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(54) **LIQUID DRAINAGE SYSTEM FOR A HARD-TOP SURFACE**

FLÜSSIGKEITSABFLUSSSYSTEM FÜR OBERFLÄCHEN MIT HARTBELAG

SYSTEME D'ECOULEMENT DES EAUX POUR SURFACE DE REVETEMENT EN DUR

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Description

[0001] The invention is related to a liquid drainage system for a hard-top surface, such as at an airport, harbour area and the like, comprising a gutter which is provided in the said surface and is connected to a plurality of sink holes in succession, from which the liquid can be drained via a sewer.

[0002] The gutter may have a narrowed top side, which leaves free a gap through which the liquid can flow into the wider gutter channel situated at a lower level and then into a sink. The diameters of gutter and sinks are selected such that the capacity is sufficient even in the event of a heavy rainfall.

[0003] In view of the fact that all kinds of activities take place on the hard-top surfaces in which the gutter is situated, it is inevitable that pollution will occur. In the case of airports, for example, kerosine is spilt during the refuelling of aircraft. Moreover, polluted washing water is released when washing the aircraft. Finally, it is necessary to take into account contamination produced when combatting icing on the wings, for which glycol is used. Anti-skid measures also produce contamination in the form of urea.

[0004] However, because of recent legislation, contamination of this nature has to be collected separately as far as possible, so that it does not pass into the environment mixed with precipitation. This could mean, for example, that activities where contamination may be produced, such as refuelling and cleaning aircraft, would have to be carried out at separate locations which are provided with the necessary collection devices. A solution of this kind is, however, extremely expensive, in view of the associated investment. Moreover, such a state of affairs entails the risk of delay, which is scarcely acceptable to the users of the airport.

[0005] Another expensive solution would be the provision in the hard-top surface of a separate gutter system. Apart from the high costs, this also has the drawback that contamination could still pass into the gutter system intended for precipitation.

[0006] The object of the invention is to provide a gutter system which avoids these drawbacks.

[0007] This object is achieved in that a ball valve is provided in each sink hole, the valve comprising a valve body, a ball body which floats in water and sinks in a lighter liquid, such as kerosene, as well as a valve seat, which ball valve is located between the gutter and the sewer, and in that a bypass gutter is provided for guiding relatively small amounts of liquid past the sink.

[0008] Reference is made to the drain valve as disclosed in DE-A-1658231, comprising a valve body which floats in water and sinks in a lighter fluid. Said drain valve is not provided in a gutter, and does not have a bypass for preventing small amounts of liquid from entering the sink.

[0009] The gutter system according to the invention is largely similar to the known gutter systems, which has the advantage that there is no need, or scarcely any need, to carry out work in the hard-top surface. By placing a ball valve in the sink hole, on the one hand the clean precipitation can be drained normally. However, as soon as light contamination passes into the sink hole, the normal drainage is blocked and there is sufficient time to remove this contamination.

[0010] The contamination can be removed, for example, by pumping out the sink in question. In the event of contamination over a relatively large area, it may be necessary to pump out a plurality of sinks, which is rather labour-intensive.

[0011] The bypass gutter is provided for guiding moderate amounts of liquid past the sink. Such quantities of contamination pass via the bypass gutter into the last sink, viewed in the direction of flow. The clear-up work can then remain limited to emptying the last sink.

[0012] Even the pumping-out of this last sink, in which the contamination collects, can be omitted if an auxiliary sewer, which is directly connected to this sink hole, is provided. The contaminated liquid can be drained to a treatment plant via the said auxiliary sewer.

[0013] The sinks which are already in operation are designed such that they are connected to a gutter part at opposite positions. The bypass gutter preferably extends between the said positions, such that it spans the distance between two gutter parts. In particular, the bypass gutter may have a hollow profile which is open at the top side, such that the top edges of the bypass gutter lie at a lower level than the top edge of the adjacent gutter parts.

[0014] This design ensures that limited quantities of liquid always flow directly through to the last sink. The intervening sinks are then missed out. In the event of large quantities of liquid, such as in the event of a downpour, the bypass gutters overflow, as a result of which the intervening sinks are also automatically included in the collection process.

[0015] However, it is always ensured that water and lighter liquid remain separate, owing to the blocking action of the ball valves, which are arranged in all the sinks.

[0016] In order to counteract odour pollution or undesired evaporation of, for example, kerosine, each gutter part may be provided, in the region of a sink, with shut-off valves which can be opened by the flow of liquid.

[0017] The last sink, in the direction of flow, may be connected to a reservoir for receiving contaminated liquid.

[0018] In another embodiment, the ball valve may have a second ball body which sinks in water, which second ball body is situated at a lower level than the other ball body which floats in water and sinks in a lighter liquid, such as kerosine, such that the two ball bodies together float in water. In this case, a quantity of water always remains behind above the bottom ball body. The advantage of this design is that any oil leaks and the like which occur during the start of a rain shower are unable to escape into the sewer via the valve.

[0019] Preferably, the difference in level between the ball bodies is adjustable. As a result, it is possible to establish by experimentation which difference in level provides an optimum separation between water and contamination.

[0020] The liquid drainage system according to the invention will be explained in more detail below with reference to the exemplary embodiment depicted in the figures, in which:

Figure 1 shows a top view of a hard-top surface having a liquid drainage system according to the invention.
Figure 2 shows a vertical section through a sink of the drainage system in accordance with Figure 1.
Figure 2a shows a section on line IIa-IIa of Figure 2.
Figure 3 shows a second vertical section of the sink, with an actuating lever for the valve.
Figure 4 shows the detail IV-IV of Figure 2.
Figure 5 shows a sewer with the ball valve in the open position.
Figure 6 shows the ball valve in the closed position.
Figures 7a to d show various states in which the liquid drainage system according to the invention may be.
Figures 8a to 8c show an alternative design.
Figure 9 shows a further alternative design.

[0021] Figure 1 shows a top view of part of the asphalt of an airfield, in particular the areas around a pier. The pier is denoted overall by 1, the hard-top surface lying around the pier 1 by 2. A gutter 3, which has a narrowed, slot-like entry 4 which opens into a wider channel 5, is made in the hard-top surface.

[0022] Sinks 6 are situated at a regular spacing in the longitudinal direction of the gutter 3.

[0023] The liquid drainage system in question is designed such that the liquids flow towards the central sink hole 7, which sink hole is in turn connected to sewer 8 for draining precipitation to the environment, for example a ditch.

[0024] In addition, the central sink hole 7 is connected via a valve 9 to an auxiliary sewer 23, which is intended to drain off contaminated liquids. Figure 2 shows how the sink 6 is designed, using a vertical longitudinal section. Hole 6 comprises a vertical casing 10, which can be closed off at the top by means of a cover 11 and which is connected at the underside to the main body 12 of the sink. The casing 10 is provided with two mutually opposite openings 13, to which those parts of the gutter denoted overall by 3 are connected. The gutter is designed as a so-called concealed gutter, in which the top side has a longitudinal gap 4 which adjoins the cylindrical, widened gutter channel 5.

[0025] The main body 12 of the sink is likewise provided with two mutually opposite openings 14, which are connected to the parts 15 of the sewer.

[0026] The ball valve, which is denoted overall by 16, is mounted in the casing 10. This ball valve comprises a valve seat 17, a valve body 18, as well as a guide cage 19. Finally, a bypass gutter 20 is also provided, which extends between the mutually opposite openings 13 in the casing 10 and which is sealed into the said openings by means of, for example; cement.

[0027] The ball valve 16 functions as follows. As soon as sufficiently large quantities of water pass into the liquid drainage system according to the invention, as illustrated in the gutter system of Figure 5, it will flow over the sides of the bypass gutter 20 and pass into the sewer 15 via the valve seat 17. In the event of very large quantities of rainwater, the valve body 18 will float, but the open communication between concealed gutter 5 and sewer 15 is maintained.

[0028] As soon as a lighter liquid passes into the liquid drainage system according to the invention, the situation shown in Figure 6 occurs. In the event of there being sufficiently large quantities, a liquid of this kind will also flow over the sides of the bypass gutter 20 and pass onto valve body 18 which is situated on the seat 17. Since the relative density of the contaminated liquid, such as kerosine, is low, the valve body continues to rest on the seat 17, so that no communication with the sewer 15 is produced.

[0029] The liquid is therefore forced to flow into the next sink, as indicated by arrow 21. There, the same process is repeated, until ultimately the central sink 7, seen in Figure 1, is reached. This situation is illustrated diagrammatically in Figure 7a. Having arrived at the central sink 7, the contaminated liquid will accummulate there if the valve 9 is closed. The liquid can then be pumped off or be automatically drained to a treatment plant by opening valve 9 and auxiliary sewer 23 (see Figure 1).

[0030] An overview will now be given of the various situations which may arise.

[0031] In the event of a minor leak of contaminated substance, such as kerosine or oil, the situation depicted in Figure 7c occurs. A small quantity of this kind will not overflow from the bypass gutters 20 but will pass directly into the central sink hole 7. In view of the low relative density of the contamination, however, the central sink hole 7 remains closed.

[0032] The same obviously applies to a small quantity of rainwater as well; but in this case the situation shown in Figure 7a occurs. The rainwater ultimately collects in central sink hole 7, but since the valve body 18 then floats, the water can be drained directly into the sewer 15.

[0033] In the event of large quantities of rain, the situation illustrated in Figure 7b occurs: the water will overflow from all the bypass gutters 20 directly into the sink hole 12 situated below. From there, the total quantity of water is then drained off via sewer 15.

[0034] Figure 7d illustrates the operation of the system according to the invention in the case of a relatively large quantity of contaminated liquid. This liquid over-

flows from some or all of the bypass gutters 20 and passes into the appropriate sink. The valve body 18 remains closed, however, preventing the contamination from flowing away. In that case, the sinks in question have to be pumped out; as an alternative, the liquid can be drained off to a treatment plant.

[0035] In certain circumstances, it may be desirable to hold the sinks in the closed position in advance, for example in the event of emergencies where large quantities of contaminated fire-extinguishing water are released. Figure 3 shows that the valve bodies 18 can then be kept closed by means of a manual actuating lever 25. This ensures that contaminated fire-extinguishing water does not pass into the sewer 15. All the fire-extinguishing water can be collected in a treatment plant connected to the gutter 5 or can be pumped off.

[0036] Figures 8a to 8c show a variant in which the ball valve 21 has two ball bodies 22, 28. These ball bodies are coupled to one another by means of a rod 27. The relative density of the lower ball body 22 is greater than that of water, for example 1.1. The relative density of the upper ball body is lower than that of water, for example 0.8.

[0037] The consequence of these relative densities is that a certain quantity of water always remains above the lower ball body 22, which rests on the valve seat 17 and which also forms the valve body. This quantity is determined by the mutual spacing between the two ball bodies 22, 28.

[0038] Figure 8a shows the situation in which an oil leak or the like has occurred. The oil has flowed over the bypass gutter 20 and collects above the water, without being able to flow into the sewer 15. The oil flows to the relevant collection point via the concealed gutter 5.

[0039] In the event of a minor oil leak, the situation illustrated in Figure 8b occurs, which corresponds to the situation of the previous figures.

[0040] In the event of a combined situation in which there is both a rain shower and an oil leak, the situation illustrated in Figure 8c is reached. Water mixed with oil passes into the sink 6, the oil continuing to float on the water. The water itself can flow away, owing to the fact that the ball valve 21 moves upwards, lifting the lower ball body 22, which forms the valve, off the seat 17.

[0041] By suitably selecting the length of the connecting piece 27, it can be ensured that the correct amount of water remains in the sink 6.

[0042] The further alternative design, illustrated in Figure 9, of the sewer system comprises a ball valve which is denoted overall by 30 and comprises a casing 31. At the top side, the casing is fastened to the bypass gutter 20 which opens into it and has a lowered side edge 32 and a grille-like portion 33.

[0043] At the opposite side, the casing 31 is provided with a valve seat 34, which is able to interact with the ball 35, in particular in the region which forms the valve body. The ball valve 30 is supported with respect to the wall of the sink by means of supports 36.

[0044] In the exemplary embodiment illustrated, a relatively minor leakage of oil 37 can be seen which oil passes into the casing 31 via duct 5 and over the lowered edge 32 of the bypass gutter 20 and through the grille-like part 33 thereof. Water 41, in which the ball 35 was floating, was initially situated in the bottom of the casing. However, the ball 35 does not float in the oil pool 38 collecting above this water, so that, if the water level falls further, the ball falls.

[0045] The casing 31 of the ball valve 30 projects as a whole into the bowl-like receptacle denoted by 39, the top edge 40 of which receptacle lies above the level of the valve seat 34. The underside of the casing 38 thus always remains surrounded by a quantity of water, which ensures that not even a fraction of the oil 37, 38 can pass into the main sewer 15.

[0046] As soon as the area 18 of the ball 35 touches the valve seat 34, further passage for the oil column 38 is blocked, as a result of which the oil will flow away via bypass gutter 20.

Claims

1. Liquid drainage system for a hard-top surface, such as at an airport, harbour area and the like, comprising a gutter (3), which is provided in the said surface (1) and is connected to a plurality of sink holes (6, 7) in succession, from which the liquid can be drained via a sewer (8, 15), **characterised in that** a ball valve (16, 30) is provided in each sink hole (6, 7), the valve comprising a valve body (18), a ball body (24, 28) which floats in water and sinks in a lighter liquid, such as kerosene, as well as a valve seat (17), which ball valve (16, 30) is located between the gutter (3) and the sewer (8, 15), and **in that** a bypass gutter (20) is provided for guiding relatively small amounts of liquid past the sink (6, 7).

2. System according to Claim 1, in which an auxiliary sewer (23), which is directly connected to a sink (6, 7), is provided.

3. System according to Claim 1 or 2, in which at least one sink (6, 7) is connected at opposite positions (13) to a gutter part (3), and a bypass gutter (20) extends between the said positions (13).

4. System according to Claim 3, in which the bypass gutter (20) has a hollow profile (5) which is open at the top side (4), such that the top edges of the bypass gutter (20) lie at a lower level than the top edge of the adjacent gutter parts (3).

5. System according to Claim 4, in which the gutter (3) is narrowed at its top side, leaving free a gap (4) through which the liquid can flow in from the hard-top surface (1), and each gutter part (3) is provided,

in the region of a sink (6, 7), with shut-off valves (26), which can be opened by a flow of liquid.

6. System according to Claim 3, 4 or 5, in which the last sink (7), in the direction of flow, is connected to a reservoir for receiving contaminated liquid.

7. System according to one of the preceding claims, in which the ball valve (16) comprises a frame which is fastened in the sink, which frame bears a valve seat (17) as well as a cage (19), which extends above the latter and in which a freely movable valve body (18) is situated.

8. System according to one of Claims 1-6, in which the ball valve (30) comprises a casing (31) which is connected to the bypass gutter (20), which casing (31) bears a valve seat (34) on its underside.

9. System according to Claim 8, in which the bypass gutter (20) has a lowered and/or grille-like portion (32, 33) at the casing (31).

10. System according to Claim 8 or 9, in which the casing (31) projects on the underside into a bowl-like receptacle (39), the top edge (40) of which lies above the level of the valve seat (34) which is provided in the casing (31).

11. System according to Claim 8, 9 or 10, in which the casing (31) is supported (36) with respect to the wall of the sink.

12. System according to one of the preceding claims, in which the ball valve (21) has a second ball body (22) which sinks in water, which second ball body (22) is situated at a lower level than 5 the other ball body (28) which floats in water and sinks in a lighter liquid, such as kerosine, such that the two hall valves together float in water.

13. System according to Claim 8, in which the difference in level between the ball bodies can be adjusted by means of a connecting piece (27).

14. System according to one of the preceding claims, in which the valve body (18) and a ball body (22, 24) form a unit.

Patentansprüche

1. Flüssigkeitsentwässerungssystem für eine Hartbelagoberfläche, wie z.B. bei einem Flughafen, Hafenbereich und dergleichen, umfassend eine Rinne (3), die in der Oberfläche (1) vorgesehen ist und mit einer Mehrzahl von Abflusslöchern (6,7) hintereinander verbunden ist, von denen die Flüssigkeit über einen Abwasserkanal (8,15) entwässert werden kann, **dadurch gekennzeichnet, dass** in jedem Abflussloch (6,7) ein Kugelventil (16,30) vorgesehen ist, wobei das Ventil einen Ventilkörper (18), einen Kugelkörper (24,28), der in Wasser schwimmt und in einer leichteren Flüssigkeit, wie z.B. Kerosin, versinkt, sowie einen Ventilsitz (17) umfasst, welches Kugelventil (16,30) sich zwischen der Rinne (3) und dem Abwasserkanal (8,15) befindet, und dadurch, dass eine Bypassrinne (20) vorgesehen ist, um verhältnismäßig geringe Mengen von Flüssigkeit an dem Abfluss (6,7) vorbei zu leiten.

2. System nach Anspruch 1, bei dem ein Hilfsabwasserkanal (23) vorgesehen ist, der direkt mit einem Abfluss (6,7) verbunden ist.

3. System nach Anspruch 1 oder 2, bei dem mindestens ein Abfluss (6,7) an entgegengesetzten Positionen (13) mit einem Rinnenteil (3) verbunden ist und sich eine Bypassrinne (20) zwischen den Positionen (13) erstreckt.

4. System nach Anspruch 3, bei dem die Bypassrinne (20) ein Hohlprofil (5) aufweist, das an der Oberseite (4) offen ist, so dass die oberen Ränder der Bypassrinne (20) auf einem tieferen Niveau liegen als der obere Rand der benachbarten Rinnenteile (3).

5. System nach Anspruch 4, bei dem die Rinne (3) an ihrer Oberseite verengt ist, wobei ein Spalt (4) freibleibt, durch den die Flüssigkeit von der Hartbelagoberfläche (1) her einfließen kann, und jeder Rinnenteil (3) im Bereich eines Abflusses (6,7) mit Absperrventilen (26) versehen ist, die durch einen Flüssigkeitsstrom geöffnet werden können.

6. System nach Anspruch 3, 4 oder 5, bei dem der letzte Abfluss (7) in Strömungsrichtung mit einem Reservoir zum Aufnehmen von verunreinigter Flüssigkeit verbunden ist.

7. System nach einem der vorangehenden Ansprüche, bei dem das Kugelventil (16) einen Rahmen umfasst, der im Abfluss befestigt ist, welcher Rahmen einen Ventilsitz (17) trägt sowie einen Käfig (19), der sich über dem letzteren erstreckt und in dem sich ein frei beweglicher Ventilkörper (18) befindet.

8. System nach einem der Ansprüche 1-6, bei dem das Kugelventil (30) ein Gehäuse (31) umfasst, das mit der Bypassrinne (20) verbunden ist, welches Gehäuse (31) einen Ventilsitz (34) auf seiner Unterseite trägt.

9. System nach Anspruch 8, bei dem die Bypassrinne (20) einen abgesenkten und/oder gitterartigen Teil

(32,33) an dem Gehäuse (31) aufweist.

10. System nach Anspruch 8 oder 9, bei dem das Gehäuse (31) auf der Unterseite in eine schalenähnliche Aufnahme (39) vorsteht, deren oberer Rand (40) über dem Niveau des Ventilsitzes (34) liegt, der im Gehäuse (31) vorgesehen ist.

11. System nach Anspruch 8, 9 oder 10, bei dem das Gehäuse (31) in Bezug zur Wand des Abflusses abgestützt (36) ist.

12. System nach einem der vorangehenden Ansprüche, bei dem das Kugelventil (21) einen zweiten Kugelkörper (22) aufweist, der in Wasser versinkt, welcher zweite Kugelkörper (22) sich auf einem tieferen Niveau befindet als der andere Kugelkörper (28), der in Wasser schwimmt und in einer leichteren Flüssigkeit, wie z.B. Kerosin, versinkt, so dass die zwei Kugelventile zusammen in Wasser schwimmen.

13. System nach Anspruch 8, bei dem der Niveauunterschied zwischen den Kugelkörpern mittels eines Verbindungsstücks (27) eingestellt werden kann.

14. System nach einem der vorangehenden Ansprüche, bei dem der Ventilkörper (18) und ein Kugelkörper (22,24) eine Einheit bilden.

Revendications

1. Système d'écoulement de liquide pour surface de revêtement en dur, telle que sur un aéroport, une zone portuaire et analogue, comprenant un caniveau (3), qui est aménagé dans ladite surface (1) et qui est relié à une pluralité de puisards (6, 7) qui se suivent, et depuis lesquels le liquide peut être évacué par l'intermédiaire d'un égout (8, 15), **caractérisé en ce qu'**un clapet à bille (16, 30) est prévu dans chaque puisard (6, 7), le clapet comprenant un corps de clapet (18), un corps sphérique (24, 28) qui flotte dans l'eau et coule dans un liquide moins dense, tel que le kérosène, ainsi qu'un siège de clapet (17), lequel clapet à bille (16, 30) est situé entre la caniveau (3) et l'égout (8, 15), et **en ce qu'**un caniveau de dérivation (20) est prévu pour guider de relativement petites quantités de liquide au-delà du puisard (6, 7).

2. Système selon la revendication 1, dans lequel il est prévu un égout auxiliaire (23), qui est relié directement à un puisard (6, 7).

3. Système selon la revendication 1 ou 2, dans lequel au moins un puisard (6, 7) est relié à une partie du caniveau (3), en des positions (13) en regard l'une de l'autre, et un caniveau de dérivation (20) s'étend entre lesdits positions (13).

4. Système selon la revendication 3, dans lequel le caniveau de dérivation (20) a un profil peu profond (5) qui est ouvert sur le dessus (4), de telle sorte que les bords supérieurs du caniveau de dérivation (20) se trouvent à un niveau inférieur à celui du bord supérieur des parties adjacentes du caniveau (3).

5. Système selon la revendication 4, dans lequel le caniveau (3) est rétréci au niveau de sa face supérieure, de manière à laisser un espace libre (4) à travers lequel le liquide peut s'écouler en provenance de la surface de revêtement en dur (1), et chaque partie de caniveau (3) est pourvue, dans la région d'un puisard (6, 7), de clapets d'arrêt (26), qui peuvent être ouverts par un écoulement de liquide.

6. Système selon la revendication 3, 4 ou 5, dans lequel le dernier puisard (7) dans le sens d'écoulement est relié à un réservoir destiné à recevoir du liquide contaminé.

7. Système selon l'une des revendications précédentes, dans lequel le clapet à bille (16) comprend un cadre qui est fixé dans le puisard, lequel cadre supporte un siège de clapet (17), ainsi qu'une cage (19), qui s'étend au-dessus de ce dernier et dans laquelle se trouve un corps de clapet (18) libre de se déplacer.

8. Système selon l'une des revendications 1 à 6, dans lequel le clapet à bille (30) comprend une enveloppe (31) qui est reliée au caniveau de dérivation (20), laquelle enveloppe (31) supporte un siège de clapet (34) au niveau de sa face inférieure.

9. Système selon la revendication 8, dans lequel le caniveau de dérivation (20) a une partie abaissée et/ou analogue à une grille (32, 33), au niveau de l'enveloppe (31).

10. Système selon la revendication 8 ou 9, dans lequel l'enveloppe (31) fait saillie, au niveau de sa face inférieure, dans un récipient du type bol (39), dont le bord supérieur (40) se trouve au-dessus du niveau du siège de clapet (34) qui est réalisé dans l'enveloppe (31).

11. Système selon la revendication 8, 9 ou 10, dans lequel l'enveloppe (31) est montée (36) sur la paroi du puisard.

12. Système selon l'une des revendications précédentes, dans lequel le clapet à bille (21) a un deuxième corps sphérique (22) qui coule dans l'eau, lequel deuxième corps sphérique (22) est situé à un ni-

veau inférieur à celui de l'autre corps sphérique (28), qui flotte dans l'eau et coule dans un liquide moins dense, tel que le kérosène, de sorte que les deux clapets à bille flottent ensemble dans l'eau.

13. Système selon la revendication 8, dans lequel la différence de niveau entre les corps sphériques peut être réglée par une pièce de liaison (27).

14. Système selon l'une des revendications précédentes, dans lequel le corps de clapet (18) et un corps sphérique (22, 24) forment une unité.

Fig.1

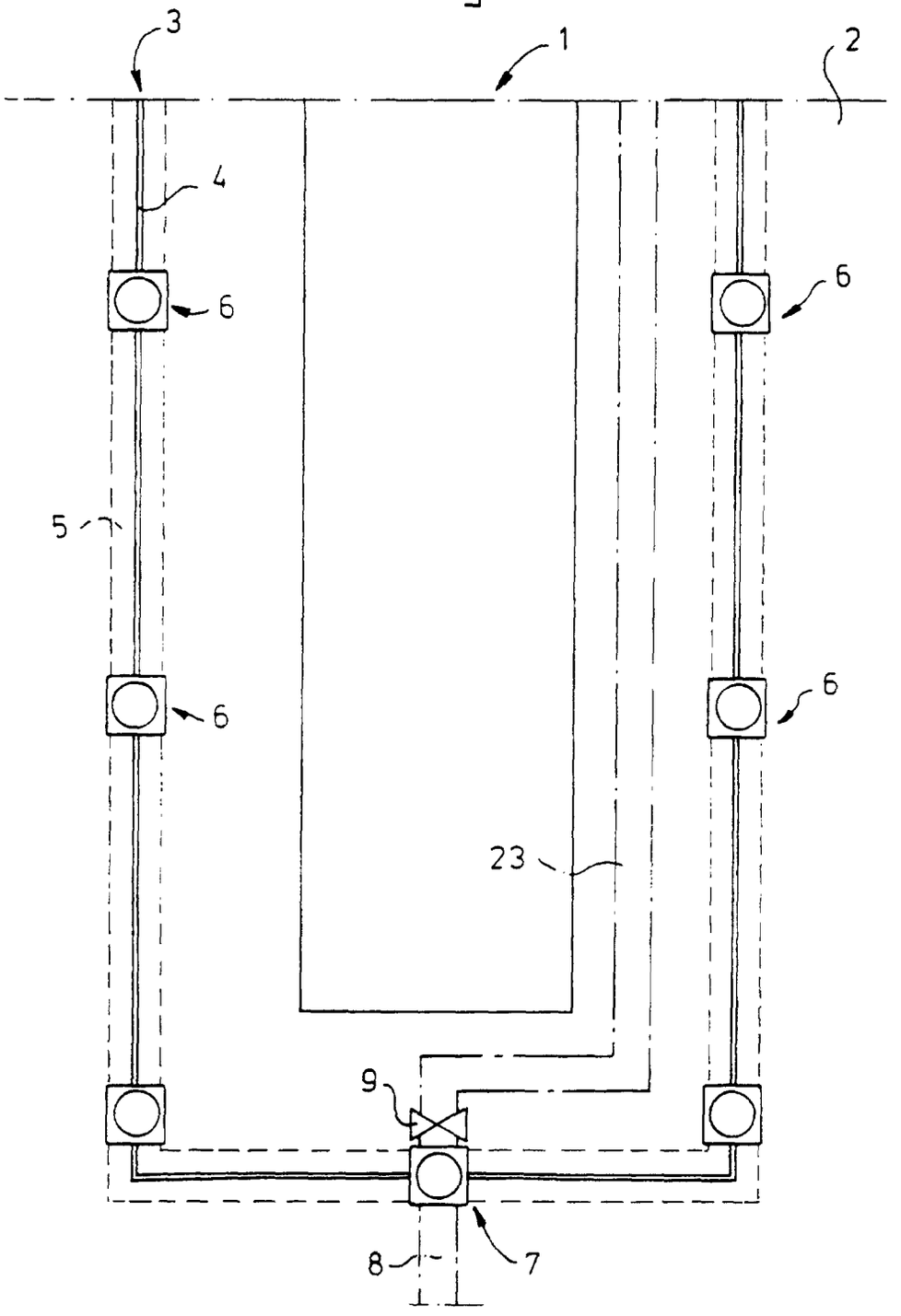

Fig-2

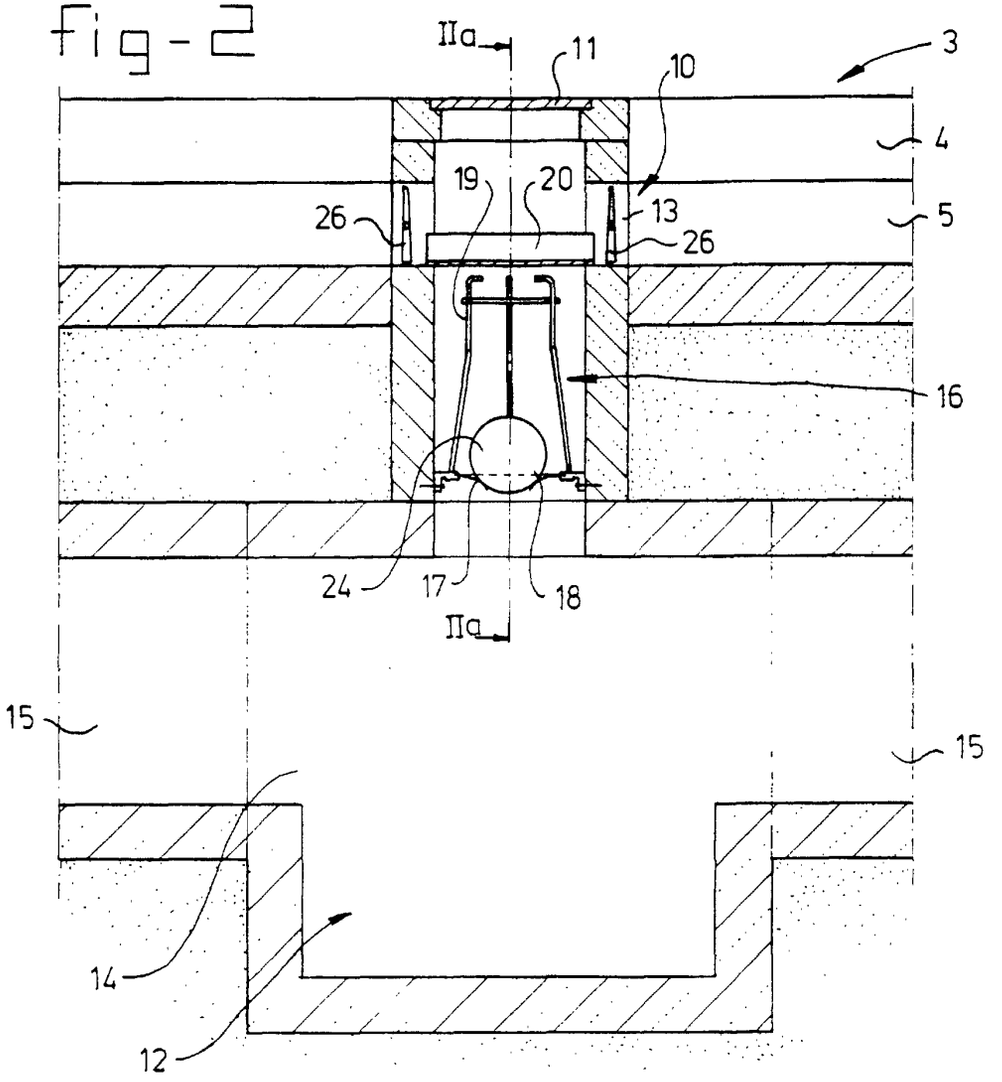
IIa
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Fig-2a

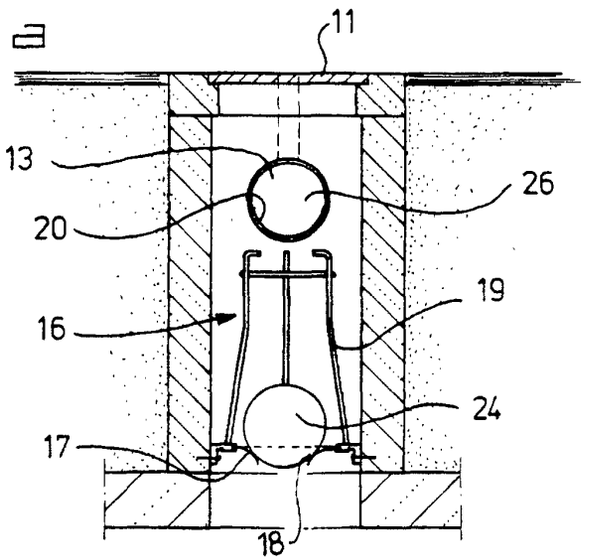
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Fig-3

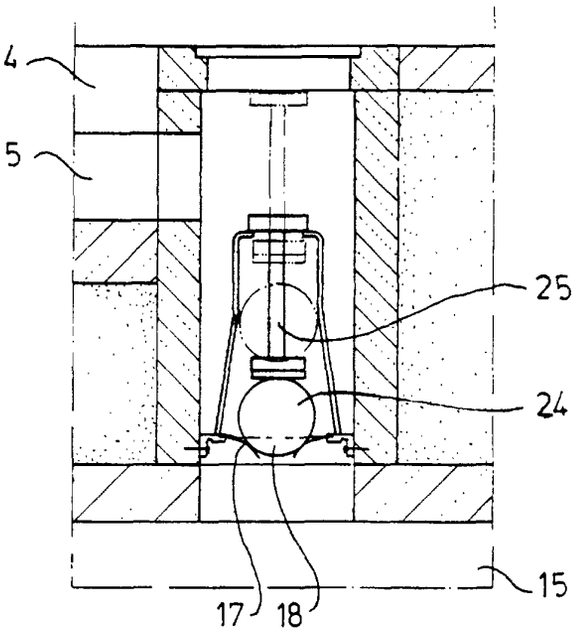

Fig-4

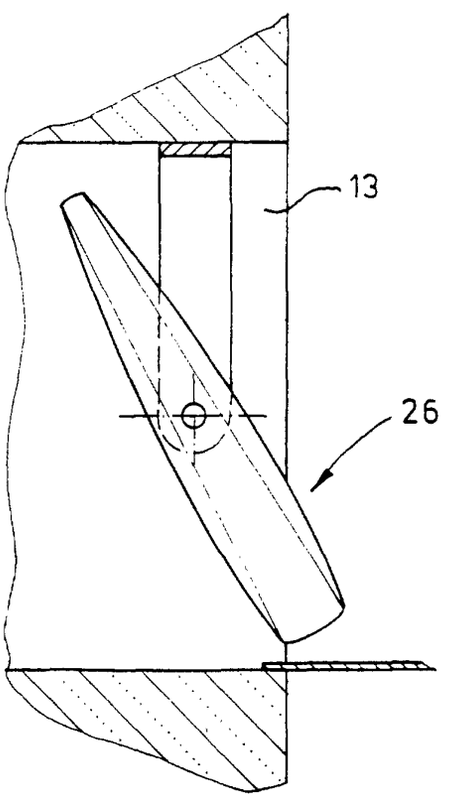

Fig-5

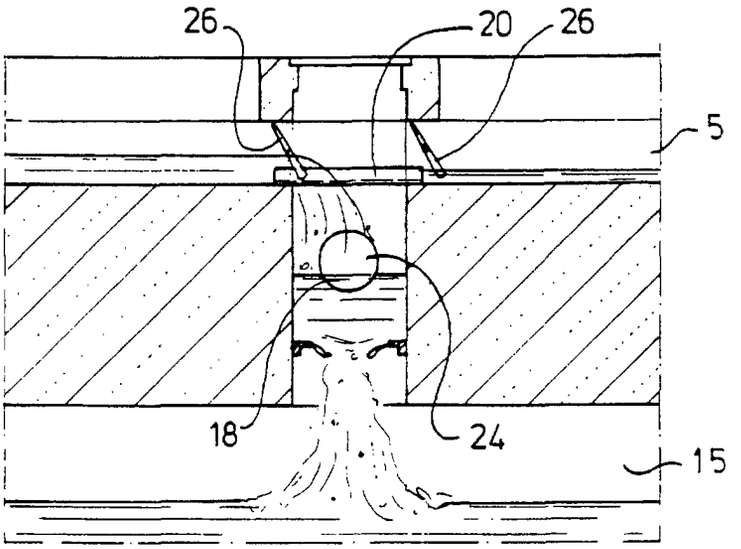

Fig-6

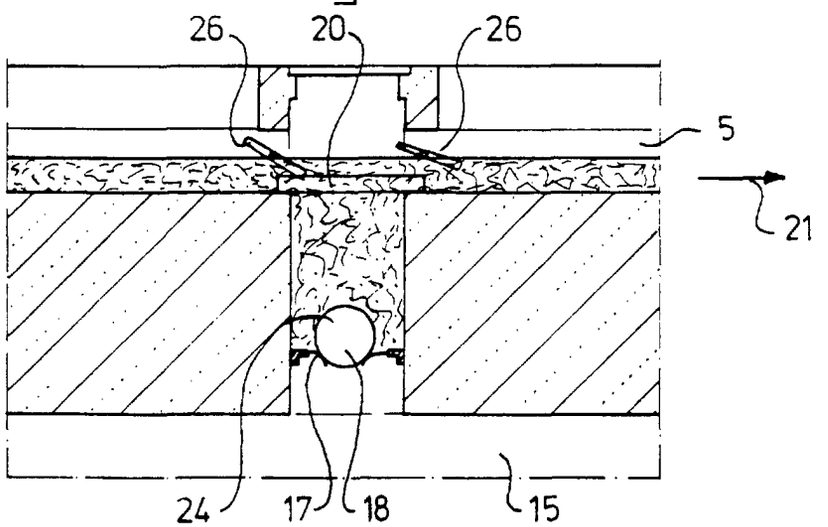

Fig-7a

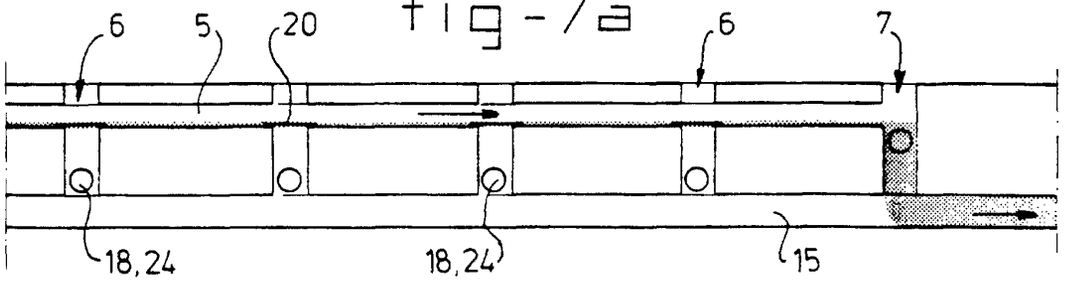

Fig-7b

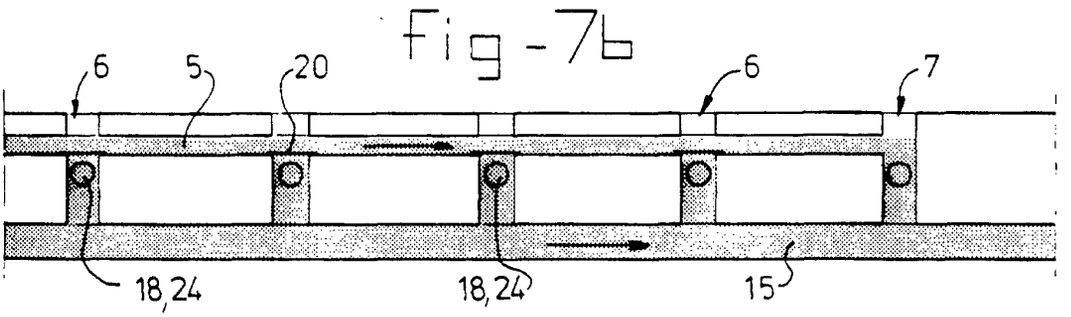

Fig-7c

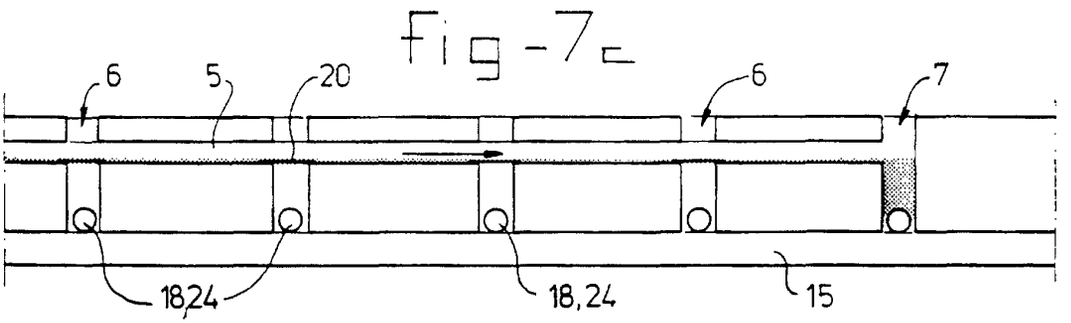

Fig-7d

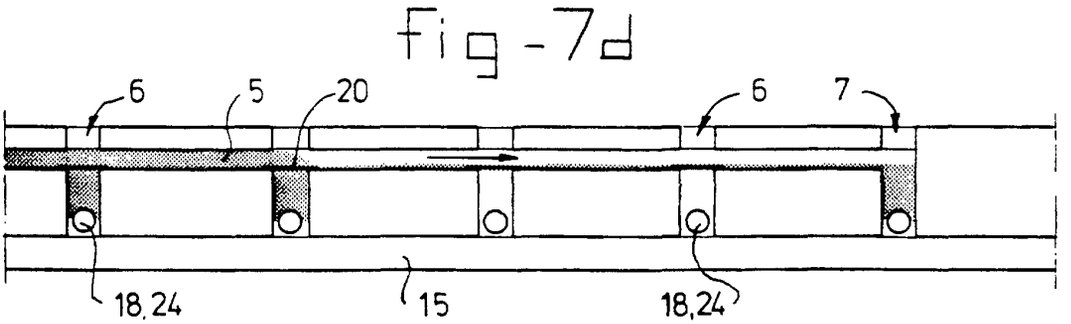

Fig-8a

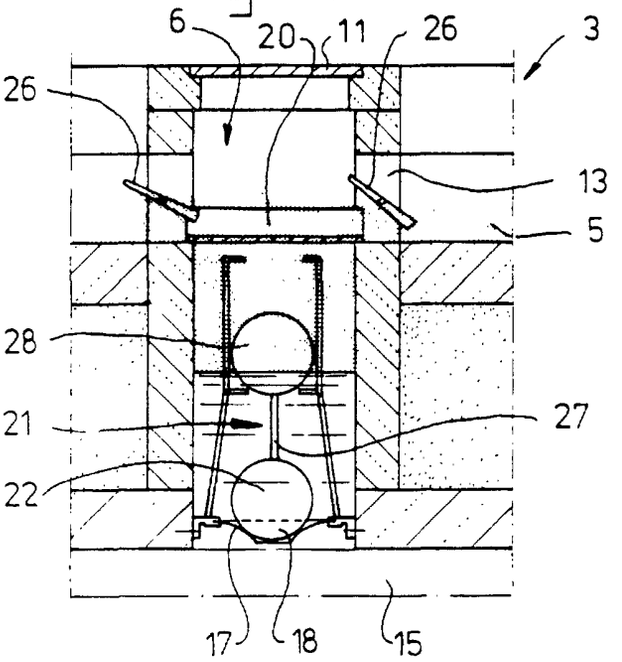

Fig-8b

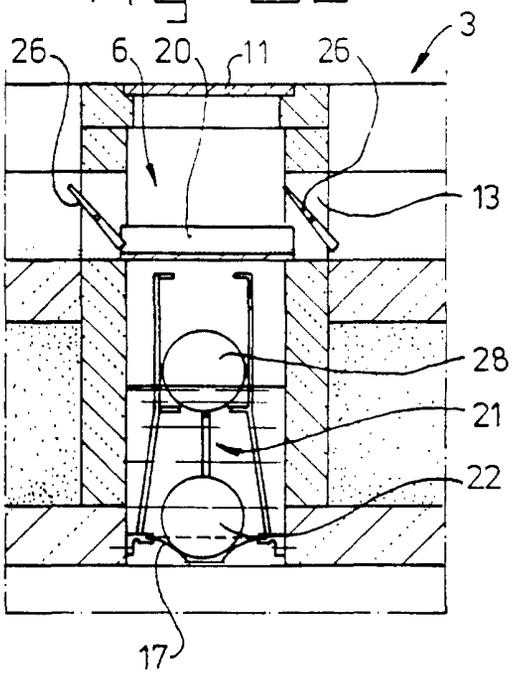

Fig-8c

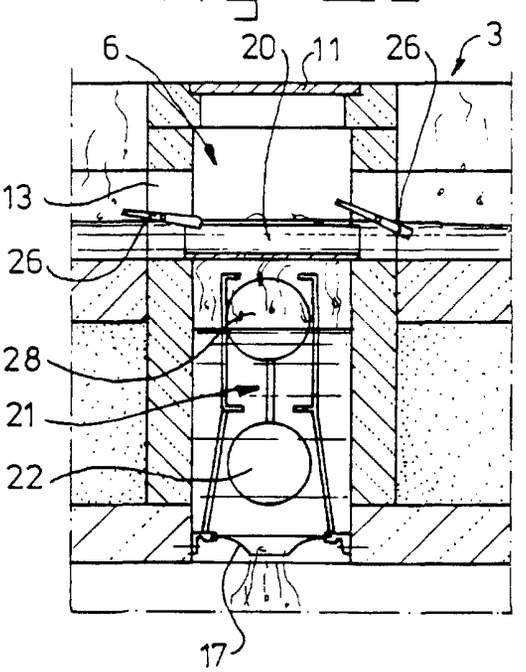

fig-9