Nov. 7, 1967 HANS-DIETER BAEHR 3,351,248

OUTLET DEVICE FOR BUNKERS FOR BULK GOODS

Filed July 21, 1966 4 Sheets-Sheet 1

Fig.1

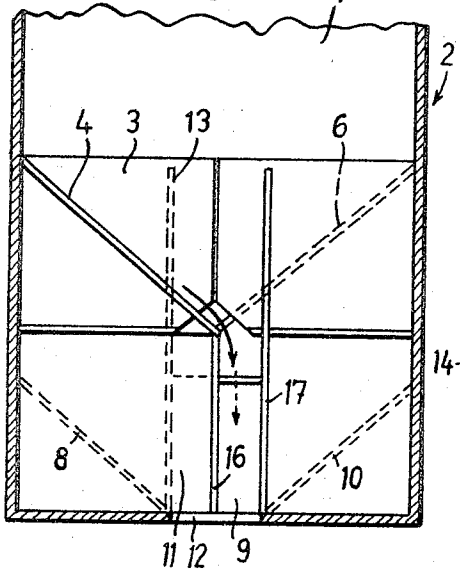
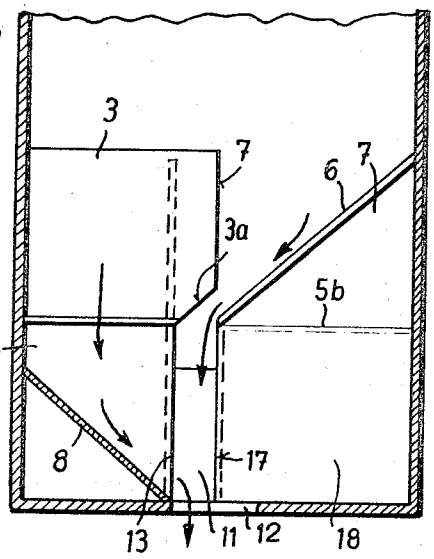


Fig.3



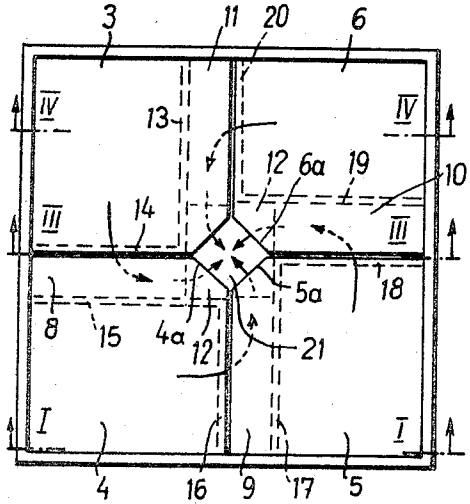


Fig.2

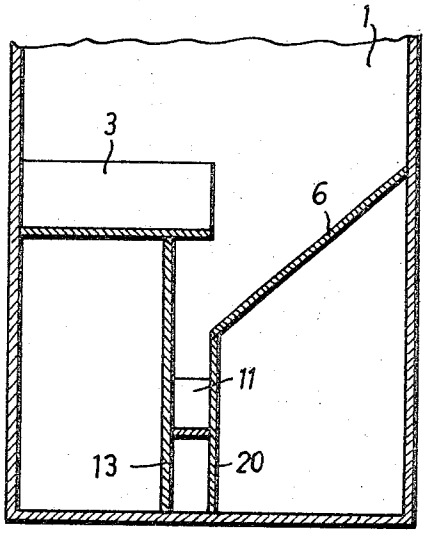


Fig.4

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Nov. 7, 1967 HANS-DIETER BAEHR 3,351,248

OUTLET DEVICE FOR BUNKERS FOR BULK GOODS

Filed July 21, 1966 4 Sheets-Sheet 2

Fig.5

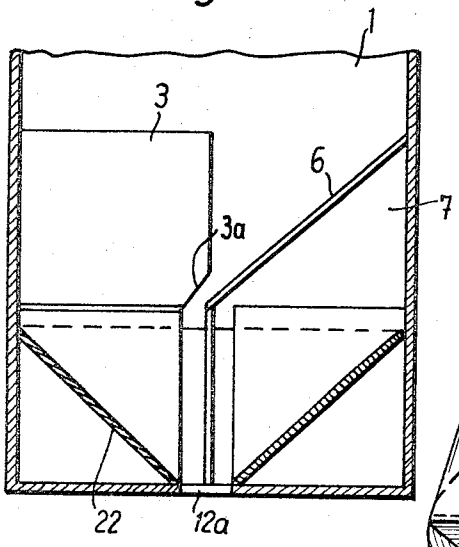
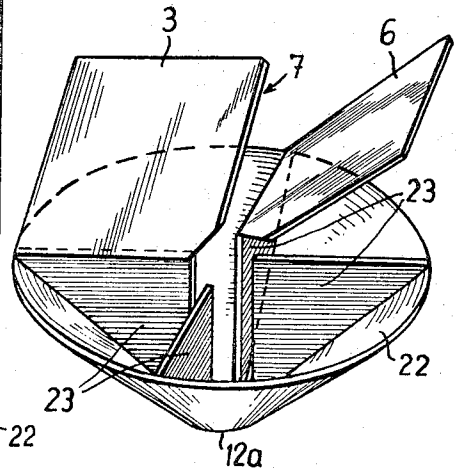


Fig.7



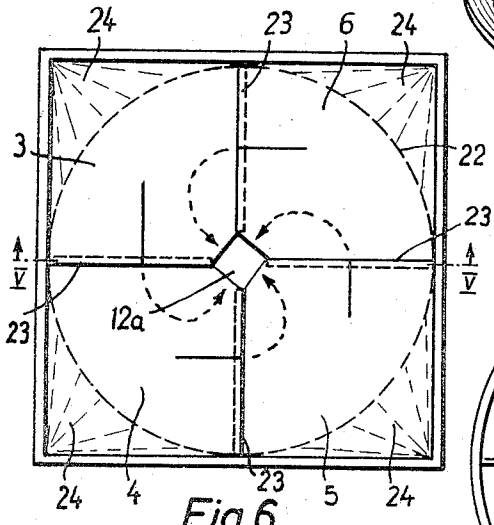
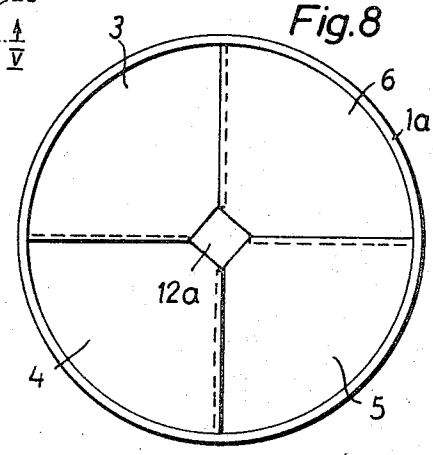


Fig.6

Fig.8



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Nov. 7, 1967 HANS-DIETER BAEHR 3,351,248

OUTLET DEVICE FOR BUNKERS FOR BULK GOODS

Filed July 21, 1966 4 Sheets-Sheet 3

Fig.9

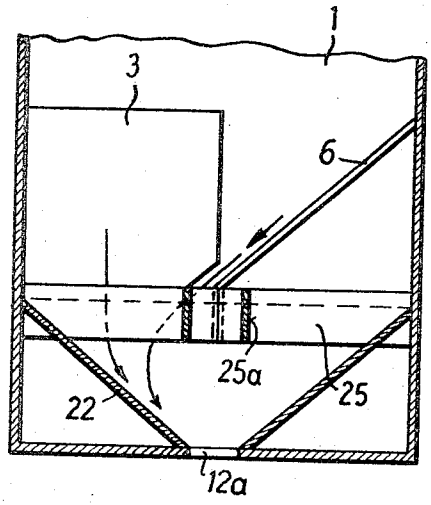


Fig.11

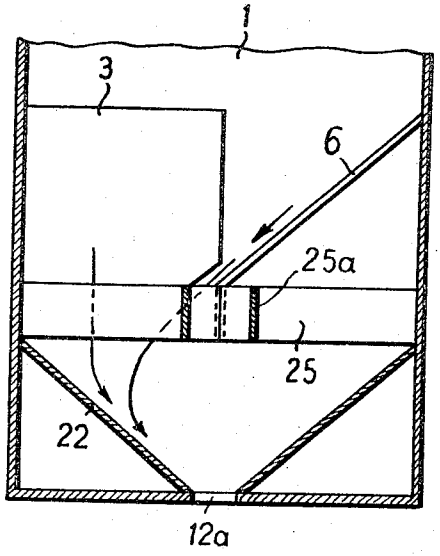


Fig.10

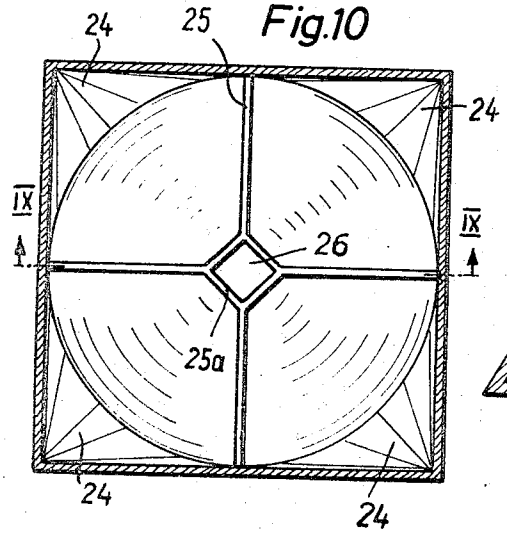
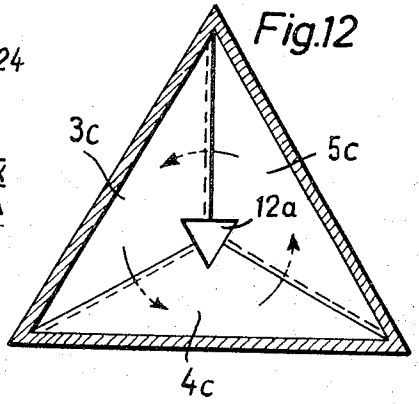


Fig.12



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Nov. 7, 1967 HANS-DIETER BAEHR 3,351,248

OUTLET DEVICE FOR BUNKERS FOR BULK GOODS

Filed July 21, 1966 4 Sheets-Sheet 4

Fig.13

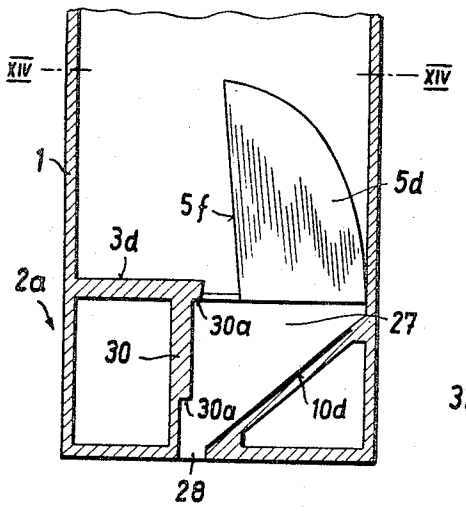
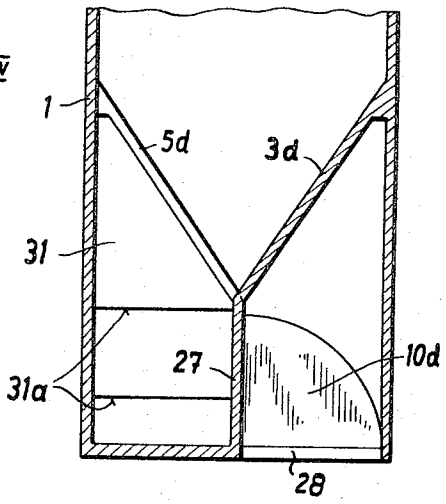


Fig.15



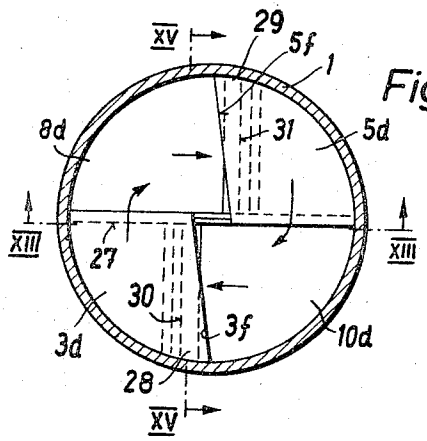


Fig.14

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OUTLET DEVICE FOR BUNKERS FOR BULK GOODS

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Claims priority, application Germany, June 30, 1966, I 31,208
4 Claims. (Cl. 222—459)

ABSTRACT OF THE DISCLOSURE

The disclosure herein relates to a silo cell or bunker having inlet and outlet means and a plurality of intervening inclined walls or oblique surfaces in the general proximity of the outlet means with such oblique surfaces set at varying angular degrees and relatively offset to facilitate the flow of material through the silo or bunker.

The invention relates to an outlet device for bins or bunkers for bulk goods, particularly for heavily-flowing bulk goods, in which oblique surfaces are arranged in the bunker space upon which bed the goods are led to an outlet-opening.

Many efforts have already been made to construct outlet devices for bunkers, particularly high bunkers,which would achieve a perfect flow of the bulk material stored in the bunker. In the case of heavily-flowing bulk goods and of bunkers of great heights difficulties still arise because the bulk material generally becomes blocked during emptying as a result of extreme pressures engendered by the height of the stored material. In conventional bunker construction such as one having a square base, the base surface has been divided by a middle wall. The parts of the bunker are each sectioned and include an oblique guide surface inclined downward in one portion of the bunker towards one side, and a guide surface in another portion inclined downwardly towards another side. This makes possible the extension of the lower section of one portion of the bunker under the oblique guide surface of the neighbouring portion of the bunker, and vice versa. The outlet-opening is situated at the end of the oblique guide surfaces. Loosening of the material is effected by the extension of one oblique section beyond an oblique section of the neighbouring portion of the bunker running opposite directions. However, such a criss-cross outlet device does not lead to the desired result. The effect is the same as if all that is involved is a bunker with a longitudinally-rectangular section, in which only one oblique section is present, this section extending to the outside of the bunker. In this case the material has in fact the opportunity to move sideways before the outlet-opening. Yet the weight of the full height of material in the silo rests unhindered on the oblique surface or section filling the entire bunker part, whereby this weight restricts the sideways flow of the material. In a bunker section there are generally no oblique catchment surfaces, for facilitating a loosening of the flow of material. In the above-mentioned outlets, the single oblique surface is exposed to the wedging-effect of the material in the silo or bunker, whereby blockages and jams arise in the emptying process.

An object of the invention is to make an outlet device for bulk goods in bunkers in which a free flow of the material takes place, even in silos of considerable height, and under the pressures thereby engendered. The bunker outlet device of this invention is formed such that the sectional surface of one and the same cell is divided into sectors by upper oblique outlet surface means, whereby each sector leads into the hollow space created below the oblique surface of the sector preceding it, measured

about the inner periphery of the bunker and that one sector oblique surface covers the outlet-opening of the previous sector.

This formation of the outlet device allows a perfect flow, even for heavily-flowing bulk material. The whole bunker section is divided into sectors having surfaces supporting the pile of material disposed thereabove, but allows the material to be led from one sector into the hollow space of the next sector because each sector oblique surface has a leading edge inclined towards the preceding sector's hollow space. The weight is thus distributed over the whole bunker section, whereby a desired number of free openings of sufficient size for the spaces under the sector surfaces are present. In the actual outlet part of the outlet device, therefore, congestion and disturbances in the flow of the material through the silo can no longer arise. In this connection it is important that the sectors be directed in such a way that the direction of their inclination leads to the free hollow space below the neighbouring sector oblique surface. Wedging effects and jamming of the material in the bunker, are thus prevented. Lower oblique outlet surface means are present in the hollow spaces or sectors below the upper surface means, making possible a perfect terminal flow or run of the bulk goods to the outlet-opening situated at the end of these lower oblique outlet surfaces. Here the further outlet surfaces can be directed towards a common central outlet-opening. In this way it is possible to lead the material present over the whole area of the bunker to a central outlet-opening without risk of jamming. The inventive construction of the outlet device has the added advantage that the entire outlet device is restricted in height. In this way the capacity of the bunker is considerably improved.

The lower oblique sector surface means can be arranged in different ways. For example, each lower sector can be formed as a narrow outlet channel, offset from the bunker's centre. These channels then empty into an outlet-opening on the same side, inside which the actual take-off opening can be optionally formed. A further advantageous formation may reside in a construction whereby the sectors are joined into a common outlet funnel which is circular in section. This gives the simple possibility of directing the material in a bunker of square or circular section to a small central emptying-hole, without blockage of material in the funnel arising. By the fact that the sectors stand at an angle of less than, or exactly, 180 degrees to one another, a spiral flow of the material is achieved under the sectors, to the central outlet-opening. Additionally, support members may be arranged about the outlet opening for the lower surface means.

The number of the sectors in the structure, and thereby of upper oblique surfaces may coincide with the number of sides on the section of the bunker.

According to another embodiment of the invention the upper oblique sector surfaces may be offset in the upper part of the outlet device, and of these sectors only two oblique surfaces in an upper storey and only two outlet surfaces in a lower storey are provided each oblique upper sector surface being off-set at 90 degrees to the corresponding lower outlet sector surface, about the inner periphery of the bunker. In this embodiment the lower outlet sectors lead to outlet slots, which are offset from the center of the cell-floor. The sector surfaces in the upper storey are arranged at diagonally opposite bunker portions, as are sector surfaces in the lower storey, while the upper oblique sector surfaces and their corresponding lower outlet sector surfaces are off-set at an angle of 90 degrees to one another about the bunker inner periphery. The outlet slots are essentially kept covered by the oblique sector surfaces. The material is brought through the oblique sectors, set at 90 degrees to one another, through the outlet sectors, in a spiral effect which results in a pour-

ing, free flow of the material from the high silo cell. The space below the oblique sectors of this embodiment is unnecessary for the progress of the flow of material to the outlet slots.

It is of advantage in this latter embodiment if the oblique surfaces of the sectors are led from the bunker wall to the discharge point on the sectors by a vertical supporting wall. This wall is continuous throughout the whole bunker. Opposite the lower outlet sector surface a vertical wall is set inside the bunker space. This can be formed so as to be offset inwards and downwards one or more times.

The invention is described in detail by means of the exemplary embodiments represented in the drawing.

An embodiment of the bunker outlet device is shown in FIGS. 1 to 4, whereby FIG. 1 shows a vertical section along the line I—I of the view of FIG. 2.

FIG. 2 is a plan view of the bunker of FIG. 1.

FIG. 3 shows a vertical section along line III—III of FIG. 2.

FIG. 4 is likewise a vertical section along line IV—IV of FIG. 2.

FIG. 5 shows a further embodiment of an outlet device, in vertical section along line V—V of FIG. 6, using an outlet funnel.

FIG. 6 is a plan view of FIG. 5.

FIG. 7 shows a pictorial detail of an outlet device.

FIG. 8 shows a plan view of the outlet device of a bunker with a circular section.

FIGS. 9 and 11 show further constructions of the outlet devices of bunkers with square section, each in vertical section.

FIG. 10 is a plan view of the outlet device of FIG. 9.

FIG. 12 shows the arrangement of an outlet device in plan view, for a bunker having a triangular section.

FIG. 13 shows a longitudinal section through the outlet device along line XIII—XIII of the cross-section view of FIG. 14.

FIG. 14 is a cross-section along line XIV—XIV of FIG. 13.

FIG. 15 is a further longitudinal section along line XV—XV of FIG. 14.

The bunker **1**, square in cross-section, and of optional height, is provided at its lower part with an outlet device **2**. In this, the bunker cross-sectional surface, free of vertical dividing walls, is divided into four sectors, in each of which an upper oblique surface **3**, **4**, **5** or **6** is arranged to form an oblique sector. Each oblique surface is arranged, inclined from the outer rim towards the opposite inner rim, all obliques being oriented in similar directions relative to bunker walls from which they extend at their upper ends, whereby all the oblique surfaces lie at right angles to the previous and subsequent oblique upper surfaces. The relative positions of these surfaces about the bunker inner periphery are thus angled at 90 degrees between each surface. Each upper oblique surface leads to a triangularly-shaped opening **7** below the previous oblique surface. In the section of FIG. 3 only the leading edge **5***b* of the oblique surface **5** is recognisable. Between the leading edge **5***b* of surface **5** and the previous surface **6**, offset at 90 degrees, there is present the triangular opening **7**, through which the material can flow into the free space below the previous surface. This applies to each surface **3** to **6** which is provided in the square cross-section.

The space below the surfaces **3** to **6** can be divided into channels, in which lower oblique outlet surfaces **8**, **9**, **10** and **11** are arranged. These outlet surfaces lead to a common outlet-opening **12**. The channels can be bordered by vertical walls **13** to **20**, these at the same time supporting oblique surfaces **3** to **6** in the manner illustrated. These sector surfaces are necessarily provided at the inner corners at the place at which the oblique surfaces meet with cut-off portions **3***a*, **4***a*, **5***a* and **6***a*, so that a free passage **21** is effected centrally. As can be seen from the figures, upper oblique surfaces **3** to **6** cover the leading edges of respective lower oblique outlet surfaces **11**, **8**, **9** and **10**, spaced below associated upper oblique surfaces, so that the entire cross-sectional surface of the bunker below the oblique sectors **3** to **6**, with the exception of the central opening **21**, is covered. The flowing-out of the material in the outlet device shown takes place following the path of the arrows illustrated. The outlet-opening **12**, which is square in the shown plan, can also be formed in a circular configuration, or as a longitudinal rectangle. The lower oblique outlet surfaces in the lower part of the bunker, **8** to **11**, may be formed accordingly.

In the embodiment in FIGS. 5 and 6, under the oblique surfaces **3** to **6**, instead of the single outlet surfaces **8** to **11**, a funnel **22** is provided, which leads to the outlet-opening **12***a*. The funnel **22** fills the entire hollow space below the oblique surfaces **3** to **6**. The oblique surfaces **3** to **6** lie with their leading edges on associated walls **23**, which divide the space of the funnel **22**. The cut-off portions **3***a*, **4***a*, **5***a* and **6***a*, on the oblique surfaces **3** to **6** here give an opening which can correspond in configuration to the lower outlet-opening **12***a*. In a bunker with a square cross-sectional surface correspondingly inclined corner surface portions **24** are situated in the corners, connected to the upper edge of the funnel **22**. FIG. 7 shows a detail of the formation of the outlet device of FIGS. 5 and 6, the bunker walls and both forward oblique surfaces **4** and **5** being omitted for the sake of clarity.

FIG. 8 shows a plan view of a bunker **1***a* with circular cross-section, in which the oblique surfaces **3** to **6** are arranged so as to be inclined at right angles to one another in the way described, their outer rims running in a way adapted to the inner circumferential surface of the cylindrical bunker. Instead of having a square section as a cross-section, the section of the bunker can also be many-sided, e.g. hexagonal. The inventive arrangement of the outlet device can also be provided for a bunker whose section is an equilateral triangle. In FIG. 12 such a corresponding formation is illustrated in plan view. The oblique surfaces **3***c*, **4***c* and **5***c*, as catchment-surfaces, are set with their inclinations correspondingly oblique, so that the material can flow in the paths illustrated by the arrows through the triangular openings formed into the space below the oblique surfaces **3***c*, **4***c* and **5***c*.

In the embodiments of FIGS. 9 and 10, as of FIG. 11, a free-spanning supporting-wall **25** is arranged in order to support the surfaces **3** to **6**, this wall revealing in the center of the bunker a closed four-sided part **25***a* which forms the central opening **26**. The funnel **22** can begin close to the upper rim of this cross-wall **25**, as can be seen from FIG. 9. However, the funnel **22** can also be begun at the lower edge of the cross-wall **25**. In this way the funnel space is completely or almost completely free of vertical supporting-walls. On the whole a relatively low height of construction of the outlet device is achieved.

In the exemplary embodiment of FIGS. 13 to 15 the bunker **1**, of optional height, reveals an outlet device **2***a*, in which oblique sectors **3***d* and **5***d* are provided, diametrically opposite one another in diametrically opposite bunker corners, these leading to oblique outlet surfaces **8***d* and **10***d* respectively, which lie offset at 90 degrees to the oblique sectors **3***d* and **5***d* about the bunker inner periphery. The oblique outlet surfaces each open into associated respective outlet slots **28** and **29** on the floor of the bunker, and these slots lie offset to one another from the middle of the bunker's cross-section. The oblique sectors **3***d* and **5***d* rest in their lower part, on leading edges, on a medial supporting-wall **27** which extends over the whole of the bunker's cross-section. The oblique sectors **3***d* and **5***d* run on their free sides to lines **3***f* and **5***f* in such a way that the outlet slots **28** and **29** are essentially covered by the upper oblique sector surfaces. The rims **3***f* and **5***f* of the oblique sectors advantageously run parallel to one another and end a predetermined distance apart on the supporting-wall **27**.

Opposite each lower outlet surface is situated a vertical wall **30** or **31**, which extends obliquely through the bunker at a distance from the bunker's outer wall. These walls **30** and **31** extend upwards to associated upper oblique sector surfaces. The vertical walls facing the lower outlet surfaces **8***d*, **10***d* can be provided in a suitable way with short stops **30***a*, **31***a*, each of which extend inwards and downwards.

The outlet device described is applicable for bunker cells of various cross-section, e.g. for circular or oval as well as square or rectangular or even polygonic formations.

What is claimed as new is:

1. An outlet device for bunkers for bulk goods, wherein upper oblique surface means are serially arranged about the inner periphery of the bunker and extend inwardly therefrom for directing material generally spirally to an outlet opening, the bunker outlet being divided in cross-section into a plurality of sectors by said upper oblique surface means, each said surface means having a leading edge and a trailing edge and wherein each said leading edge leads into a hollow space of a previous sector, below an edge of a previous upper oblique surface means, each oblique surface means covering the outlet opening of the previous oblique sector, each oblique sector opening into a shaft having at least one vertical wall, the lower oblique outlet surface being arranged in the shafts and being directed towards a common central outlet opening, the oblique outlet surface means terminating inwardly in an outlet opening having a contour generally similar to that of the bunker's cross-section, the oblique surface means further being directed into a common outlet funnel of circular cross-section, the said oblique surface means being provided with cutout portions at their surface portions nearest a geometric central axis of the bunker, the leading edges of the oblique surface means terminating on transverse wall members extending across the bunker, the bunker being of circular cross-section and at least three oblique surface means being provided at different heights, and the upper and lower oblique surface means being offset and at different vertical heights.

2. An outlet device for bunkers for bulk goods, wherein upper oblique surface means are serially arranged about the inner periphery of the bunker and extend inwardly therefrom for directing material generally spirally to an outlet opening, the bunker outlet being divided in cross-section into a plurality of sectors by said upper oblique surface means, each said surface means having a leading edge and a trailing edge and wherein each said leading edge leads into a hollow space of a previous sector, below an edge of a previous upper oblique surface means, two upper oblique surface means and two lower oblique surface means being provided at different heights, with each upper surface means offset 90° to the corresponding lower surface means, the lower surface means leading to outlet slots offset from a geometric central axis of the bunker.

3. The device of claim **2** wherein both surface means are supported on a vertically disposed supporting wall extending across the center of the bunker.

4. The device of claim **3** wherein at least one secondary vertical wall is disposed opposite the lower outlet surface means, each secondary wall having at least one downwardly and inwardly offset portion.

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STANLEY H. TOLLBERG, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,351,248 November 7, 1967

Hans-Dieter Baehr

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, lines 8 and 9, for "Claims priority, application Germany, June 30, 1966, I 31,208" read -- Claims priority, application Germany, July 22, 1965, J 28,625; June 30, 1966, I 31,208 --.

Signed and sealed this 17th day of December 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents