

In particular, US3820762 describes a mobile station, fitted with several units which are detached from each other and may be assembled at the time of use.

However, some of these units are dismantled in order to be assembled only at the time of use. In particular, the central control unit is configured to be completely separate and is transported independently. In addition, the station consists of a whole wet central unit, i.e. provided with a mixer, and requires aggregate weighing, as it cannot be used with self-loading concrete mixers.

This station, therefore, requires long and complex assembly operations to function normally. For example, the provision of a conveyor belt to deliver the mixture from the weighing hopper to the mixer requires digging a hole in the ground in correspondence with the discharge outlet of the hopper.

Some problems of these stations are actually related to the increased complexity associated with the maintenance of equipment, such as screw conveyors, thus increasing the risks of a system failure, as well as transport and assembly of individual screw conveyor units.

Scope of the invention

The invention is aimed at overcoming the above-mentioned drawbacks by providing a mobile loading system for concrete mixers, such as dumpers or alike, thus featuring high efficiency and cost-effectiveness.

A specific object is to provide a mobile loading facility for concrete mixers which is particularly compact and may be carried in a container, ensuring easy transportation and readiness for use by following simple assembly steps.

Yet another object is to provide a mobile loading system for concrete mixers which may speed up the loading process of the concrete mixer and enable automatic control of the component dosage for the production of concrete.

Another object is to provide a mobile loading system for concrete mixers of high versatility and compact size, so as to be mounted virtually anywhere, even in spaces of limited dimensions.

Not last object is then to make a mobile system adapted for loading dumper or similar mixer which does not require the use of lifting and transport systems of considerable dimensions for its installation, such as cranes.

All the above-mentioned and other possible objects are achieved by a mobile loading system for concrete mixers according to claim 1.

Advantageous embodiments of the invention may be obtained according to the appended dependent claims.

Brief description of the drawings

More specific features and advantages of the invention will become more apparent in the light of a detailed description of a preferable but not exclusive embodiment of the system, shown in as a non limiting example in the attached drawing table, wherein:

FIG. 1 is an isometric view of the system in condition of use;

FIG. 2 is a front view of the plant of **Fig.** 1;

FIG. 3 is a side view of the plant of **Fig. 1**;

FIG. 4 is an enlarged view of a first detail of the plant of **Fig. 1**;

FIG. 5 is a top view of the plant of **Fig.** 1;

FIG. 6 is an isometric view of the plant in transport condition;

FIG. 7 is an isometric view of the plant of **Fig. 6** inserted in a container;

FIG. 8 is a front view of the plant of **Fig. 6**;

FIG. 9 is an enlarged view of a detail of **Fig. 7**;

FIG. 10 is an enlarged view of two further details of the plant of **Fig. 1**;

FIG. 11 is a top view of the plant of **Fig. 6**.

Best mode of carrying out the invention

Drawings illustrate the main, but not exclusive, configuration of a mobile system for concrete loading such as a dumper or self-loading concrete mixer, to be installed on a construction site for the storage and supply of cement to a cement mixer.

The system, generally depicted in **1**, essentially comprises a silo **2** for the storage of cement with a loading inlet **3** and a discharge outlet), first means **5** for cement loading inside the storage silo **2** through the loading inlet **3**, dosing means **6** of the concrete places at the discharge outlet **4** and second means **7** for loading a concrete mixer, adapted to draw the concrete from the dosing means **6** and lift it to a predetermined position to bring it in level with the loading inlet of the mixer.

The storage silo **2** is mounted on top of the base frame **8**, substantially adapted to be placed on the ground, possibly with the interposition of a concrete plate or other masonry or even without it if a preventive stability verification allows it.

The storage silo **2** is hinged to the frame **8** to be raised from a horizontal position, thereby allowing to move in the pipeline to an operative vertical position.

Fig. 1 illustrates the system **1** with the storage silo **2** in the vertical position.

As indicated in the figure, the silo **2** is supported by a structure **9** hinged to the base frame **8** and with vertical legs **10** that delimit an area within which the dosing means are arranged **6**.

As it can be seen more clearly from **Fig.2**, the dosing means **6** comprise a hopper **11** which is arranged below the discharge outlet **4** of the silo **2** and a dosing device **12** with load cells which is arranged directly below **13**.

Fig. 3 shows that the hopper **11** is preferably, but not exclusively, fitted with dual discharge outlet to ensure a quick but precise dosing.

In fact, it will use the first discharge outlet with a larger diameter for a more rapid and coarse filling, whereas the second discharge outlet with a smaller diameter will be used in the final stage for a slower but more precise dosing.

The hopper **11** is fitted with valves, which are not illustrated, and consist of, for example, a butterfly valve for each of the discharge outlets to enable the selection of the discharge outlet to be used. These valves can be controlled by an electric control panel **14** arranged in a dedicated seat on the base frame **8**.

Inside the silo **2** there may be a not-shown vent tube from the dosing unit **12** to avoid increased air pressure, resulting in wrong weight value and dosing error. In order to avoid the cement falling in the vent tube, it is provided with a protective sheet at the top.

The dosing unit **12** will be attached to the support structure **9** of the silo **2** to be able to move integrally in the same stage of the system installation from a horizontal to a vertical operating position.

In particular, during transport the dosing unit **12** will be integral with the support structure **9** thanks to fixing bolts which will be removed once the silo **2** will be in the vertical operating position, at which the dosing unit **12** will be supported only by the load cells **13**, as visible more clearly in **Fig.4**.

Preferably but not exclusively, the dosing unit **12** may be dimensioned so as to be able to load the amount of cement required to fill a concrete mixer of $5m^3$ in one step.

The base frame **8** also includes an anchoring structure **15** for a bag breaker **16** which delimits a chamber for pouring cement from the bags. The structure is connected with the first horizontal screw conveyor **17** to transfer the cement from the bag breaker to the first loading means **5**.

In the illustrative but not limiting configuration outlined in the figures, the bag breaker **16** consists of two flanged bodies constituting the hopper that will convey the cement to the horizontal screw conveyor **17** located below.

The bag breaker **16** further comprises an upper cover bolted on lower flanges and is also arranged for the installation of a filter to recover volatile material lost during cement bag breakage.

The pouring chamber contains a grid, which cannot be seen in the figures, provided with blades to allow breaking the bag and enable pouring of the material.

Slamming the bag on the blade, the operator will ensure rupture of the bag with the subsequent pouring of the cement that will fall directly onto the horizontal screw conveyor **17** located below.

The horizontal screw conveyor **17** is connected to the first loading means **5**, so as to allow continuous filling of the silo **2**, with no need to wait for the mixer to arrive at the cement storage place for loading. The advantage of the proposed system lies in the division of the manual phase of breaking the bag, which is the operator's responsibility, from the automatic loading into the concrete mixer carried out by the dosing means **6** and the first and second loading means **5**, **7**.

Access to the bag breaker **16** is facilitated by an access ramp **18** formed by two steps and a platform, which will be sized to allow the operator to obtain the grid at pelvis height for comfortable breaking of cement bags.

In addition to the electric panel **14** for controlling the system **1,** bag breaker **16** and the silo **2**, the base frame **8** also contains a water tank **19** functioning as an accumulator tank, fitted with level indicators, and additive tanks **20** for the dosing of additives, as shown in **Fig.5**.

This figure also illustrates that the silo **2** is provided on top with a filter **21** for the recovery of cement and with a relief valve **22**.

The system **1** will be fitted with all the essential components for immediate use, thus ensuring full functionality after a few quick and assembly operations.

Fig. 6 illustrates the system **1** in transport configuration where the storage silo **2** is in the horizontal position. In this condition, some parts may be conveniently dismantled, such as the bag breaker **16** with the relative access ramp **18**, which will be present on the frame **8** but in a dismantled condition to allow the horizontal positioning of the silo **2**, and the protective grid **23** of the ladder **24** to access the loading inlet **3** of the silo **2**.

For practical reasons, the grid **23** can be mounted when the silo **2** is still in the horizontal position, while the assembly of the bag breaker **16** takes place after the silo **2** has been lifted.

In this way, the system **1** will have a sufficiently compact configuration to be put in a container **25**, e.g. a 40-foot container of the open-top type, as shown in **Fig. 7**.

Conveniently, the transition from the horizontal to the vertical position will be achieved automatically by assemblies connected to the frame **8** and the silo **2**, configured to ensure a roto-translational movement of the silo **2**.

In the shown configuration, the assemblies comprise a pair of actuators **26** of the hydraulic piston type, each having a fixed end hinged to the frame **8** and one end connected to the base of the storage silo **2**, i.e. silo support frame **9**, to ensure the roto-translational movement necessary for the transition from the horizontal to the vertical position and vice versa.

Moreover, the actuators **26** will be powered by a hydraulic power unit **27** with non-return valves in order to prevent a possible piston failure once the oil pump stops working. In alternative configurations, the actuators may be pneumatic, hydraulic, electro-mechanical etc.

The use of similar handling means will help to avoid the use of cranes for lifting the silo, even though a lifting crane may be required in a further configuration.

The support structure **9** of the silo **2** comprises support legs **10** with a vertical fixed section

28 integral to the base frame **8** and a mobile section **29** integral to the storage silo **2** to ensure their movement together with the silo and secure connection to the fixed section **28** when the storage silo is in the vertical operating position.

In particular, the support structure **9** of the silo **2** is hinged by a pin to the fixed sections **28** of the support legs **10**, which are welded to the frame **8**. Actuators **26** are hinged at the bottom of the support legs **10**.

In addition, the support structure **9** contains a hinge **30** for the mobile sections **29** of the legs **10** which in the initial stages of lifting the silo move along horizontal guide rails **31** fixed to the frame **8** to ensure that the mobile sections of the legs **29** remain in line, as shown in **Fig. 8**, and even more clearly in a detail of **Fig.9**.

Such movement may be supported by a steel cable not shown in the figure, which is connected to the mobile sections **29** and will be disconnected after its detachment from the rails **31**. Once the mobile sections **29** are in position, they are bolted to the corresponding fixed section **28** located on the frame **8**, as shown in the enlarged details of **Fig.10**.

After securing the support structure **9**, the bag breaker **16** is positioned on a special anchoring structure **15** provided on the frame **8**.

The first loading means **5** comprise a vertical screw conveyor **32** whose casing is anchored to the storage silo **2** to rotate both parts integrally in the transition from the horizontal to the vertical position. It will also be in the vertical position while in use.

During the assembly, the lower end of the vertical screw conveyor **32** will be connected by a flange to the horizontal screw conveyor **17** to form an integrated loading duct ensuring the transfer of cement from the bag breaker **16** to the loading inlet **3** of the silo **2**.

As shown in **Fig. 11**, in order to avoid interference between the vertical screw conveyor **32** in rotation while lifting the silo **2** and the horizontal screw conveyor **17**, the horizontal screw conveyor will be suitably rotated in the transport configuration with a predetermined angle to a horizontal axis that extends longitudinally to the frame **8**, for example 6°. Only after vertical positioning of the silo **2** it will be anchored to the vertical screw conveyor **32**.

The first loading means **5** also comprise an additional vertical delivery pipe **33** to load the silo **2** from a tanker truck.

The silo **2** contains a level indicator system **34**, while the walls of the double-mouth hopper **11** contain cement fluidification system **35** to ensure that the cement does not consolidate excessively and escape from the valves. A compressor **36** located on the frame **8** supplies air to the nozzles, which are an integral part of the fluidification system **35**.

The second loading means **7** comprise an additional screw conveyor **37** provided with an inlet **38** to draw the cement from the dosing unit **12** and a discharge outlet **39** to the concrete mixer.

The third screw conveyor **37** is hinged to the support structure **23** to rotate around it and bring its inlet **38** below the dosing unit **12** and the outlet **39** to the predetermined position to enable discharge in a concrete mixer.

The height of the discharge outlet **39** of the third inclined screw conveyor **37** is adjusted manually by a winch **40** positioned at operator height and locked in position to ensure the transfer from the dosing unit **12** to the inclined screw conveyor **37**.

The system **1** also comprises pumps to draw water and additives from the corresponding tanks **19**, **20** to achieve the predetermined amount of substances for loading in the mixer. The third screw conveyor **37** will be supplied with water and additives from water and additive piping fixed to the screw conveyor **37** and connected to the water tank **19** and additive tank **20** by means of hoses and hose connections.

All the components are connected to the electric control panel **14** which will ensure automatic dosage of cement, water and additives according to preset formulas.

From the description of the devised system it appears evident that the plant has achieved the explicitly stated goals.

In particular, the system enables loading all the main components for the production of the concrete, except for the aggregates. It is compact and easy-to-transport in a single self-contained container which may be easily moved and unloaded, thus saving space on the construction site.

Discharge of the components in a self-loading concrete mixer takes less time than discharge in a regular concrete mixer.

In addition, there is no downtime for cement loading, as the operation is performed by screw conveyors rather than manually; breaking the cement bags and pouring cement into the mixer takes place in two separate stages so as to speed up the whole operation.

In fact, the operator can break the bags continuously until the overflow alarm of the silo level indicators goes off. The operator will not have to wait until the concrete is ready to continue breaking the bags, as occurs with self-loading concrete mixers equipped with a bag-splitting blade.

In horizontal silo systems it is not possible to enable constant dosing of concrete while loading the silo. It is due to the fact that these silos are equipped with a deduction dosing system, where cement loading into the mixer during discharge might distort weights.

However, in the present invention, the first loading means are independent from the second concrete mixer loading means.

Due to the devised dosing system and dust filters placed at the critical points, i.e. silo and the bag breaker, there is no concrete waste and the dispersion of dust is reduced as the cement remains confined in an enclosed space during the entire process.

Moreover, the system enables automatic control of dosing for the production of concrete, except for the aggregates.

The system is fully automated and allows setting different formulas and monitoring real-time and former dosing readings.

Due to automatic mobile sections, silo may be lifted by easily accessible equipment rather than cranes, thus reducing the time necessary for lifting the silo considerably to have the system ready in a short time.

According to the present invention, the system can be easily altered or adjusted within the devised framework in the appended claims. All the details may be replaced by other technically equivalent elements, whereas materials may differ according to the needs within the scope of protection of the proposed invention.

Although the system has been described with particular reference to the associated figures, the reference numbers in the description and in the claims are used to facilitate understanding of the invention and do not constitute any limitation to the claimed scope of protection.

Claims

1. A mobile loading system for concrete mixers, comprising:

- a storage silo **(2)** with a loading inlet **(3)** and a discharge outlet **(4)**;
- first means **(5)** for loading cement in the storage silo **(2)** through loading inlet **(3)**;
- dosing means **(6)** of the cement placed at the discharge outlet **(4)**;
- second means **(7)** for loading concrete mixer adapted to draw concrete from dosing means **(6)** to lift it to a predetermined height to bring it at the loading inlet of the mixer;
- a base frame **(8)** which may be positioned on the ground, a mobile storage silo **(2)** hinged to base frame **(8)** to be lifted from a horizontal transport position to an operative vertical position;

characterized in that the first loading means **(5),** dosing means **(6)** and second loading means **(7)** are mounted on the base frame **(8)** to ensure compact configuration to be transported in a single container.

2. System as claimed in claim 1, characterized in that said frame **(8)** is sized to be inserted inside a 40-foot container of the open-top type.

3. System as claimed in claim 1 or 2 is characterized by comprising actuators **(26)** integral with the frame **(8)** and adapted to move storage silo **(2)** between horizontal and vertical position.

4. System as claimed in claim 3, characterized in that said actuators **(26)** comprise one or more pneumatic, hydraulic, electro-mechanical or similar actuators, each having a fixed end hinged to frame **(8)** and one end connected to the silo **(2)** to ensure the roto-translational movement necessary for the transition from the horizontal to the vertical position and vice versa.

5. System as claimed in any preceding claim, characterized in that said storage silo **(2)**, comprises a support structure **(9)** having at least one support leg **(10)** with a vertical fixed section **(28)** integral with the base frame **(8)** and a mobile section **(29)** integral with the storage silo **(2)** to ensure their movement together with the silo and secure connection to the fixed section **(28)** when the storage silo **(2)** is in the vertical operating position.

6. System as claimed in claim 5, characterized in that said base frame **(8)** comprises horizontal guide rails **(31)** for mobile sections **(29)** of the legs **(10)**.

7. System as claimed in claim 5 or 6, characterized in that said dosing means **(6)** comprise a dosing device **(12)** with load cells **(13)** integral with the support structure **(9)**

of the silo **(2)** adapted to move with it from the horizontal to the vertical position.

8. System as claimed in claim 7, characterized in that said dosing means **(6)** comprise a hopper **(11)** arranged below the discharge outlet **(4)** of the silo **(2)**, and a dosing unit **(12)** arranged below the hopper **(11)**.

9. System as claimed in claim 8, characterized in that said hopper **(11)** has a double discharge outlet, with a first discharge outlet having larger diameter for a more rapid and coarse dosing and a second discharge outlet with a smaller diameter to be used in the final stage for a more precise dosing.

10. System as claimed in any preceding claim, characterized in that said base frame **(8)** comprises an anchoring structure **(15)** for a bag breaker **(16)** which delimits a chamber for pouring cement from the bags and the first horizontal screw conveyor **(17)** adapted to transfer the cement from the bag breaker to the first loading means **(5)**.

11. System as claimed in claim 10, characterized in that said first loading means **(5)** comprise a vertical screw conveyor **(32)** whose casing is rigidly coupled to storage silo **(2)** to rotate both parts integrally; the lower end of the vertical screw conveyor is anchored to the horizontal screw conveyor **(17)** when the silo **(2)** is in the vertical position to form an integrated loading duct ensuring the transfer of cement to the loading inlet **(3).**

12. System as claimed in any preceding claim, characterized in that said second loading means **(7)** comprise a third screw conveyor **(37)** hinged to the support structure **(9)** to rotate around it and bring the inlet **(38)** of the third screw conveyor **(37)** below the dosing unit **(6)** and a discharge outlet **(39)** of the third screw conveyor **(37)** to said predetermined height to enable discharge in a concrete mixer.

13. System as claimed in any preceding claim, characterized in that a water tank **(19)** and one or more additive tanks **(20)** for the dosing of additives are mounted on said frame **(8)**, there being also provided respective pumping means adapted to draw water and additives to achieve said predetermined height for the loading thereof in the mixer.

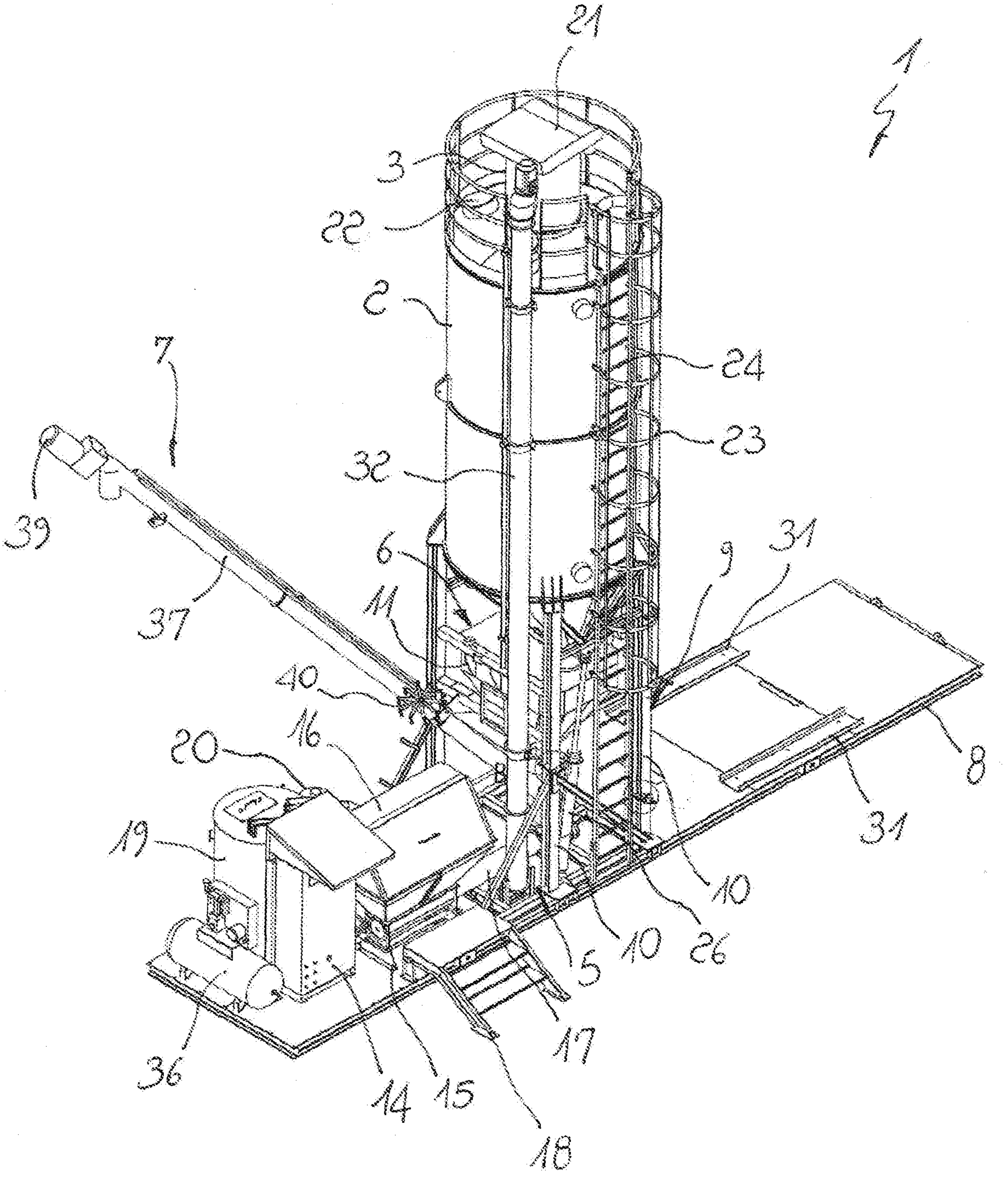
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FIG. 1

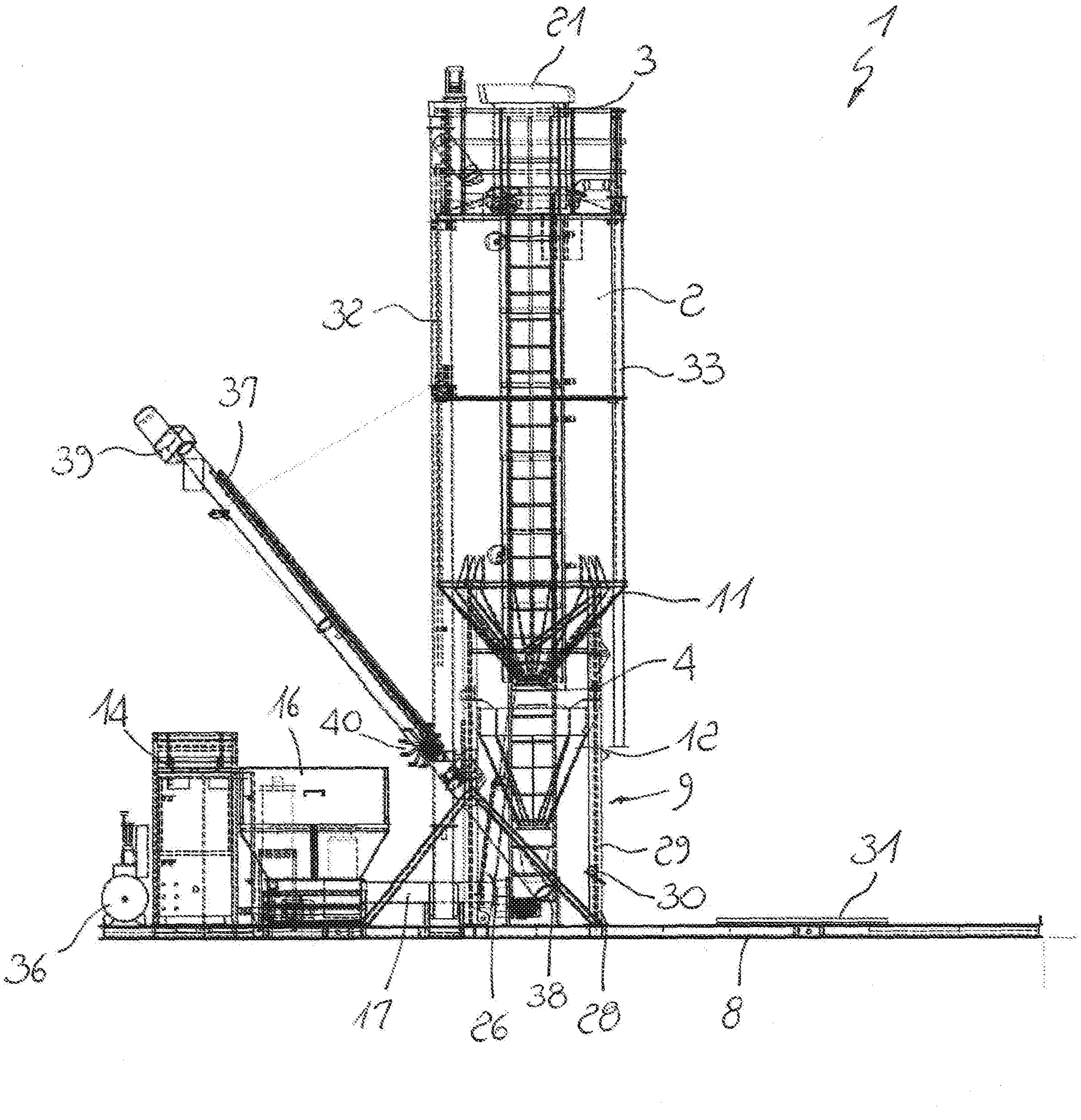

FIG. 2

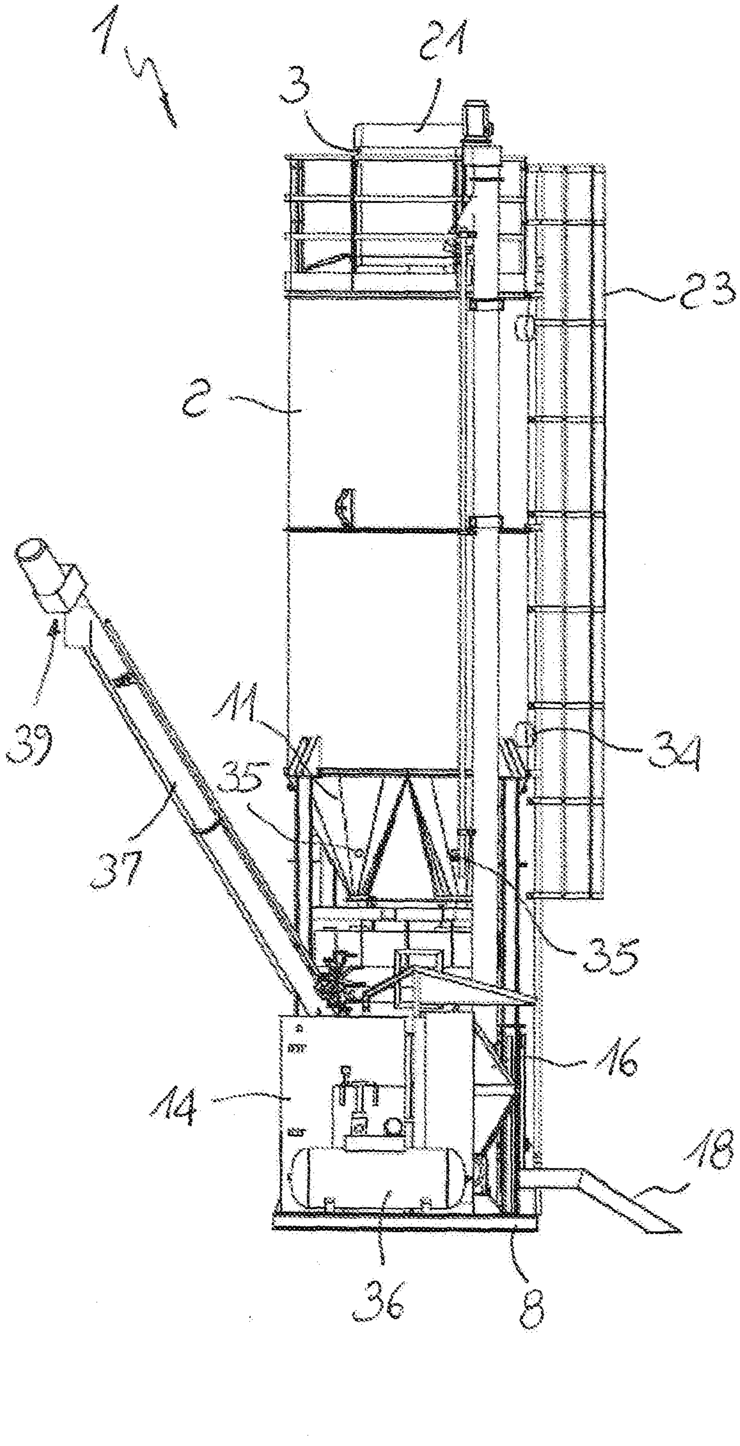

FIG. 3

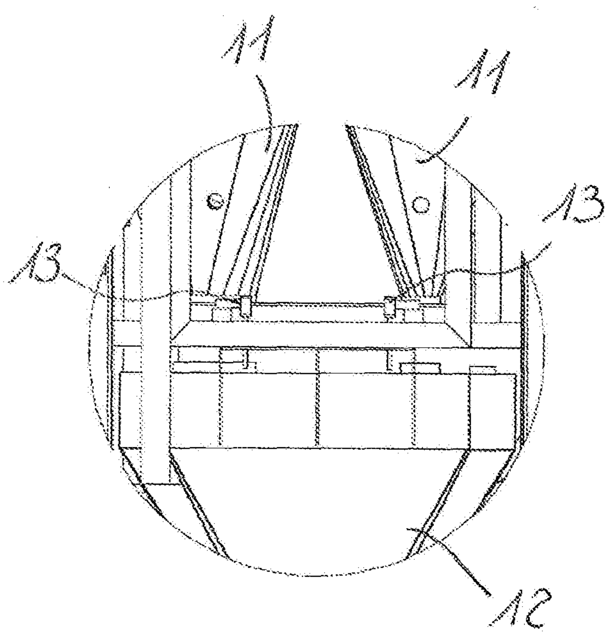

FIG. 4

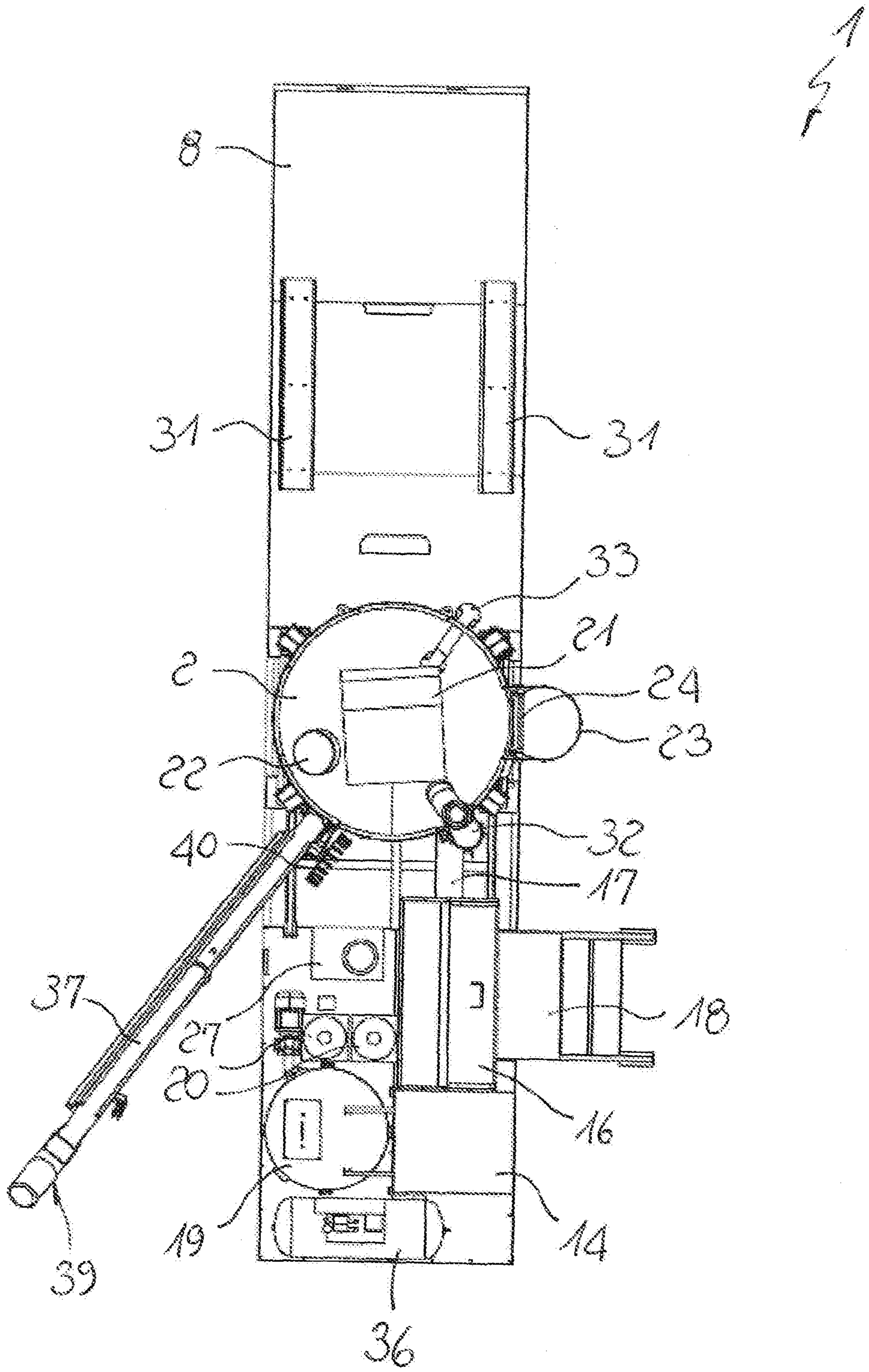

FIG. 5

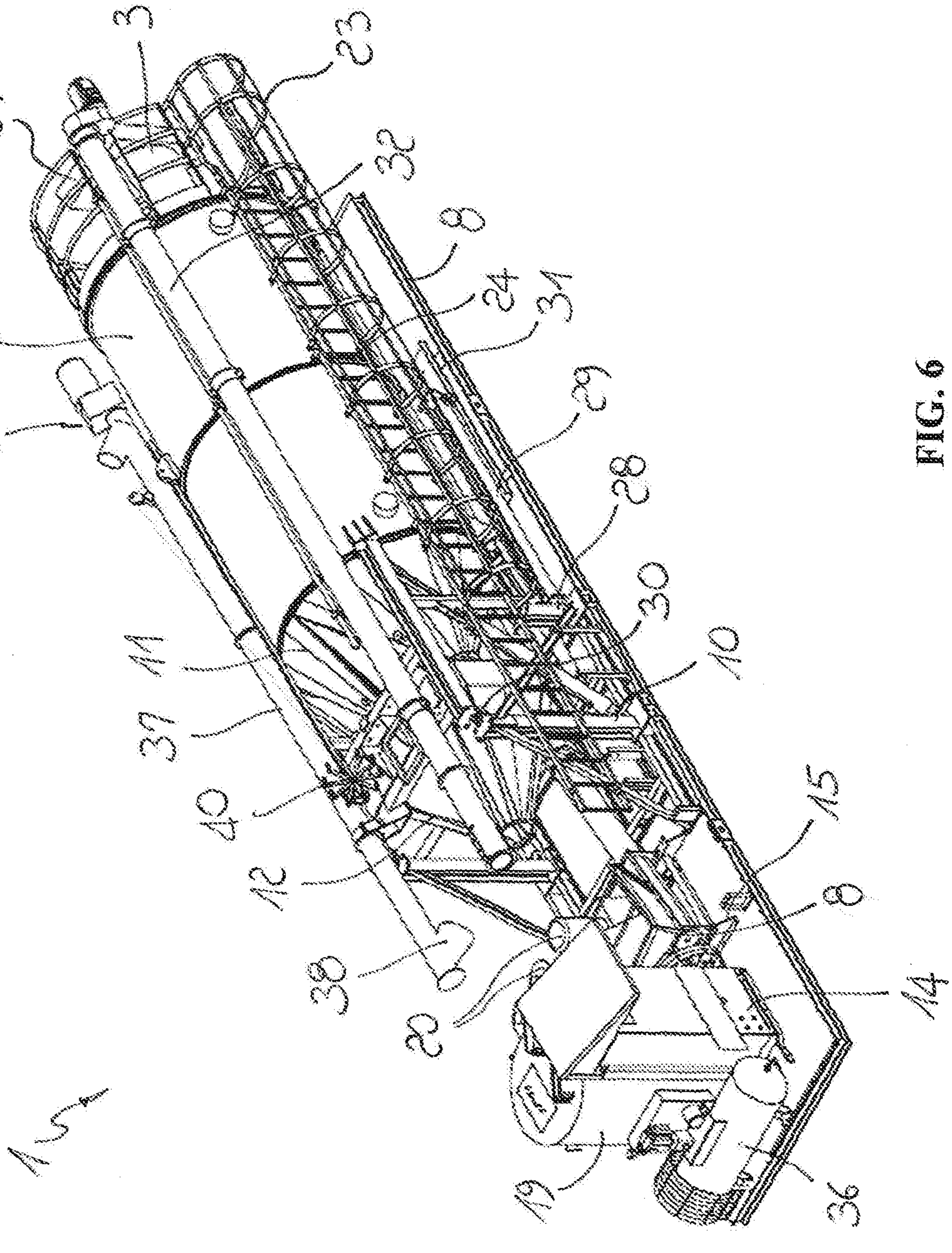

FIG. 6

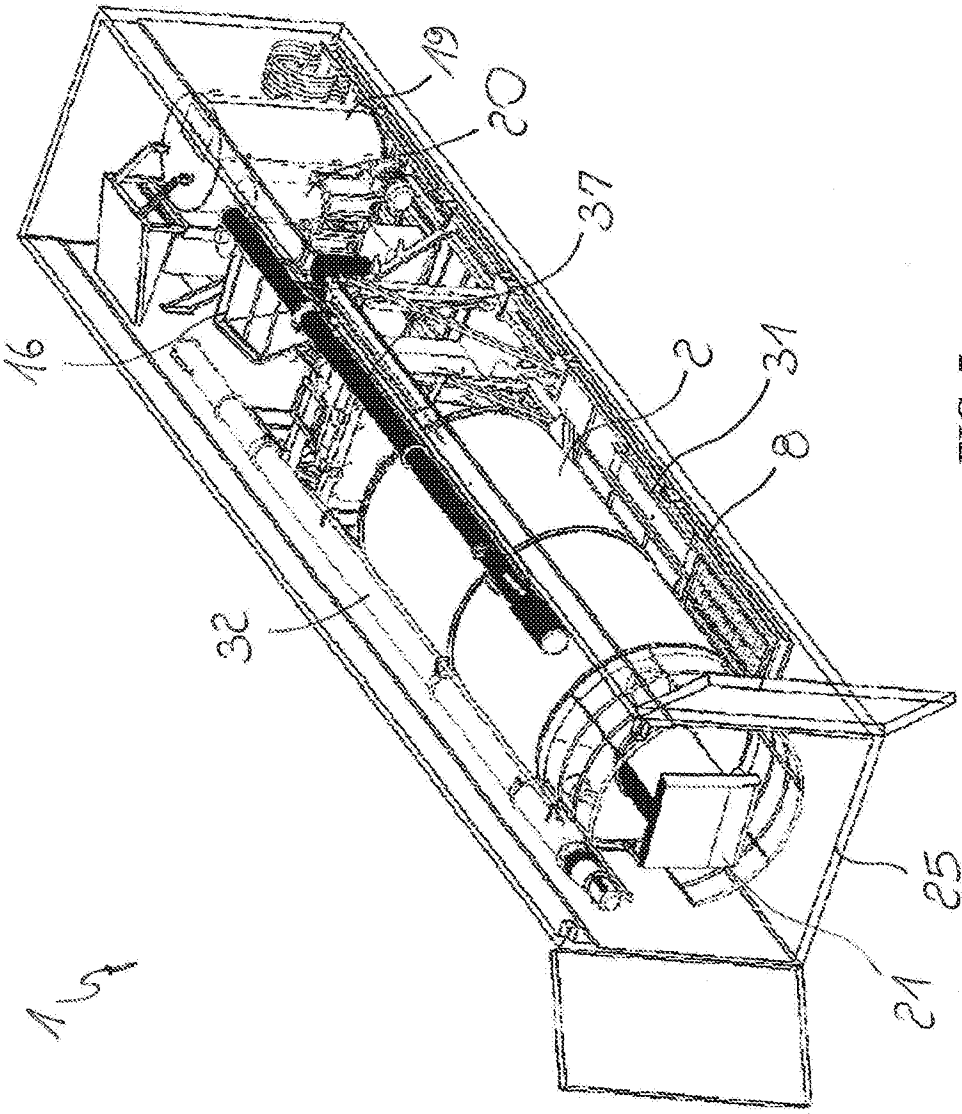

FIG. 7

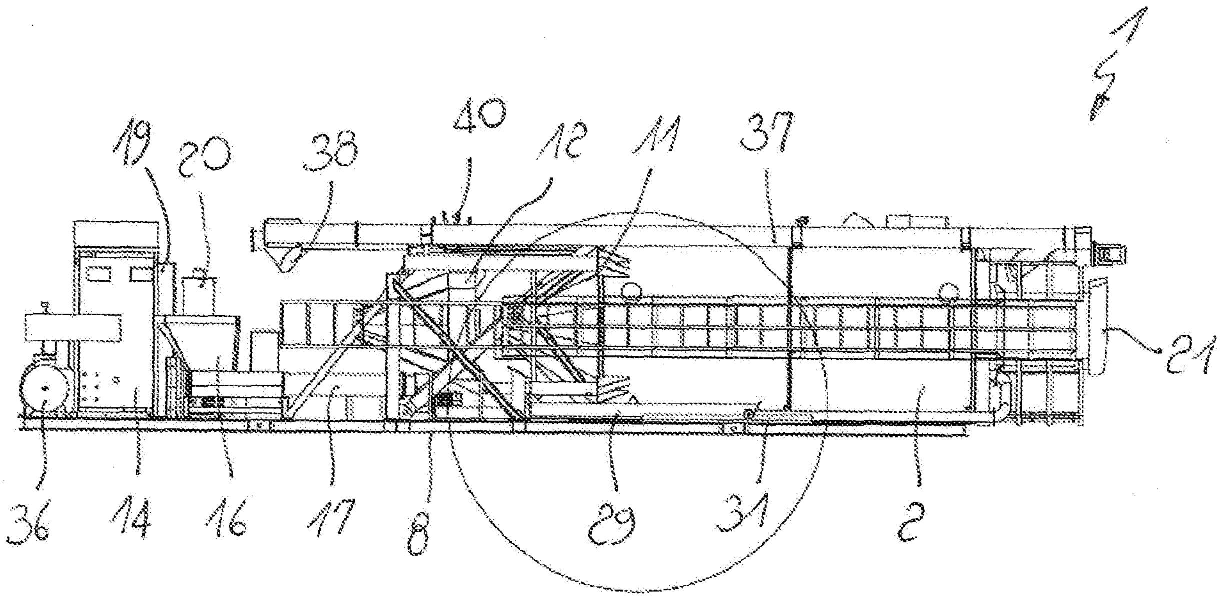

FIG. 8

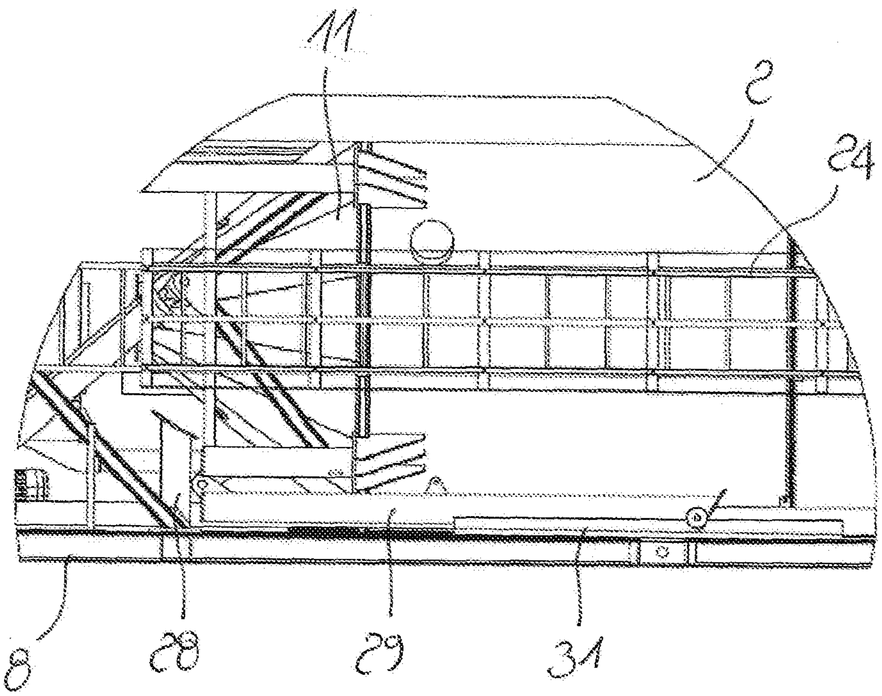

FIG. 9

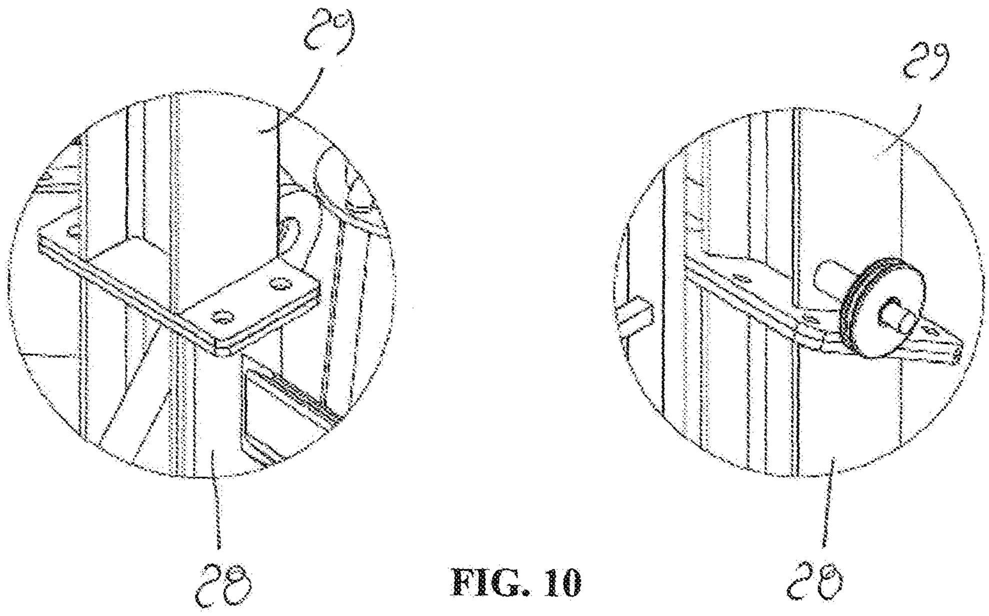

FIG. 10

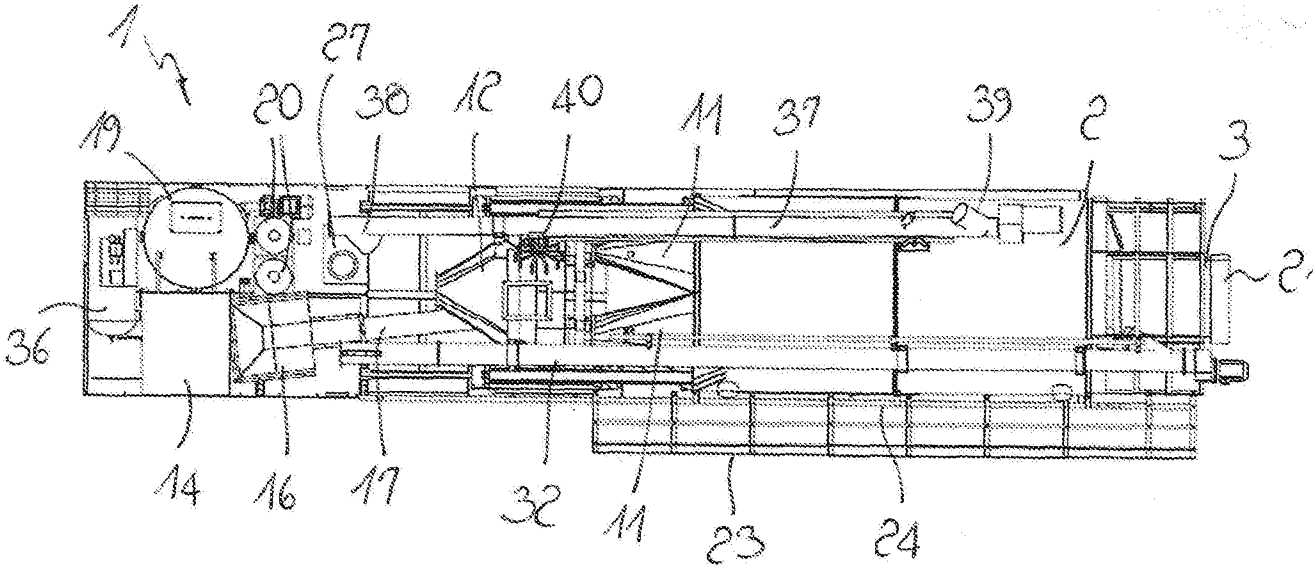

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/058541

A. CLASSIFICATION OF SUBJECT MATTER
INV. B28C7/00 B28C7/04 B65D88/30
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B28C B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3 820 762 A (BOSTROM S ET AL) 28 June 1974 (1974-06-28) column 2, line 50 - column 3, line 65; figures 1,2,6,7 column 5, line 3 - line 60	1,3-6 2,7,8, 12,13
X	US 3 029 958 A (RUBY HAROLD W) 17 April 1962 (1962-04-17) column 1, line 59 - page 4, line 9; figures	1,10-12
X	US 3 313 435 A (WELK PETER M) 11 April 1967 (1967-04-11) column 1, line 64 - column 4, line 4; figures	1,3,4, 10-12

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2018	12/04/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Orij, Jack

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 502 855 A1 (FEHR GROUPE [FR]) 26 September 2012 (2012-09-26) paragraph [0010] - paragraph [0018] paragraph [0021] - paragraph [0073]; figures	2,12,13
Y	DE 33 01 429 A1 (ELBA WERK MASCHINEN GMBH & CO [DE]) 19 July 1984 (1984-07-19) page 4 - page 8; figures	7,8,13
A	FR 2 718 668 A1 (BINGLER ALBERT [FR]) 20 October 1995 (1995-10-20) page 5, line 6 - page 8, line 22; figures	3-9

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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