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(54) **Apparatus for dissolving agranulate, primarily a predetermined quantity of ferrous sulfate granulate with water.**

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Description

Technical Field

The present invention relates to an apparatus for dissolving a granulate, primarily a predetermined quantity of ferrous sulphate granulate, with water, comprising a tank, a filler hole for introducing the granulate, water inlet means for supplying water to the tank, a primary water supply device provided at the bottom of the tank and connected to the water inlet means and a defined area for accumulating and discharging the solution.

Background Art

Typically, an apparatus comprising a tank of this type have a capacity of 10-15 tons of ferrous sulphate granulate and thus an output allowing it to supply a sewage purification plant serving a town of 4,000 - 50,000 inhabitants with a constant and sufficient quantity of ferrous sulphate solution. A control system connected to the tank ensures that the dose of ferrous sulphate solution to the sewage purification plant is proportional to the flow quantity of sewage. In the sewage purification plant, the ferrous sulphate binds phosphates present in the sewage, said phosphates consequently precipitating as phosphate sludge.

GB-A-979 344 describes a mixing container for preparing a suspension of earth with gas and water for hydraulic and pneumatic conveyance to a pipe line in which a container at the bottom comprises rows of parallel tubes each having a series of perforations through which water can be supplied and which tubes all are connected to the one and same water supply source.

DE-A1-2 922 586 discloses a device for producing brine, and which comprises a container with a water supply device in form of a coiled tube with openings positioned at the bottom of the container.

It is necessary to equip the known types of apparatuses with expensive mechanical agitators as well as a control means to achieve a fairly uniform, predetermined concentration of the ferrous sulphate solution during operation, said solution preferably being a so-called "saturated" solution, where the concentration is always known because of the chemical equilibrium. In known types of appararatuses not equipped with mechanical agitators, it is impossible during operation to produce a ferrous sulphate solution having a uniform, predetermined concentration. Furthermore, these apparatuses have to be of such a size as to be supplied with disproportionately large quantities of ferrous sulphate granulate in relation to the ferrous sulphate solution produced to ensure that the solution is of a fairly and approximately uniform concentration. Another problem in the known types of apparatuses without agitators is the ever-appearing undesirable cone-shaped cavity formations in the ferrous sulphate granulate as said granulate dissolves, thus allowing water to percolate too quickly through the granulate in the centre of such a cone-shaped cavity formation.

Consequently, it is expensive to manufacture all the types of apparatuses mentioned above, said apparatuses either having to be equipped with expensive, mechanical agitators or having to be of such a size as to ensure a fairly uniform concentration of the ferrous sulphate solution produced (said concentration however not being guaranteed) and said apparatuses also being uneconomical to operate because of excessive concentration variations in the ferrous sulphate solution.

Disclosure of the Invention

The object of the present invention is therefore to provide an apparatus of the type mentioned above, said apparatus being inexpensive to manufacture and allowing the production of a ferrous sulphate solution of as uniform a concentration as is possible, thus ensuring economical operation.

According to the present invention, each primary water supply devices connected to the water inlet means by connection means, each primary water supply device covering a defined area of the bottom of the tank, the primary water supply device(s) evenly covering the entire bottom of the tank in such a way that the entire extent of the primary water supply device(s) principally provides the same water discharge outlet area per unit area of the bottom of the tank, that at least one primary water supply device, principally in its entire extent, is subdivided into two or more secondary water supply devices in such a way as to cover separate, smaller areas of any defined area of the bottom of the tank and in that control system means for the water inlet maens are provided, which control the water supply in such a way as to supply water in predetermined quantities per unit time and for a predetermined period of time alternatively to the secondary water supply devices. Consequently, the so-called cone-shaped cavity formation always appearing approximately in the centre of the ferrous sulphate granulate during the dissolution of said quantity and therefore producing an uneven concentration of the solution and resulting in uneconomical operation, is constantly shifted in the quantity of ferrous sulphate granulate and is therefore of an infinitesimal size.

This allows the use of an even smaller quantity of ferrous sulphate granulate and thus a smaller tank to produce the same output, whereby the size and thus also the construction price of the appara-

tus may be reduced considerably compared to the known apparatuses of the same output.

If the level of the non-dissolved ferrous sulphate granulate in the tank constantly exceeds a specific, sufficient level and if at the same time the quantity of water supplied per unit time and the supply pressure of water are below specific levels, the result is a sufficient percolation passage and a sufficient water percolation time through the ferrous sulphate granulate, thus always ensuring a production of a "saturated" solution of ferrous sulphate. This ensures a constant production of a ferrous sulphate solution of a uniform concentration (the concentration variations of a "saturated" solution being 2-3% under normal conditions), at the same time allowing the most economical operation of the tank.

Furthermore, all secondary water supply devices may, according to the invention, principally and preferably have the same water discharge outlet area per area unit of the bottom of the tank.

Moreover, the tank may, according to the invention, principally be cylindrical with a circular bottom, and the secondary water supply devices of the water supply device may comprise two parallel pipes positioned helically to cover the bottom of the tank, the helical centres preferably being close to the centre of the bottom. As a result, the tank is particularly economical to manufacture in view of its output.

Furthermore, the mutual radial distance between two adjacent pipes in each of two successive convolutions of the helices may be 10 cm principally anywhere in the tank, and each pipe may on its upper side and in its entire extent be provided with holes at a mutual distance of approximately 20 cm, said holes preferably having a diameter of 1-2 mm. The manufacture of this discharge system is particularly simple and quick.

Finally, in a particularly advantageous embodiment of the invention, the upper side of the water supply device may be provided as a grate or a sieve.

Brief Description of Drawings

The invention is explained in greater detail below and with reference to the accompanying drawings, where

Fig. 1 is a side and partially sectional view of the apparatus according to the invention, said apparatus being dug into the ground close to a sewage purification plant not shown in the drawing.

Fig. 2 is a top view of the tank, and

Fig. 3 is a sectional view along the line III - III of Fig. 1.

Best Mode for Carrying Out the Invention

Fig. 1 shows a tank 1 comprising a water supply device 2 provided at the circular bottom 3 of the tank and a filler hole 4 with one end above the level of the ground, the embodiment shown being a tank dug into the ground. The filler hole 4 may be opened and closed by means of a cover 5 operated by means of a winch 6 so that the tank 1 may be filled with ferrous sulphate granulate through the filler hole 4 from a lorry platform to be tipped when required at regular intervals. At the bottom 3, the tank 1 is provided with outside attachment devices 7 secured to holding means 8, said holding means principally being large concrete blocks with tie bars in the ground. Moreover, the tank 1 comprises a defined area principally in the shape of a vertical pipe 9 for accumulating the ferrous sulphate solution produced, before said solution is dosed for the sewage purification plant through a pipeline system not shown in the drawings. On top of the tank 1 and above ground level there is a pipe connection means 10 connected to a water supply device not shown, the sewage purification plant and a system, not shown, to control the water supply to the tank 1 and the solution of ferrous sulphate dosed from the tank to the purification plant.

The tank dug into the ground principally ensures a constant, uniform temperature in the tank, resulting in economical operation during conditions of hard frost. The tank may, however, equally well be positioned on the ground.

The tank 1 is principally made of cast fibreglass-reinforced polyester with an internal smooth surface. Having a capacity of 10-15 tons of ferrous sulphate granulate, the tank may have a diameter of 3.35 m and a height of approx. 4 m. The pipe 9 has a diameter of 400 mm. Thus the tank 1 has a capacity sufficiently large to supply a purification plant serving a town of up to 50,000 inhabitants, said quantity being extremely large for such a small tank.

The water supply device 2 principally comprises two parallel plastic pipes 2' and 2'', said plastic pipes preferably being polyethylene pipes. The pipes 2' and 2'' are principally positioned helically to cover the bottom 3 of the tank 1 at a radial distance of approx. 10 cm with the helical centre preferably in the centre of the bottom 3 of the tank 1, cf. Fig. 3. The pipes 2' and 2'' are connected to the pipe connection means 10. The pipes 2' and 2'' are primarily secured inside the bottom 3 of the tank 1 by means of radial stringers or the like not shown.

On its upper side and over its entire extent, each pipe 2' and 2'' is provided with holes at a mutual distance of approximately 20 cm. Prefer-

ably, the holes have a diameter of 1-2 mm. This ensures that anywhere in the tank the water supply device 2 has approximately the same water discharge outlet area per area unit of the bottom of the tank 3. The water supplied is therefore discharged evenly over the entire bottom 3 of the tank and is allowed to percolate evenly through the entire quantity of ferrous sulphate granulate. If the level of the non-dissolved ferrous sulphate granulate in the tank constantly exceeds a specific, sufficient level A (in the present embodiment, at some 6-700 mm above the pipes 2' and 2''), and if at the same time the quantity of water supplied per unit time is 300-1,000 l/hour and the supply pressure of water corresponds to that of tap water, the result is a sufficient percolation passage and a sufficient water percolation time through the ferrous sulphate granulate, thus allowing a constant production of a "saturated" solution of ferrous sulphate in water. Half of the ferrous sulphate granulate filled into the tank thus being dissolved, the ferrous sulphate granulate level is typically at B. The upper liquid level is typically kept constant at C. The solution is accumulated in the pipe 9 and is dosed for discharge to the sewage purification plant.

The production of a "saturated" solution of ferrous sulphate granulate always being ensured, a very high output is achieved in the tank 1 along with really economical operation.

Water is supplied alternately and at predetermined intervals to be set by means of the control system from the water inlet means not shown through the pipe connection means 10 to one pipe 2' or to the other pipe 2'', but never simultaneously to both of the pipes 2' and 2''. The result is that the undesirable cone-shaped cavity formation (said formation always appearing in a quantity of ferrous sulphate granulate because of the internal friction and the friction against the tank wall from the granulate) always disappears when the water supply is switched from one pipe 2' to the other pipe 2'' or vice versa. This ensures that water passes in the same flow direction when percolating through the quantity of ferrous sulphate granulate to allow a constant production of a "saturated" solution. The required minimum quantity of ferrous sulphate granulate in the tank before refilling may also be reduced considerably.

The device may be varied in many ways without thereby deviating from the scope of the invention. The upper side of the water supply device may be provided as a sieve or the water supply device may comprise a large number of nozzles positioned evenly over the bottom of the tank.

Claims

1. Apparatus for dissolving a granulate, primarily a predetermined quantity of ferrous sulphate granulate, with water, comprising a tank, a filler hole for introducing the granulate, water inlet means for supplying water to the tank, a primary water supply device provided at the bottom of the tank and connected to the water inlet means and a defined area for accumulating and discharging the solution, **characterised** in that there are one or several primary water supply devices (2) connected to the water inlet means by connection means (10), each primary water supply device covering a defined area of the bottom (3) of the tank (1), the primary water supply device(s) evenly covering the entire bottom (3) of the tank (1) in such a way that the entire extent of the primary water supply device(s) (2) principally provides the same water discharge outlet area per unit area of the bottom (3) of the tank (1), that at least one primary water supply device (2), principally in its entire extent, is subdivided into two or more secondary water supply devices (2', 2'') in such a way as to cover separate, smaller areas of any defined area of the bottom (3) of the tank (1) and in that control system means for the water inlet means are provided, which control the water supply in such a way as to supply water in predetermined quantities per unit time and for a predetermined period of time alternatively to the secondary water supply devices (2', 2'').

2. Apparatus as claimed in 1, **characterised** in that both of the secondary water supply devices (2', 2'') principally have the same water discharge outlet area per area unit of the bottom of the tank (3).

3. Apparatus as claimed in 2, where the tank is principally cylindrical with a circular bottom, **characterised** in that the secondary water supply devices (2', 2'') of the water supply device (2) comprise two parallel pipes (2', 2'') positioned helically to cover the bottom (3) of the tank (1), the helical centres preferably being close to the centre of the bottom (3).

4. Apparatus as claimed in 3, **characterised** in that the mutual radial distance between two adjacent pipes (2', 2'') in each of two successive convolutions of the helices is 10 cm principally anywhere in the tank and that each pipe (2', 2'') on its upper side and in the entire extent is provided with holes at a mutual distance of approximately 20 cm, said holes pref-

erably having a diameter of 1-2 mm.

5. Apparatus as claimed in 1, **characterised** in that the upper side of the water supply device (2) is provided as a grate or a sieve.

Patentansprüche

1. Apparat zum Auflösen eines Granulates, bevorzugt eines Eisen(II)-sulfat-Granulates, in Wasser, umfassend einen Tank, eine Füllöffnung zum Einbringen des Granulats, Wasserzufuhrmitteln, um dem Tank Wasser zuzuführen, eine primäre Wassereinbringungsvorrichtung am Boden des Tanks, die mit den Wasserzufuhrmitteln verbunden ist und ein definiertes Gebiet um die Lösung anzureichern und auszubringen, dadurch gekennzeichnet, daß eine oder mehrere primäre Wassereinbringungsvorrichtungen (2) durch Verbindungsmitteln (10) mit den Wasserzufuhrmitteln verbunden sind, daß jede primäre Wassereinbringungsvorrichtung ein definiertes Gebiet des Bodens (3) des Tanks (1) abdeckt, daß die primäre Wassereinbringungsvorrichtung(en) den ganzen Boden (3) des Tanks (1) auf solche Weise gleichmäßig abdecken, daß über die ganze Erstreckung der primären Wassereinbringungsvorrichtung(en) (2) im wesentlichen der gleiche Ausströmquerschnitt pro Flächeneinheit des Bodens (3) des Tanks (1) zur Verfügung steht, daß zumindest eine primäre Wassereinbringungsvorrichtung (2), im wesentlichen über ihre ganze Erstreckung in zwei oder mehrere sekundäre Wassereinbringungsvorrichtungen (2', 2'') so geteilt ist, daß sie separate, kleinere Gebiete eines definierten Gebietes des Bodens (3) des Tanks (1) abdekken, und dadurch, daß Steuermittel für die Wasserzufuhrmitteln vorgesehen sind, die die Wasserzufuhr so steuern, daß Wasser in vorbestimmten Mengen pro Zeiteinheit und über ein vorbestimmtes Zeitintervall alternativ den sekundäre Wassereinbringungsvorrichtungen (2', 2'') zugeführt wird.

2. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß beide der sekundären Wassereinbringungsvorrichtungen (2', 2'') im wesentlichen den gleichen Ausströmquerschnitt pro Flächeneinheit des Bodens des Tanks (3) aufweisen.

3. Apparat nach Anspruch 2 mit im wesentlichen kreisförmigen Boden, dadurch gekennzeichnet, daß die sekundären Wassereinbringungsvorrichtungen (2', 2'') der Wassereinbringungsvorrichtung (2) zwei parallele Rohre (2', 2'') umfaßt, die so spiralförmig angeordnet sind, daß sie den Boden (3) des Tanks (1) abdecken, wobei bevorzugt die Zentren der Spiralen nahe des Zentrums des Bodens (3) liegen.

4. Apparat nach Anspruch 3, dadurch gekennzeichnet, daß der gegenseitige radiale Abstand zwischen zwei benachbarten Rohren (2', 2'') zweier aufeinanderfolgender Windungen der Spiralen im wesentlichen überall im Tank 10 cm beträgt und daß jedes Rohr (2', 2'') an seiner Oberseite über die ganze Länge mit Löchern in einem Abstand von etwa 20 cm voneinander versehen ist, wobei diese Löcher bevorzugt einen Durchmesser von 1-2 mm haben.

5. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß die Oberseite der Wassereinbringungsvorrichtung (2) als Rost oder Sieb ausgebildet ist.

Revendications

1. Appareil pour dissoudre un granulat, et plus précisément une quantité prédéterminée de sulfate ferreux en granulés dans de l'eau, comprenant un réservoir un orifice de remplissage pour introduire les granulés, un moyen d'arrivée d'eau pour alimenter le réservoir en eau, un dispositif primaire d'alimentation d'eau placé au fond du réservoir et raccordé au moyen d'arrivée d'eau et une zone déterminée pour l'accumulation et la décharge de la solution, ledit appareil se caractérisant par le fait qu'il peut comporter un ou plusieurs dispositifs primaires d'alimentation d'eau raccordés au moyen d'arrivée d'eau par l'intermédiaire du moyen de raccordement de canalisations (10), chaque dispositif primaire d'alimentation d'eau couvrant une partie déterminée du fond (3) du réservoir (1), les dispositifs primaires d'alimentation d'eau couvrant de manière régulière la totalité du fond (3) du réservoir (1) de façon à ce que la totalité du ou des dispositifs primaires d'alimentation d'eau (2) fournissent essentiellement la même surface de décharge d'eau par unité de surface du fond (3) du réservoir (1), et caractérisé en outre par le fait qu'au moins un dispositif primaire d'alimentation d'eau (2), essentiellement sur toute sa longueur, est subdivisé en deux ou plusieurs dispositifs secondaires d'alimentation d'eau (2', 2'') de façon à couvrir des zones séparées de plus petite dimension d'une partie déterminée du fond (3) du réservoir (1) et caractérisé en outre par le fait que l'appareil comporte un moyen à système de contrôle pour chaque

moyen d'arrivée d'eau pour contrôler l'eau d'alimentation de manière à ce que cette eau soit alimentée en quantités prédéterminées par unité de temps et pendant des périodes de temps déterminées alternativement à chaque dispositif secondaire d'alimentation d'eau (2', 2'').

2. Appareil selon la revendication 1 ci-dessus, caractérisé par le fait que les deux dispositifs secondaires d'alimentation d'eau (2', 2'') ont essentiellement la même surface d'orifice de décharge d'eau par unité de surface du fond (3) du réservoir (1).

3. Appareil selon la revendication 2 ci-dessus, dans lequel le réservoir est de forme générale cylindrique avec un fond circulaire, caractérisé par le fait que les dispositifs secondaires d'alimentation d'eau (2', 2'') du dispositif d'alimentation d'eau (2) comprennent deux canalisations parallèles (2', 2'') disposées en hélice sur toute la superficie du fond (3) du réservoir (1), le centre de chaque hélice occupant de préférence une position très voisine du centre du fond (3).

4. Appareil selon la revendication 3 ci-dessus, caractérisé par le fait que l'intervalle entre deux canalisations adjacentes (2', 2'') dans chacune des convolutions successives des hélices est de 10 cm de manière générale dans la totalité de l'espace formé par le réservoir et par le fait que chaque canalisation (2', 2'') comporte à la partie supérieure de la paroi des trous disposés à intervalles d'environ 20 cm sur toute la longueur de ces canalisations, et ayant de préférence un diamètre de 1 à 2 mm.

5. Appareil selon la revendication 1 ci-dessus, caractérisé par le fait que la partie supérieure du dispositif d'alimentation d'eau (2) comporte une grille ou un tamis.

Fig.1

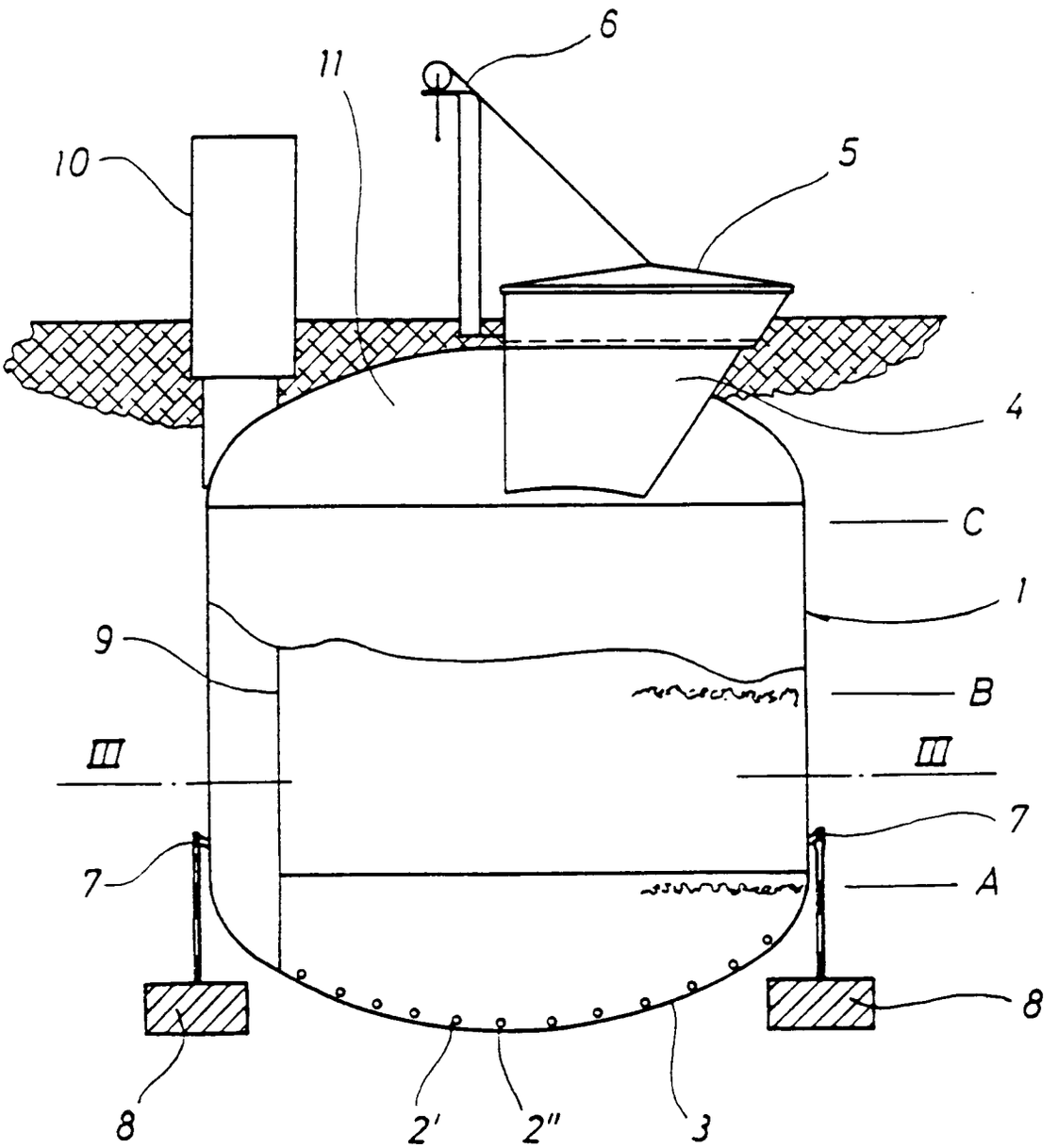

Fig. 2

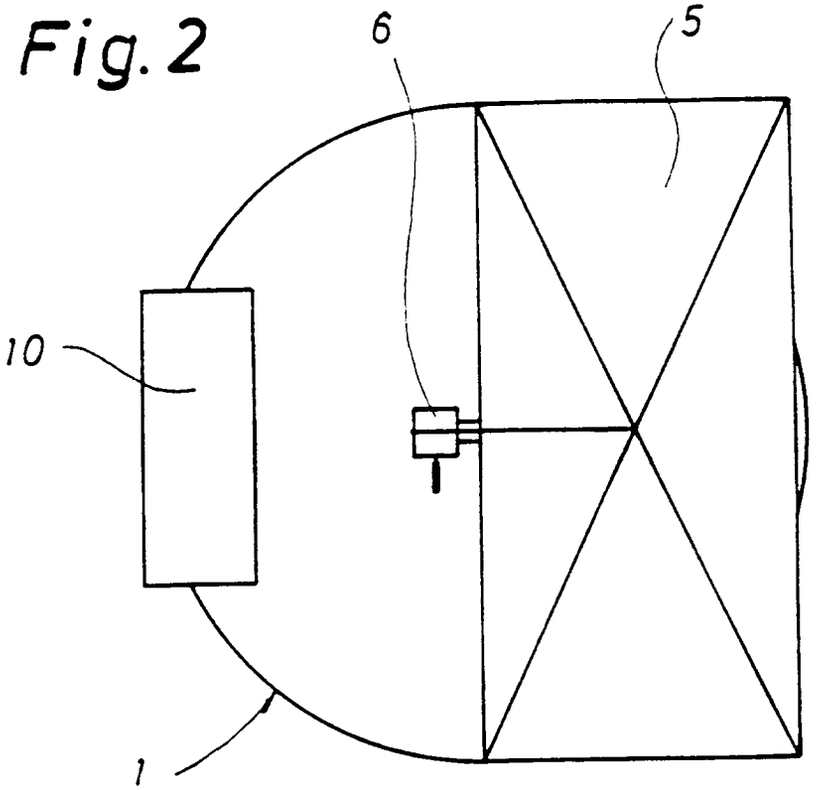

Fig. 3