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Nikowitz

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[54] **SILO CONTAINER**

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[52] **U.S. Cl.** **222/185,** 222/462

[51] **Int. Cl.** **E04h 7/22**

[58] **Field of Search** 222/185, 460, 462; 52/196, 52/245, 63, 3, 80, 82, 83, 90; 150/.5

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[57] **ABSTRACT**

A silo which has an outer silo container and an inner supporting framework supporting the container. The container is composed of roof and floor units and a foldable tubular side wall unit extending between the roof and floor units. Upper and lower connecting rings serve to connect the side wall at its upper and lower ends respectively to the roof and floor units. The supporting framework is situated in the interior of the container and includes a central supporting column which extends upwardly from the floor unit and carries the roof unit, the latter having a supporting structure which extends radially around the supporting column and which carries the upper connecting ring.

10 Claims, 3 Drawing Figures

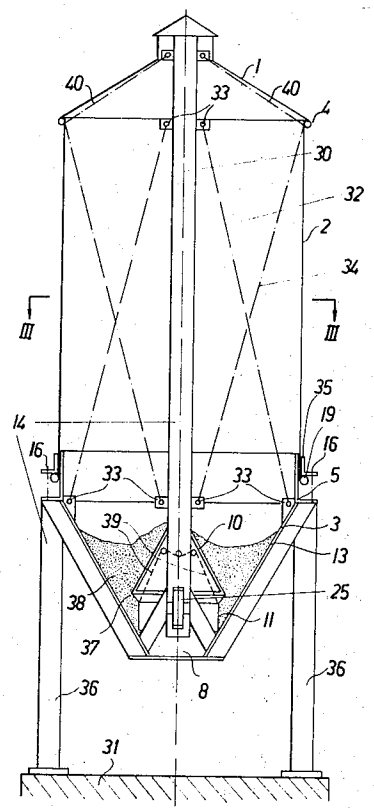


FIG.1

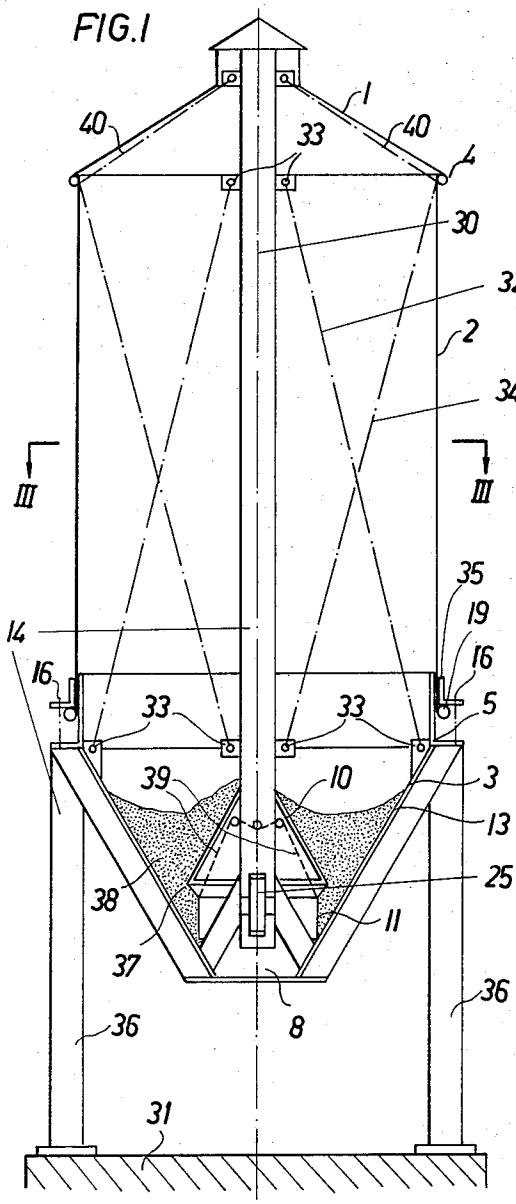
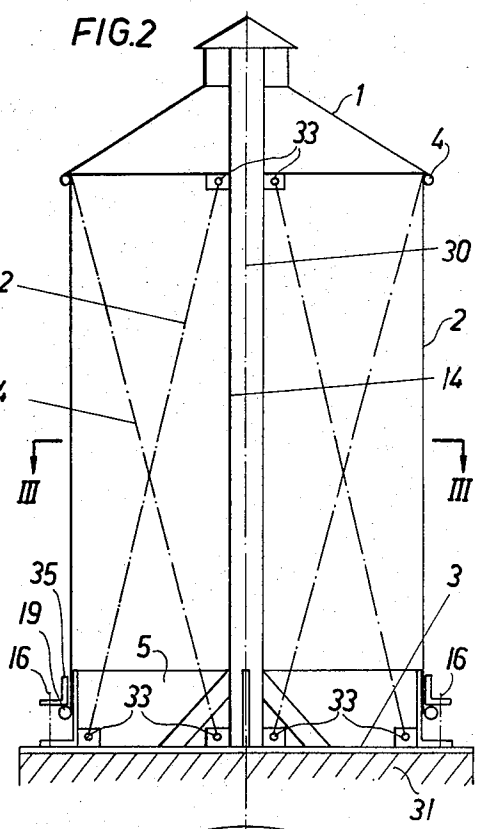


FIG.2



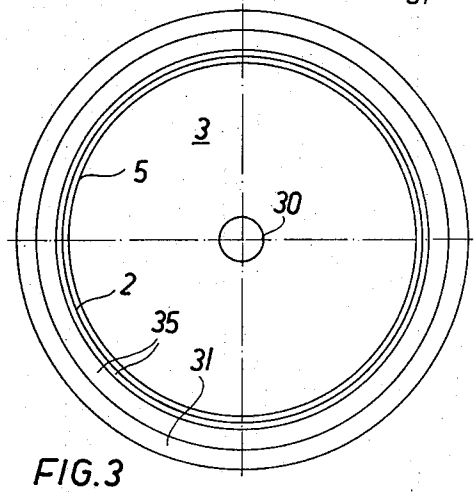


FIG.3

SILO CONTAINER

BACKGROUND OF THE INVENTION

The present invention relates to silos.

In particular, the present invention relates to large silos having an interior volume on the order of more than 150 cubic meters.

It has already been proposed to construct silos of this type out of roof and floor units interconnected by a cylindrical side wall unit with the silo container including in addition to the latter units a pair of connecting rings which serve to connect the side wall of the silo to the roof and floor units thereof with the components of the silo being clamped to these connecting rings.

With silo constructions of the above type considerable difficulties are involved because of their relatively complex structure and the relatively large costs involved in transporting the relatively bulky components required for the silo. These components are assembled at the location where the silo is set up for use.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a silo which will avoid the above drawbacks.

In particular, it is an object of the present invention to provide a silo of relatively simple construction capable of being set up in a relatively simple manner.

In addition, it is an object of the present invention to provide a silo construction which permits the components of the silo to be transported in a highly convenient and relatively inexpensive manner.

Thus, it is an object of the present invention to provide a silo which is made up of components which are not very bulky so that they can be shipped very easily.

In accordance with the invention the silo includes a silo container made up of roof and floor means and a flexible foldable tubular side wall means extending between and connected with the roof and floor means. Upper and lower connecting ring means serve to connect the side wall means respectively to the roof means and floor means. A supporting framework is situated in the interior of the silo container and includes a central supporting column extending upwardly from the floor means and carrying the roof means. This roof means is in the form of a supporting structure which is radially arranged around the supporting column and which carries the upper connecting ring means.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic sectional elevation of one embodiment of a silo according to the invention, the plane of FIG. 1 containing the central axis of the silo;

FIG. 2 is a schematic vertical section elevation of another embodiment of a silo according to the invention with the plane of FIG. 2 also containing the central axis of the silo; and

FIG. 3 is a schematic sectional plan view taken along line III—III of FIGS. 1 and 2 in the direction of the arrows.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIG. 1, the silo illustrated therein includes a steel supporting framework to which the outer silo container or cell is connected. In setting up the silo container the floor means 3 thereof is first mounted in its position of use, and then the central supporting column 30 of the supporting framework is fixed to the floor means 3 extending upwardly therefrom. This central supporting column 30 is braced with respect to a lower connecting ring means 5 by way of a plurality of elongated bracing means 32. The plurality of elongated bracing means 32 may be in the form of suitable guide cables or elongated bars or bracing rods. For this purpose the supporting column 30 fixedly carries adjacent its upper end a plurality of connecting lugs 33 which are fixed to and extend radially from the supporting column 30 while the connecting ring means 5 also fixedly carries a plurality of lugs 33, these lugs 33 being connected to the floor means 3 as well as to the lower connecting ring means 5. The plurality of elongated bracing means 32 are connected at their upper ends to the lugs 33 which are fixed to the upper region of the column 30 while at their lower ends the plurality of bracing means 32 are respectively connected with the lugs 33 each of which is connected in part to the ring means and in part to the floor means 3.

Then the roof means 1 is mounted on the top end of the supporting column 30 so as to be carried by the latter. The roof means 1 is braced by way of a plurality of elongated bracing means 34 also in the form of suitable guy wires or cables or bracing bars or rods. The elongated bracing means 34 are fixed at their top ends to the outer peripheral region of the roof means 1 and at their bottom ends to a plurality of additional connecting lugs 33 which are fixed to and project radially from the column 30 at the region of the floor means 3.

After the floor means is set up on the foundation 31, in a manner described in greater detail below, and the column 33 is mounted on the floor means 3, followed by mounting of the roof means 1 on the top end of the column 30, as described above, the foldable tubular or cylindrical side wall 2 of the silo container is unfolded after being connected with the upper connecting ring means 4 which is carried by the roof means 1 at the outer periphery of the latter, so that during this unfolding of the tubular side wall 2 of the silo container it will extend down to the lower connecting ring means 5, being clamped against the lower ring means 5 by way of a lower clamping ring 35. Thus, the lower end of the cylindrical wall 2 is hemmed so as to surround a ring 19 which is situated directly beneath the lower horizontal flange of the clamping ring 35 while the vertical flange of the latter engages the exterior surface of the side wall 2 with the latter situated between the vertical flange of the clamping ring 35 and the connecting ring 5 in the form of a relatively short cylindrical wall, and this cylindrical or vertical flange of the clamping ring 35 is located directly over the ring 19. Suitable bolts 16 are provided for pulling the clamping ring 35 downwardly, these bolts being connected to the horizontal circular flange of the clamping ring 35 as well as to the horizontal circular flange of the connecting ring 5, so that by way of these bolts 16 it is possible to pull the ring 35 downwardly and thus tension the cylindrical

wall 2 between the upper connecting ring 4 and the lower connecting ring 5.

The roof means 1 of the silo is primarily made up of a supporting structure similar to that of a spoked sheel. Thus, the supporting structure 40 of the roof means 1 is arranged radially around the column 30 and carries at its outer periphery the connecting ring means 4. This supporting structure 40 of the silo roof means is covered by a woven fabric sheet material, for example, which is provided with a plastic coating, this sheet material being, for example, a Trevira woven fabric. However, it is also possible to replace the spoked wheel type of structure of the roof means 1 with the plastic woven fabric sheet material which in this case is then directly connected with the connecting ring means 4 by way of a suitable clamping connection structure.

The side wall means 2 of the silo container is made up of a cylindrical, tubular woven sheet material which is seamless and which is also coated in a manner similar to the woven fabric sheet material of the silo roof means. Thus, the fabric sheet material of the cylindrical side wall means 2 renders the latter flexible and foldable as well as lacking the rigidity to be self-sustaining. At its upper end the side wall means 2 is clamped by a suitable clamping structure to the upper connecting ring means 4. At its lower end the side wall means 2 is formed with a hem or tubular lower periphery in which is located the circular pipe 19 or simply a heavy hemp rope, so that the lower tubular periphery of the side wall means 2 in this way will have in its interior the ring 19 against which the clamping ring 35 is pulled downwardly as described above.

The floor means 3 of the silo container has a funnel-shaped or tapered construction in the embodiment of FIG. 1 where it is formed by the steel tapered structure 13 which in turn is mounted on the supporting framework 36 with the lower connecting ring means 5 being fixed to the floor means 3 and the framework 36 at the location where the steel structure 13 and framework 36 are fixed to each other.

The floor means formed by the tapered steel structure 13 is formed with a discharge outlet 8 in the form of a central opening at the bottom end of the tapered wall 13, and the discharge outlet 8 is opened and closed by way of a control means 11 in the form of a cylindrical valve member which is capable of being raised from the illustrated closed position to an open position and then again lowered to the illustrated closed position. As is apparent from FIG. 1, the column 30 carries in the interior of the funnel-shaped floor means 13 a tapered, frustoconical wall 10 the taper of which is opposite to that of the wall 13, the bottom edge of the wall 10 forming with the inner surface of the wall 13 the annular gap 37 through which the granular contents in the silo flows toward the outlet 8. The control means 11 is in the form of a cylindrical member whose height when its lower edge engages the wall 13 as shown in FIG. 1 is great enough to extend higher than the natural inclination taken by the granular material downwardly beyond the outer peripheral edge of the body 10 which forms the upper edge of the gap 37. Thus, any material flowing down through the gap 37 will engage the valve 11 when the latter is in its closed position shown in FIG. 1. The valve 11 is connected by suitable cables 39, which are guided over suitable guide rollers or pulleys, to the piston rod of a hydraulic valve-actuating means 25 which serves to actuate the control means 11. Thus, suitable hydraulic fluid can be supplied to or withdrawn from the cylinder 25 in such a way that through the cables 39 the control means 11 will be raised or lowered for the purpose of opening or closing the discharge outlet 8. In this way the flow of the granular contents 38 of the silo means out of the discharge 8 is controlled. It is to be noted that the illustrated central supporting column 30 is in the form of a pipe or tube having a hollow interior in which the actuating means 25 is accommodated and the cables 39 are of course guided through suitable openings in the wall of the tubular column 30 so as to be connected with the piston rod of the hydraulic means 25.

Referring now to FIG. 2, the embodiment of the invention which is illustrated therein also has a silo container formed by a roof means 1, a side wall means 2, and a floor means 3, with the components being interconnected by the upper connecting ring means 4 and the lower connecting ring means 5. However, the embodiment of FIG. 2 differs from that of FIG. 1 in that the floor means 3 is flat and located directly on the foundation means 31. The column 30 of the inner supporting framework also extends upwardly from and is carried by the floor means 3, this column 30 being braced with respect to the outer ring means 5 which is mounted directly on the floor means 3 in the embodiment of FIG. 2 by way of the inclined bracing means 32 in the manner described above, and also it will be noted that the roof means 1 of FIG. 2, which may be the same as that of FIG. 1, is braced by way of the elongated bracing means 34 which extend between the outer peripheral region of the roof means 1 and the inner lugs 33 which are fixed to and extend radially from the lower end of the column 30 directly next to the floor means 3.

As may be seen from FIG. 3, which shows in a plan view the structure either of FIG. 1 or of FIG. 2, the side wall means 2 is of a primarily circular cross section. However, this cross-sectional configuration is not critical to the invention since any other type of cross section, such as an octagonal cross section, can equally well be used with the structure of the invention.

With the above-described embodiments of the invention a granular material can be introduced in a well known manner through an opening at the roof means 1, and also with the embodiment of FIG. 2 the contents of the silo can be discharged in any suitable way. For example a suitable discharge pipe may be embedded in the foundation when extending up to a suitable opening in the floor 3 and having a suitable closure gate or the like so that through the latter it is possible to control the discharge of the contents out of the silo of FIG. 2.

The bracing means 32 and 34 can be made up of any suitable bracing element such as, for example, guy wires or cables or suitable bracing bars or rods fixed to the lugs 33 in the manner described above.

It is also to be noted that the top end of the side wall means 2 may be connected in any suitable way to the connecting ring means 4. Thus, for example, at its top end the tubular wall 2 may have elongated flexible tapes which extend longitudinally beyond the top edge of the cylindrical woven fabric sheet material 2, and these tapes may be wrapped around and fixed with the ring which forms the connecting ring means 4. This ring is fixed as by welding or any other type of fastening structure to the spokes of the roof structure 40, and the

tapes at the top end of the wall **2** are wrapped around the ring **4** between these spokes. As was pointed out above, the spokes which form the supporting structure **40** are arranged radially around the column **30** and are covered by a suitable sheet material such as a plastic-coated fabric sheet material.

What is claimed is:

1. In a silo, a silo container including an upper roof means, a lower floor means, and a flexible, foldable side wall means extending between said roof means and floor means, said side wall means being made of a sheet material which lacks the rigidity required to render said side wall means self-sustaining, upper and lower connecting ring means respectively connecting said side wall means to and tensioning said side wall means between said roof means and said floor means, and an inner supporting framework surrounded by said side wall means, supporting said silo container and situated in the interior of the latter, said supporting framework including a central supporting column extending upwardly from said floor means and carrying said roof means, the latter including a supporting structure extending radially around said column and carrying said upper ring means.

2. The combination of claim **1** and wherein a plurality of elongated bracing means respectively have upper ends connected to said central column and lower ends connected to said lower connecting ring means for interconnecting said column with said lower ring means.

3. The combination of claim **1** and wherein a plurality of elongated bracing means respectively have upper ends connected to said roof means adjacent an outer peripheral region thereof and lower ends connected to said central column adjacent said floor means for bracing said roof means.

4. The combination of claim **1** and wherein a foundation means carries said floor means with the latter situated between said foundation means and said column.

5. The combination of claim **1** and wherein said central column is in the form of a tube.

6. The combination of claim **1** and wherein said floor means includes a discharge outlet through which the contents of the silo can be discharged, control means operatively connected with said outlet for opening and closing the latter, and actuating means carried by said column and operatively connected with said control means for actuating the latter to close and open said outlet.

7. The combination of claim **1** and wherein said supporting structure of said roof means which extends radially around said column has a steel construction similar to a spoked wheel carrying at its periphery said upper connecting ring means with said side wall means having a tubular configuration and being connected to said upper connecting ring means, and said tubular side wall means also being connected to said lower connecting ring means and being tensioned between said upper and lower ring means.

8. The combination of claim **7** and wherein said spoked wheel supporting structure is covered with a coated plastic woven sheet material which forms part of said roof means.

9. The combination of claim **1** and wherein said silo container has an interior volume of at least 150 cubic meters.

10. The combination of claim **6** and wherein said control means includes a stationary tapered wall having an upper smaller end fixed to said column and a lower larger end situated over said discharge outlet, said tapered wall surrounding said column, and said control means further including a cylindrical valve member also surrounding said column and having a diameter smaller than that of the larger end of said tapered wall, said cylindrical valve member having a lower closed position closing said discharge outlet, and said actuating means being operatively connected with said cylindrical valve member for raising the latter upwardly toward the interior of said tapered wall so that material to be discharged will flow around the lower edge of said tapered wall and beneath said cylindrical valve member through said discharge outlet, while said cylindrical valve member can again close said outlet when lowered to the closed position of said cylindrical valve member.

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