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(54) Drainage systems.

(57) A drainage system is made up of drainage channel modules (2) which are substantially U-shaped. A waterproof membrane (40) is laid adjacent to the drainage channels. Cut edges of the membrane overlap the edges of the side walls of the channel. Membrane drain modules (22) are located above the drainage channel modules so that the bottom surface of each side wall of the membrane drain modules clampingly engages the waterproof membrane against the upper edge of the side wall of the drainage channel modules. The drainage system is completed by means of cast iron or galvanised grid covers (4) which are secured to the drainage channel modules (2), thereby also holding the membrane drain modules and membrane in place, by means of bolts (12) carrying rotatable locking bars (16). Water collecting on the waterproof membrane (40) passes into the drainage channel by means of openings (36) along the bottom of each side wall of the membrane drain module.

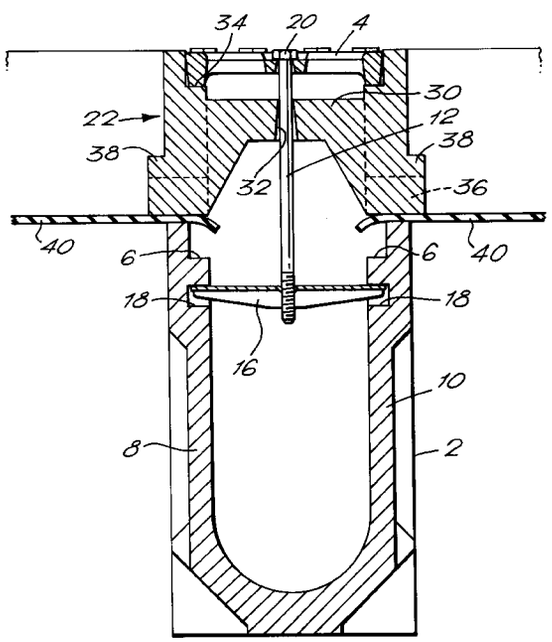

FIG. 2.

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The present invention relates to a surface drainage system and, more particularly, to a modular system for creating a network of drainage channels under an area which is surfaced with a porous medium such as tarmacadam.

For large areas where efficient drainage of surface water is required, such as roadways, car parks, shopping precincts, farm yards and airports, surface drainage is often provided by the use of a network of interconnecting U shaped channels which are laid with an appropriate fall so that the water collected flows away. The water is collected through a cover, for example a cast iron or galvanised grating which is located over the open tops of the drainage channels flush with the surface.

However, if the surrounding surfacing material is itself porous, some of the water will not be collected on the surface to flow through the grating into the channels but will soak through the surface and therefore never enter the drainage system. To prevent water draining into the layers beneath the surface, a waterproof membrane may be laid. A flexible membrane of plastics or rubber as used for damp proof courses in construction is typically employed.

This membrane must be interrupted at the drainage channels in order to allow water collected on the membrane to flow into the channels. However, such a system suffers from the technical problem that the edges of the waterproof membrane are liable to move when the slab of surfacing material is cast on top of it or when paving slabs or the like are laid on top of it. This allows water to escape beneath the membrane into the pre-cast slab below significantly reducing the efficiency of drainage.

To allow water to pass into the channel from the membrane, apertures are needed in the sides of the channel. This prevents the use of conventional polymer concrete U-shaped channels such as those marketed by Aco Polymer Products Limited as part of their ACO DRAIN (Registered Trade Mark) system.

In order to overcome these technical problems, a modular drainage system in accordance with the invention is characterised in that a membrane drain module is interposed, in use, between the drainage channel module and the cover, the membrane drain module comprising two spaced side walls defining openings therein, a bottom of each side wall adapted to engage with the top of a corresponding side wall of the drainage channel module in order to clamp an edge of a waterproof membrane therebetween.

Such a system is advantageous in that the standard locking system with rotatable locking bar can still be used as a locking means to connect the entire assembly together. The locking bolt provided must be lengthened only by the depth of the membrane drain module and therefore this system can readily be implemented using standard parts for the channel module and cover.

The membrane drain module is preferably formed of polymer concrete in which the openings through which water can flow into the drainage channel can, in a preferred embodiment, be formed therein by means of a crenellated bottom surface of each side wall. In this way the module is relatively simple to cast using a two part mould.

Two embodiments of the present invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a diagrammatic exploded view of the parts of the drainage system;

Figure 2 is a longitudinal cross sectional view through an assembled drainage system; and

Figure 3 is a detail of the right hand side of the coupling between a modified embodiment of the membrane drain module and the drainage channel module.

The surface drainage system consists of a network of open-top drainage channels. In current practice, these channels are formed of inter-locking modules cast from polymer concrete such as the channel module 2 shown in the drawings. Since the principle of the present drainage system can be adequately described by reference to one section of the overall system, the following description relates to only a single channel module. However, it will be appreciated that a system will require many modules to be laid to define a network of interconnecting channels, the configuration of which will depend on the lie of the land to be drained and the rate at which water must be removed in a manner with which architects and planners skilled in this area will be familiar.

Each drainage channel module is U shaped with parallel side walls 8, 10 and a smoothly rounded internal base in order to assist fluid flow. Ledges 6 are formed along the inside faces of the side walls at the top.

Normally a cover in the form of sections of cast iron or galvanised grid or grating 4 is seated directly on the ledges 6. The cover is held in position by means of locking bolts 12. The shaft of each bolt passes through an opening 14 in the centre of each cover section and has a head 20 which rests against the surface of the cover 4. One end of the bolt is threaded so that a locking bar 16 can be secured to it. Inwardly facing spaced recesses 18 are provided in each side wall 8, 10 of the drainage channel module beneath the ledges 6. These recessess are arcuate in plan in order to receive the ends of the locking bar when it is rotated in position (by rotating the bolt 12 by means of a head 20 from the surface) in order to rotate the locking bar from a position in which it lies parallel to the channel into a position in which its ends are received in the recesses 18. This system of using a toggle bar to lock a cover to a channel module is described in more detail in EP-B-81741.

As so far described the drainage system is essentially conventional. However, in the present system an upper membrane drain module 22 is interposed between the grid 4 and the channel 2. The only variation of the standard components necessary to accommodate the interposition of the module 22 is the need to use longer than normal bolts 12 to allow for the extra distance between the grid and the recesses 18.

The membrane drain module 22 is also cast from polymer concrete in modular sections which may be of the same standard lengths as the channel modules. Each module consists of two parallel side walls 24, 26 which are held relative to each other by means of cross members 28, 30. The cross members 28 at each end of the module and in the centre are relatively narrow. The two cross members 30, which are intended to be positioned in alignment with the holes 14 in the grid sections 4, are wider in order to accommodate a through-bore 32 necessary to receive the bolt 12.

The tops of the side walls 24, 26 are formed with ledges 34 similarly configured to the ledges 6 in the the top of drainage module 2 so that the cover 4 is able to be seated in the top of the membrane drain module. The bottoms of each side wall 24, 26 have an outwardly projecting flange 38 to provide a larger bottom surface area. This bottom surface is crenellated in order to define a series of U-shaped channels 36 along each side. The base of the module 22 cooperates in use, with the top of the side walls of the drainage module 2 in order to clamp therebetween edges of a waterproof membrane 40.

In Figure 3 an alternative embodiment of the base of the side walls 24, 26 of the membrane drain module is illustrated. In this embodiment an inwardly positioned, downwardly depending flange 42 is provided which is sized to seat on the corresponding ledge 6. Where the base is crenellated this flange 42 is not continuous but is only provided on those portions of the side wall which engage with the top of the drainage channel module. This provides a zig-zag space between the base of the side walls of the membrane drain and the top of the drainage channel which more securely retains the membrane 40 in position and resists withdrawal of the membrane 40 when it is subject to lateral forces.

In use, the drainage channels are laid as normal in the required configuration. Concrete is then poured around the drainage channels in order to create a pre-cast slab. The waterproof membrane 40 is then laid over the pre-cast slab. Where the membrane 40 abuts a drainage channel it is cut so as to leave a small overlap (as shown in Figure 2) with the upper edge of the channel. The edges of the membrane 40 cannot be left too long or they would impede the flow of water in the channel. The grids 4 together with the associated bolts 12 and locking bar are assembled to the membrane drain modules prior to installation. The assembly of the drainage system is then completed by positioning the membrane modules 22 on top of each drainage channel module such that the edges of the waterproof membrane are sandwiched between the top surface of each side wall of the drainage channel and the corresponding bottom surface of each side wall of the membrane drain module 22.

Once the position of the membrane 40 has been checked, the drainage system is completed by rotating the bolts by their heads 20 in order to bring the locking bars 16 into engagement with the corresponding recesses 18 in the drainage channels.

The edges of the waterproof membrane 40 are thus securely clamped in position and cannot move away from the drainage channels when the upper slab of surfacing material is cast around the completed drainage system, or when paving blocks are laid.

In use all the water that passes through the porous upper layer is collected at the surface of the waterproof membrane 40 and flows through the openings 36 into the drainage system.

Claims

1. A drainage system comprising a substantially U-shaped drainage channel module (2) a cover (4) for a top of the drainage channel module, and means (12, 14, 16, 18, 20) for locking the cover to the drainage channel module, characterised in that a membrane drain module (22) is interposed, in use, between the drainage channel module (2) and the cover, the membrane drain module (22) comprising two spaced side walls (24, 26) defining openings (36) therein, a bottom of each side wall (24, 26) adapted to engage with the top of a corresponding side wall (8, 10) of the drainage channel module (2) in order to clamp an edge of a waterproof membrane (40) therebetween.

2. A drainage system is claimed in claim 1, wherein the openings (36) are formed by means of a crenellated bottom surface of at least one side wall (24, 26).

3. A drainage system as claimed in any one of the preceding claims, wherein the membrane drain module (22) is cast from polymer concrete.

4. A drainage system as claimed in any one of the preceding claims, wherein the side walls (24, 26) of the membrane drain module comprise a flange (42) which engages with a corresponding ledge (6) at the top of the corresponding side wall of the drainage channel module (2).

5. A drainage system is claimed in any one of the preceding claims, wherein the side walls (24, 26)

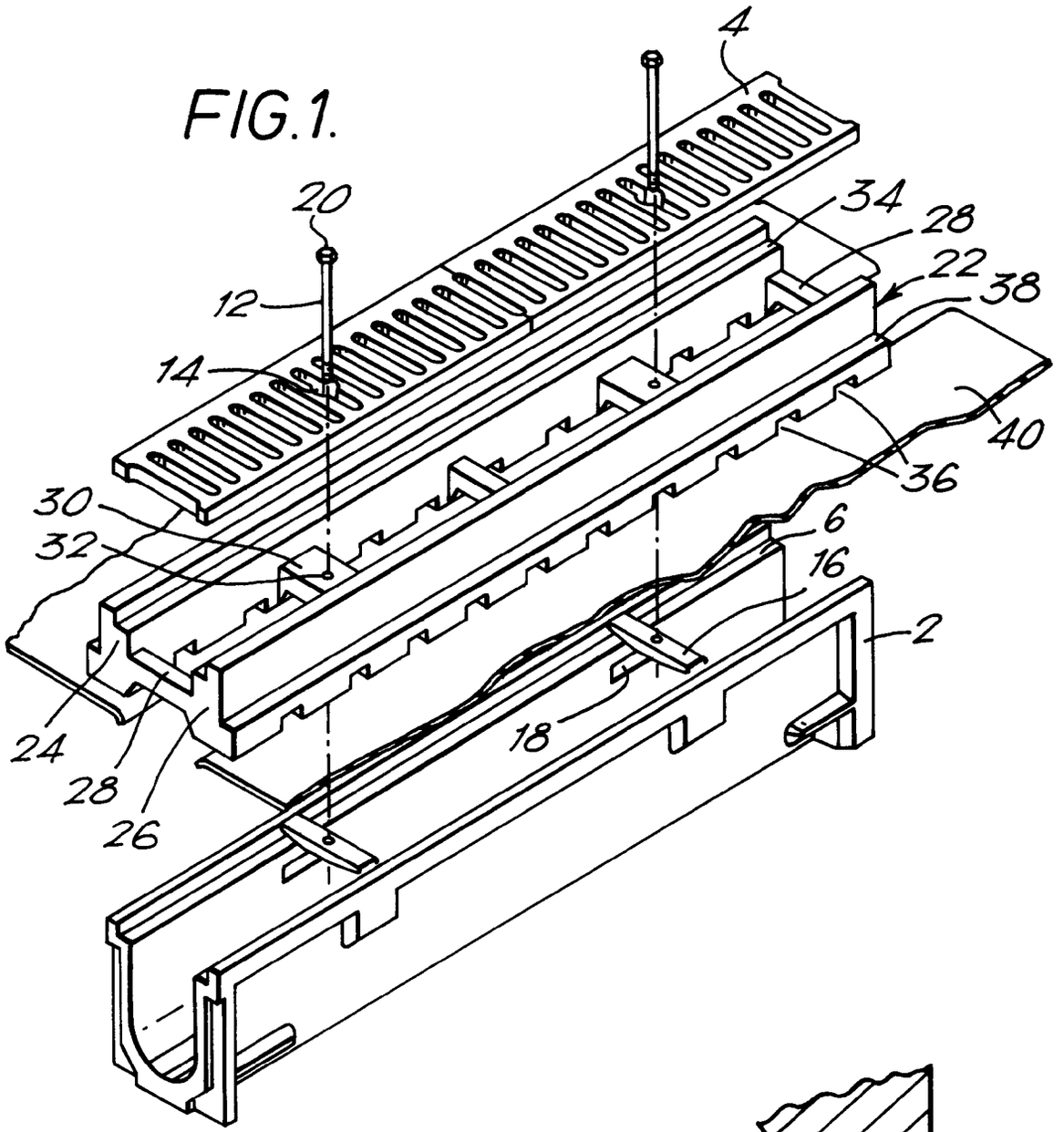
of the membrane drain module (22) are interconnected by means of spaced cross members (28, 30).

6. A drainage system is claimed in claim 5, wherein at least some of the cross members (30) are formed with through bores defined therein in order to allow passage of a locking bolt (12) of the locking means (12, 13, 16, 20).

7. A drainage system as claimed in any one of the preceding claims, wherein the locking means comprise bolts (12) which each pass from a cover (4) into a drainage module channel (2) below, each bolt carrying a rotatable locking bar (16) the ends of which are engageable with recesses (18) defined in the side walls of the drainage channel module.

8. A membrane drain module for use in a drainage system in accordance with any one of the preceding claims.

FIG.1.



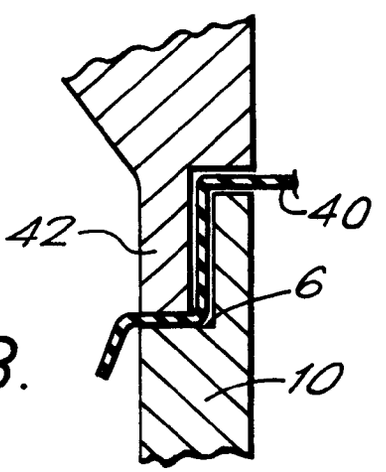


FIG.3.

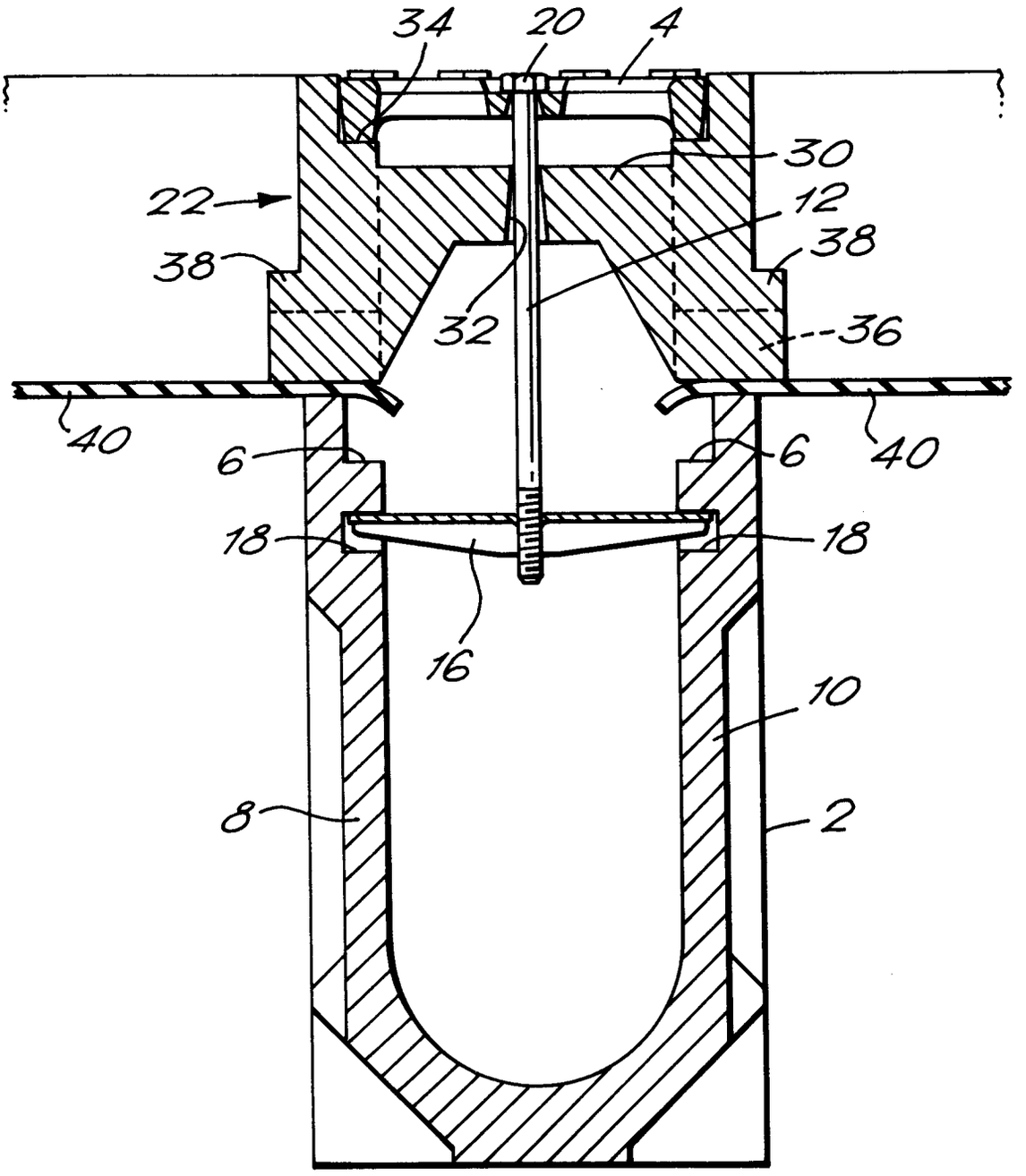


FIG. 2.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 5193

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 371 917 (POLY-BAUELEMENTE) * the whole document *	1-5,7,8	E01C11/22
Y	DE-U-8 706 254 (PASSAVANT-WERKE) * page 3, paragraph 5; claim 1; figure 1 *	1-5,7,8	
D,Y	EP-A-0 081 741 (ACO) * abstract *	7	
A	DE-U-8 707 941 (BIRCO BAUSTOFFWERK)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 SEPTEMBER 1993	VERVEER D.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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