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(71) Applicant(s):  
**Jacobs UK Limited**  
**(Incorporated in the United Kingdom)**  
**95 Bothwell Street, GLASGOW, G2 7HX,**  
**United Kingdom**

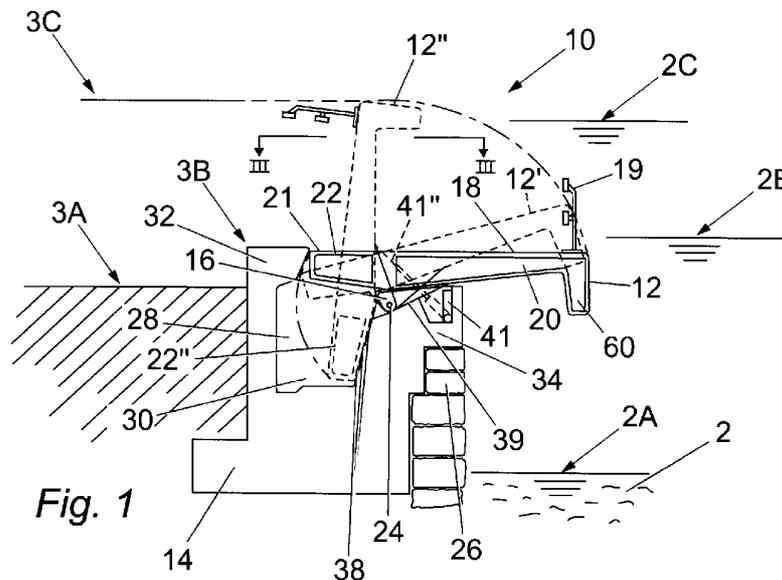
(72) Inventor(s):  
**Ronnie Falconer**

(74) Agent and/or Address for Service:  
**Murgitroyd & Company**  
**Scotland House, 165-169 Scotland Street,**  
**GLASGOW, G5 8PL, United Kingdom**

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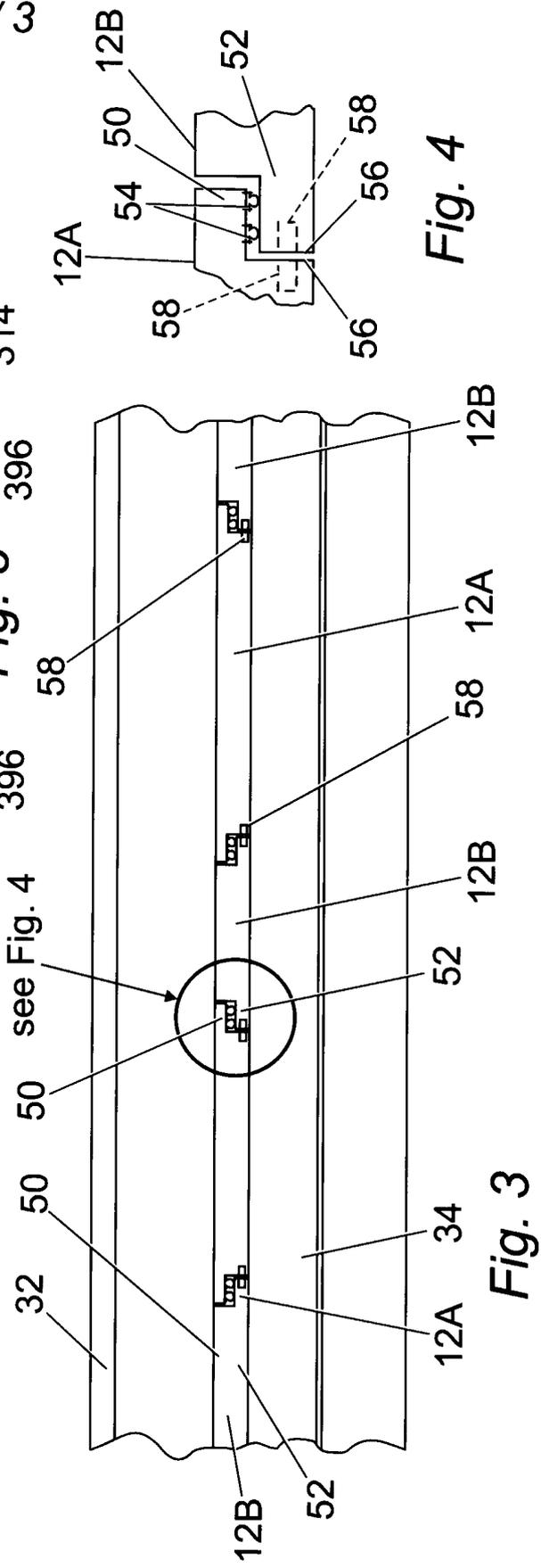
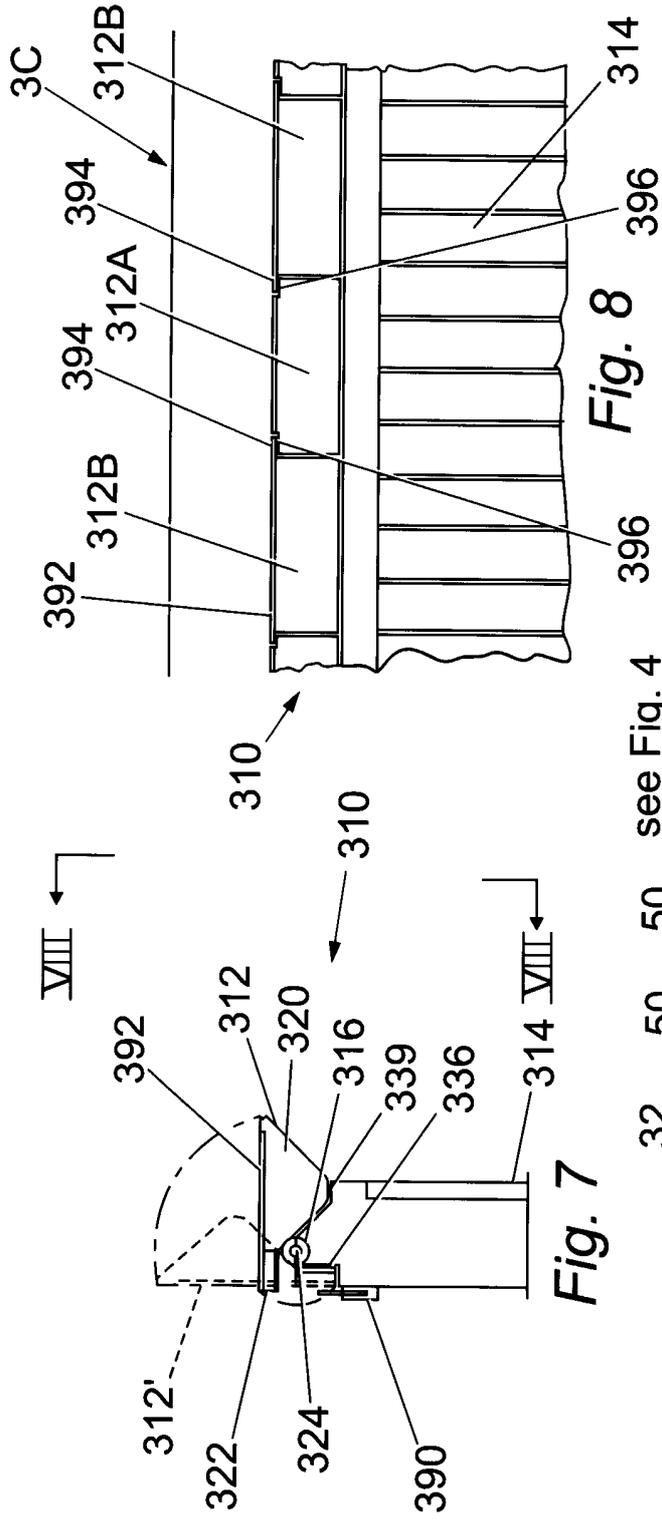
(54) Abstract Title: **Pivoting flood defence apparatus**

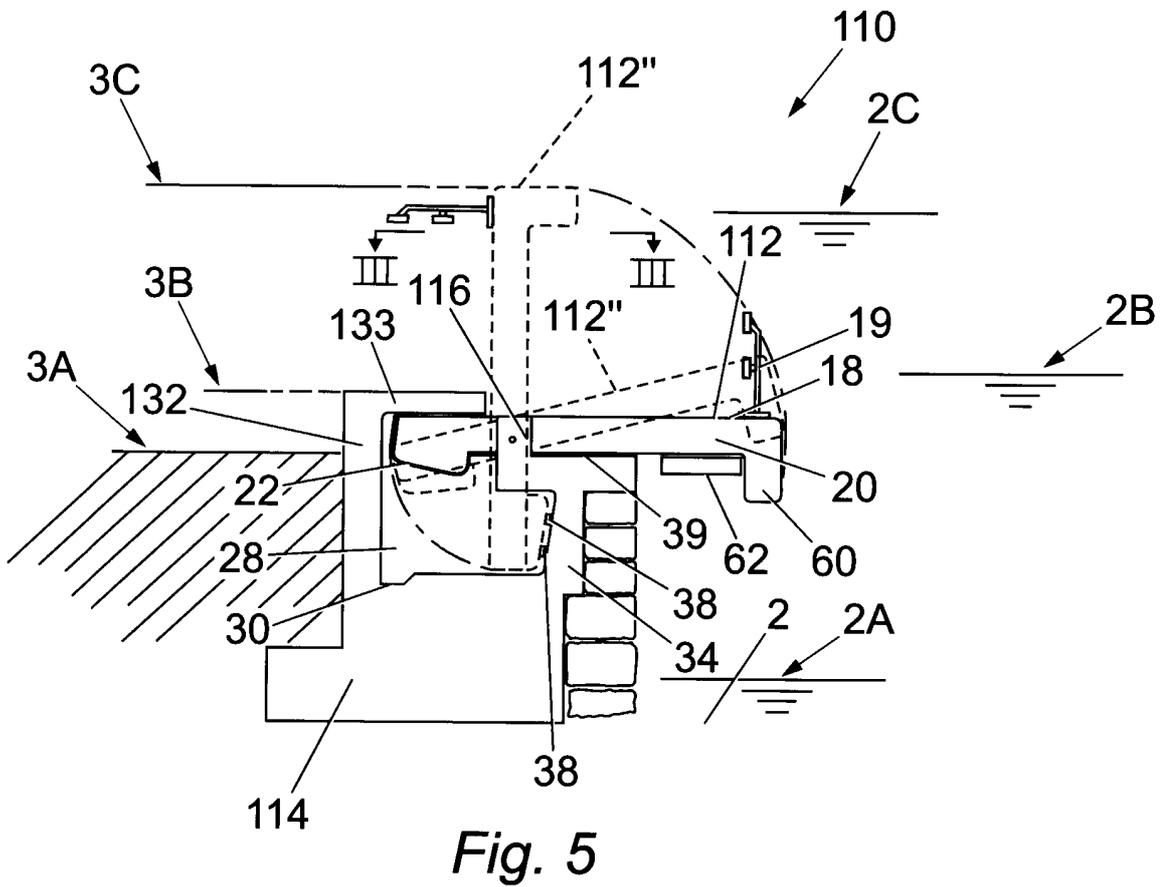
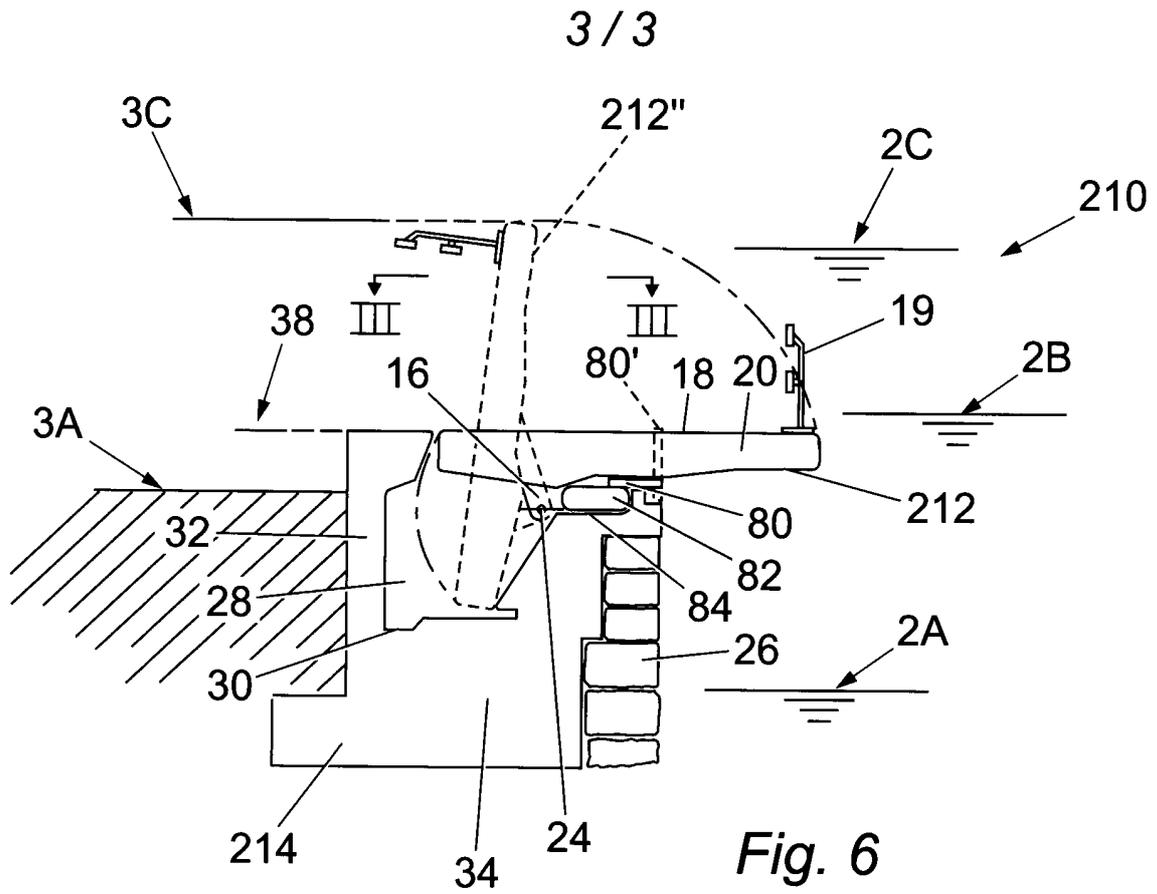
(57) A flood defence apparatus (10) comprises a support structure (14), such as a retaining wall or flood wall, and one or more tiltable wall units (12) hingedly attached about a pivot axis to the top of the support structure. Each wall unit has a buoyant water retaining lever arm (20) and a counterweighted abutment lever arm (21) arranged on opposite sides of the pivot axis. The support structure (10) is provided with abutment means (34) which abuts against the abutment lever arm (21) to hold the wall unit in a raised position when the water retaining wall is subject to hydrostatic pressure on its water facing side. In the raised position the water retaining lever arm (20) extends substantially upwards, thereby increasing the effective height of the retaining wall or flood wall (14). The water retaining lever arm (20) may be retracted by tipping back to the lowered position after the risk of flooding has passed.



**Fig. 1**







1     Tipping Flood Defence Apparatus

2

3     This invention relates to flood defence apparatus  
4     which can be installed in areas prone to flooding  
5     and is in a lowered position in normal use, but  
6     which can be deployed by tipping to a raised  
7     position to contain high water levels in the event  
8     of flooding. In particular the invention relates to  
9     flood defence apparatus which can be deployed by  
10    tipping from a lowered position to a raised position  
11    in which the apparatus forms a flood wall, and which  
12    can be retracted by tipping back to the lowered  
13    position after the risk of flooding has passed.

14

15    In fluvial and estuarine situations the adoption of  
16    fixed flood defences, such as walls or embankments,  
17    as a means of reducing flood risk can often disrupt  
18    the visual amenity of an area particularly when  
19    these defences are higher than about one metre.  
20    With flood defence schemes, particularly in urban  
21    areas, it is usual to seek to achieve environmental  
22    enhancement of the area and avoid structures that

1 detract from the visual amenity. There is therefore  
2 a requirement for a robust flood defence apparatus  
3 which does not detract from the visual amenity but  
4 which can be deployed quickly and easily to provide  
5 flood protection when the flood conditions require  
6 it.

7  
8 According to a first aspect of the present invention  
9 there is provided a flood defence apparatus  
10 comprising a support structure and at least one  
11 tiltable wall unit hingedly attached about a pivot  
12 axis to the support structure, wherein each wall  
13 unit comprises a water retaining lever arm and an  
14 abutment lever arm arranged on opposite sides of the  
15 pivot axis, and wherein the support structure is  
16 provided with abutment means adapted to abut against  
17 the abutment lever arm to hold the wall unit in a  
18 raised position in which the water retaining lever  
19 arm extends substantially upwards when the water  
20 retaining wall is subject to hydrostatic pressure on  
21 its water facing side.

22  
23 Preferably the support structure comprises a  
24 permanent retaining wall, most preferably a flood  
25 retaining wall. The support structure may be of  
26 mass concrete, reinforced concrete, steel, alloy, a  
27 mixture of any of these or any other suitable  
28 material.

29  
30 Preferably the pivot axis extends close to the  
31 centre of gravity of the wall unit. Preferably the  
32 wall unit includes a counterweight arranged on the

1 abutment lever arm. The counterweight is thus on  
2 the opposite side of the pivot axis to the water  
3 retaining lever arm. Preferably the counterweight  
4 and pivot axis are arranged such that under the  
5 action of gravity alone the wall unit is urged  
6 towards a lowered position.

7  
8 Preferably the abutment means comprises a structural  
9 element of the support structure provided below the  
10 hinge. Preferably the abutment means includes an  
11 abutment surface adapted to engage sealingly with a  
12 corresponding abutment surface on the abutment lever  
13 arm. The abutment means may include a sealing  
14 means, such as a sealing strip.

15  
16 The wall unit may include one or more buoyant  
17 portions in or adjacent to the water retaining lever  
18 arm. Preferably the buoyant portions are arranged  
19 such that rising water urges the wall unit to the  
20 raised position.

21  
22 Preferably the apparatus comprises a plurality of  
23 tiltable wall units hingedly attached to the support  
24 structure arranged to form a continuous wall when in  
25 the raised position. Preferably the wall units  
26 comprise first units and second units arranged  
27 alternately, such that a first unit is adjacent to  
28 two second units. Preferably the first units are  
29 adapted to be raised first and are provided with  
30 laterally extending flanges against which the second  
31 units can seal, while the second units are adapted  
32 to be raised after the first units have been raised.

1 Preferably the laterally extending flanges are  
2 provided with sealing slots or other sealing means.  
3 Preferably the lateral edges of the second units are  
4 provided with corresponding sealing means adapted to  
5 sealingly engage with the sealing slots or other  
6 sealing means of the first units.

7  
8 Preferably the lateral edges of the water retaining  
9 lever arms are provided with slots adapted to  
10 accommodate a stop log or other suitable means of  
11 sealing a gap between two units if a unit between  
12 the two units fails to be raised.

13  
14 In one embodiment of the invention the water  
15 retaining lever arm is provided with a traffic  
16 bearing surface on its side opposite to its water  
17 facing side. In use the traffic bearing surface may  
18 be used as a road, walkway or path when the wall  
19 unit is in its lowered position. Preferably the  
20 outer edge of the water retaining lever arm is  
21 provided with a barrier means adjacent to the  
22 traffic bearing surface. The barrier means may be a  
23 fence, guardrail, handrail or the like. The barrier  
24 means may be fixed, demountable or capable of  
25 dropping to a lowered position when the water  
26 retaining lever arm is in the raised position.

27  
28 Preferably the support structure includes a recess  
29 adapted to house the abutment lever arm and/or  
30 counterweight in both the raised and lowered  
31 positions. Preferably the recess includes a  
32 drainage channel. Preferably the support structure

1 includes a curtain wall adapted to prevent access to  
2 the underside of the wall unit while the wall unit  
3 is in the lowered position. Preferably the curtain  
4 wall includes a cover portion adapted to prevent  
5 access to the recess and/or to cover the abutment  
6 lever arm while the wall unit is in the lowered  
7 position. Optionally the cover portion may include  
8 secondary abutment means adapted to abut against the  
9 wall unit to hold it in a raised position in which  
10 the water retaining lever arm extends substantially  
11 upwards when the water retaining wall is subject to  
12 hydrostatic pressure on its water facing side.

13

14 Optionally the apparatus may include actuation means  
15 operable to raise the wall unit from the lowered  
16 position towards the raised position.

17

18 Optionally the apparatus may include releasable  
19 locking means to hold the wall unit in the lowered  
20 position.

21

22 Optionally the apparatus may include releasable  
23 locking means to hold the wall unit in the raised  
24 position.

25

26 Preferably the wall unit is of steel, alloy,  
27 reinforced concrete, a mixture of these or any other  
28 suitable material. The buoyant portions may be  
29 voids or inserts of lightweight material. The  
30 counterweight may be of reinforced or mass concrete,  
31 steel or any other suitable material.

32

1 In another embodiment of the invention the water  
2 retaining lever arm is in the form of a cope.  
3 Preferably the support structure is a flood wall.

4  
5 Preferably the cope is adapted to provide an  
6 effective increase in height of the flood wall when  
7 the wall unit is in the raised position. Preferably  
8 the abutment means is provided at the rear of the  
9 flood wall. Preferably the front of the flood wall  
10 is provided with a seating means adapted to support  
11 the wall unit when it is in the lowered position.

12  
13 Preferably the wall unit is of steel, aluminium,  
14 polypropylene, glass reinforced plastic or other  
15 suitable material.

16  
17 Examples of the invention, which are not limiting,  
18 will now be described with reference to the  
19 following drawings in which:

20  
21 Fig. 1 shows a sectional view through a unit of a  
22 flood defence apparatus of the invention according  
23 to a first embodiment;

24  
25 Fig. 2 shows a partial sectional view to an enlarged  
26 scale through the counterbalance of the flood  
27 defence apparatus of Fig. 1 in the raised position;

28  
29 Fig. 3 shows a sectional plan view III-III of a  
30 number of adjacent units of the flood defence  
31 apparatus of Fig. 1 in the raised position;

32

1 Fig. 4 shows a partial plan view to an enlarged  
2 scale of the flood defence apparatus of Fig. 3;

3

4 Fig. 5 shows a sectional view of another embodiment  
5 of a flood defence apparatus of the invention;

6

7 Fig. 6 shows a sectional view of a further  
8 embodiment of a flood defence apparatus of the  
9 invention;

10

11 Fig. 7 shows a sectional view of yet another  
12 embodiment of a flood defence apparatus of the  
13 invention; and

14

15 Fig. 8 shows a front elevational view VIII-VIII of  
16 the flood defence apparatus of Fig. 7.

17

18 With reference to Figs. 1 to 4 there is shown a body  
19 of water 2 and a flood defence apparatus 10  
20 comprising a number of tiltable wall units 12 which  
21 are each attached to a support structure 14 by a  
22 hinge bearing assembly 16. The body of water 2 may  
23 be a water course, river, lake, estuary, coastal  
24 water or any other body of water, and may not be  
25 permanently carrying water. The tiltable wall unit  
26 12 is shown in the lowered position in Fig. 1, with  
27 intermediate and raised positions of the wall unit  
28 12 indicated by the reference numerals 12' and 12''  
29 respectively. In the lowered position the upper  
30 surface of the wall unit forms a light traffic  
31 bearing surface such as a walkway 18. A guard rail

1 or hand rail 19 may be provided at the outer edge of  
2 the walkway 18.

3

4 The wall unit 12 includes a water retaining lever  
5 arm 20 extending to the right of the hinge 16 in  
6 Fig. 1, and an abutment lever arm 21 extending to  
7 the left of the hinge 16, on which is arranged a  
8 counterweight 22. The wall unit can tip about a  
9 pivot axis 24 extending through the hinge 16. The  
10 counterweight 22 is arranged so that in an  
11 equilibrium state with no buoyancy forces the  
12 overturning moment from the water retaining lever  
13 arm 20 is greater than that from the abutment lever  
14 arm 21 and counterweight 22 so that the wall unit  
15 remains in the lowered position, even if load from a  
16 pedestrian or vehicle is applied to the portion of  
17 the walkway to the left of the hinge 16.

18 Alternatively a locking mechanism (not shown) may be  
19 installed to secure the wall unit in the lowered  
20 position until such time as water levels rise to a  
21 predetermined level. At this time the locking  
22 mechanism may be released automatically, manually or  
23 remotely. Simultaneously an audible or visual  
24 warning of the impending operation of the flood  
25 defence apparatus may be provided to persons in the  
26 vicinity of the flood defence apparatus.

27

28 The support structure 14 comprises a retaining wall,  
29 constructed either as a stand-alone retaining wall  
30 or behind or above an existing retaining wall 26.

31 The support structure 14 may be of mass or

32 reinforced concrete, steel or other construction.

1 The existing retaining wall may typically be of  
2 masonry, but may be of any construction. The  
3 support structure includes a recess 28 which can  
4 accommodate the abutment lever arm 21 as the wall  
5 unit 12 tilts to the raised position 12''. A  
6 drainage channel 30 extends along the recess 28 and  
7 takes any water leaking past the raised wall unit 12  
8 to a pumping station (not shown) or water holding  
9 area (not shown). The recess 28 is bounded by a  
10 curtain wall 32 which extends to the finished ground  
11 level adjacent to the traffic bearing surface 18 of  
12 the wall unit 12 and which prevents access to the  
13 recess 28 while the wall unit 12 is in the lowered  
14 position.

15  
16 The support structure 14 includes a structural  
17 element 34 extending adjacent to the recess 28. The  
18 structural element 34 in the illustrated example is  
19 a wall which includes a sloping surface 36 which  
20 serves as an abutment means to support the wall unit  
21 12 in the raised position, by abutting against the  
22 abutment lever arm 21. As can be seen in Fig. 2  
23 sealing means, such as compressible rubber "O" ring  
24 sealing strips 38, are fixed to the structural  
25 element 34 to provide a substantially watertight  
26 seal between the support structure 14 and the wall  
27 unit 12 when the wall unit 12 is in the raised  
28 position. In this position the hydrostatic pressure  
29 of the water urges the wall unit 12 to pivot in a  
30 counter-clockwise direction, such that the abutment  
31 lever arm 21 is urged to compress the sealing strips  
32 38.

1

2 When the wall unit 12 is in the lowered position it  
3 rests on a seat 39 provided on the support structure  
4 14.

5

6 The wall unit may be provided with a locking member  
7 40 at the end of its abutment or counterweight lever  
8 arm 21. The locking member includes a detent  
9 portion 42 which is biased by a sprung hinge 44 so  
10 that it engages with a nosing 46 of steel or other  
11 suitable material when the wall unit 12 reaches the  
12 raised position. A release mechanism, for example a  
13 cable 48 leading to a manual release handle or lever  
14 (not shown) or any other suitable mechanism, may be  
15 operated to release the locking member 40 so that  
16 the wall units 12 may be lowered manually once the  
17 risk of flooding has passed.

18

19 The wall unit 10 is typically fabricated from mild  
20 steel, aluminium, plastic, lightweight concrete,  
21 composite construction or the like. The water  
22 retaining lever arm 20 includes positive buoyancy,  
23 such as hollow cavities, foamed plastic or the like,  
24 so that as the water level adjacent to the apparatus  
25 10 rises, buoyancy forces urge the water retaining  
26 lever arm 20 upwards. To this end a downwardly  
27 projecting buoyant nose portion 60 is provided at  
28 the free end of the water retaining lever arm 20, so  
29 that the buoyancy forces start to act before the  
30 water level reaches the top of the structural  
31 element 34. However it is to be understood that if  
32 required the wall unit 12 can be raised manually or

1 by means of an actuator such as the optional  
2 hydraulic ram 41. The ram 41 acts between the  
3 support structure 14 and the water retaining lever  
4 arm 20 and in its extended position 41'' holds the  
5 wall unit 12 in the raised position.  
6

7 As can be seen in the plan views of Figs. 3 and 4  
8 the flood defence apparatus 10 comprises a plurality  
9 of tiltable wall units 12 hingedly attached to the  
10 support structure 14 arranged to form a continuous  
11 wall when in the raised position. There are two  
12 types of wall unit, first 12A and second 12B units.  
13 First units 12A and second units 12B are arranged  
14 alternately, such that a first unit 12A is adjacent  
15 to two second units 12B. When the wall is raised  
16 the first units 12A are raised first. The water  
17 retaining lever arms of the first units 12A have  
18 laterally extending flanges 50 against which  
19 laterally extending flanges 52 on the water  
20 retaining lever arms of the second units 12B can  
21 seal when the second units 12B are raised. As can  
22 be seen in Fig. 4 sealing means, such as  
23 compressible rubber "O" ring sealing strips 54, are  
24 fixed to the flanges 54 of the first units 12A to  
25 provide a substantially watertight seal between the  
26 first and second units 12A, 12B when the wall units  
27 are in the raised position.  
28

29 The lateral edges 56 of the water retaining lever  
30 arms 20 are provided with slots 58 adapted to  
31 accommodate a stop log (not shown) or other similar  
32 device, in a known manner, so that stop logs or

1 other devices can be used to bridge between two non-  
2 adjacent units in the event that a unit is damaged  
3 or cannot be raised.

4  
5 In the 'normal' lowered position the apparatus of  
6 the invention minimises disruption to views of the  
7 environment of the body of water 2 from the area to  
8 be protected. Once the flood defence apparatus 10  
9 has automatically risen to its raised position  
10 during the onset of a flood or extreme high tide or  
11 water level it provides the same degree of flood  
12 protection that a fixed flood defence of equivalent  
13 height (in its raised position) would provide.

14  
15 The support structure 14 may be constructed at the  
16 top of an existing training wall or revetment, or  
17 even the top of an existing flood wall. In the  
18 lowered position the water retaining lever arm 20  
19 cantilevers out over the body of water 2 or its  
20 adjacent area and lies at some height above the  
21 normal water level 2A.

22  
23 At the onset of a flood or extreme high tide or  
24 water level, as the water level 2 rises up to and  
25 above the level of the nose portion 60 the buoyancy  
26 of the nose starts to raise the water retaining  
27 lever arm 20 until a point is reached when the whole  
28 wall unit 12 automatically tips up to the raised  
29 position and remains in that position until such  
30 time as the water level has subsided.

31

1 It is not essential that a completely watertight  
2 seal be obtained between adjacent units 12A, 12B.  
3 Any excess leakage can be drained via the drainage  
4 channel 30 to a sump (not shown) and if necessary  
5 pumped back to the body of water 2.  
6

7 After a flood or extreme high tide or water level  
8 event the units 12 are returned to the lowered  
9 position manually. In practice operational  
10 conditions may be such that the total length of a  
11 series of units may be limited, with a short length  
12 of fixed flood defence wall between each series of  
13 units provided if necessary.  
14

15 The flood defence apparatus shown in Figs. 1 to 4 is  
16 capable of providing a flood defence structure up to  
17 a level 3C around 3m high above the existing general  
18 landward ground level 3A during high water  
19 conditions. This is achieved by providing an  
20 additional approximately 2m high water retaining  
21 structure over and above the level 3B of protection  
22 provided by the structure in the lowered position  
23 which may be approximately 1m high above ground  
24 level. The dimensions are indicative only. Figs. 5  
25 and 6 show alternative arrangements capable of the  
26 same order of protection.  
27

28 Referring to Fig. 5, there is shown a body of water  
29 2, such as a river, lake, estuary, coastal water or  
30 the like, and a flood defence apparatus 110  
31 comprising a number of tiltable wall units 112 which  
32 are each attached to a support structure 114 by a

1 hinge bearing assembly 116. The tiltable wall unit  
2 112 is shown in the lowered position in Fig. 5, with  
3 intermediate and raised positions of the wall unit  
4 112 indicated by the reference numerals 112' and  
5 112'' respectively. Where elements of the apparatus  
6 are similar to the embodiment illustrated in Figs. 1  
7 to 4 these are indicated with the same reference  
8 numeral and are not described further.

9  
10 The wall unit 112 is fabricated from mild steel or  
11 aluminium U sections and plate or other suitable  
12 material, and has a concrete counterweight 22. The  
13 curtain wall 132 includes a cantilever portion 133  
14 which projects over the counterweight arm when the  
15 unit is in the lowered position, thereby avoiding  
16 the danger of debris entering the recess 28 or  
17 accidental operation of the wall unit by traffic  
18 loads. In this embodiment a locking mechanism to  
19 hold the wall unit 112 in the lowered position is  
20 not essential. The cantilever portion 133 can also  
21 serve as a kerb for the walkway 18. The support  
22 structure 114 includes an enlarged seat 39 which  
23 supports the water retaining lever arm 20 when the  
24 unit is in the lowered position. It is to be  
25 understood that this arrangement could be also  
26 adopted with the embodiment of Figs. 1 to 4.  
27 Additional buoyancy may be provided by a tank 62 of  
28 fibreglass, plastic or other suitable material  
29 fastened to the underside of the water retaining  
30 lever arm 20.

31

1 Referring to Fig. 6, there is shown a flood defence  
2 apparatus 210 in which the raising can be triggered  
3 manually or remotely. The apparatus 210 comprises a  
4 number of tiltable wall units 212 which are each  
5 attached to a support structure 214 by a hinge  
6 bearing assembly 216. The tiltable wall unit 212 is  
7 shown in the lowered position in Fig. 6, with the  
8 raised position of the wall unit 212 indicated by  
9 the reference numeral 212''. Where elements of the  
10 apparatus are similar to the embodiment illustrated  
11 in Figs. 1 to 4 these are indicated with the same  
12 reference numeral and are not described further.

13  
14 The wall unit 212 may be fabricated from mild steel,  
15 aluminium, composite, plastic, lightweight concrete  
16 or other suitable material. The support structure  
17 214 includes a hinged retaining leaf 80. When the  
18 unit 212 is in the lowered position the retaining  
19 leaf 80 is also in the lowered position and supports  
20 the water retaining lever arm 20. An inflatable  
21 rubber membrane 82, which can be inflated like a  
22 balloon with pressurised air or pumped water, is  
23 provided between the support surface 84 of the  
24 support structure 214 and the underside of the  
25 retaining leaf 80. Under normal operation, when the  
26 unit 212 is in the lowered position, the membrane 82  
27 is deflated. However when it is required to raise  
28 the flood defence the membrane 82 is inflated by  
29 controlling a pump or valve (not shown). This  
30 pushes the retaining leaf 80 upwards to a raised  
31 position 80', which in turn pushes the water  
32 retaining lever arm 20 upwards, until a point is

1 reached when the whole wall unit 212 automatically  
2 tips up to the raised position and remains in that  
3 position until such time as the water level has  
4 subsided.

5

6 Figs. 7 and 8 show a flood defence apparatus which  
7 can be used to provide additional raising of the  
8 level of protection provided by a fixed flood  
9 defence wall by up to around 0.6m.

10

11 The flood defence apparatus 310 comprises a number  
12 of tiltable wall units 312 which are each attached  
13 to a support structure in the form of a flood wall  
14 314 by a hinge bearing assembly 316. The tiltable  
15 wall unit 312 is shown in the lowered position in  
16 Fig. 7, with the raised position of the wall unit  
17 312 indicated by the reference numerals 312'.

18

19 The wall unit 312 is typically of the order of 1m  
20 wide and includes a buoyant water retaining lever  
21 arm 320 which in the lowered position forms a cope  
22 at the top of the flood wall 314, typically 500 to  
23 600 mm wide although other widths may be envisaged.  
24 On the opposite side of the pivot axis 324 is an  
25 abutment lever arm 321 with a counterweight 322.  
26 When the water level rises towards the top of the  
27 cope, the buoyancy of the water retaining lever arm  
28 320 causes the wall unit 312 to tip to the raised  
29 position 312'. A locking member 390 of any suitable  
30 type may be provided to hold the wall units 312 in  
31 the raised position once they have reached this  
32 position, thus providing an effective increase in

1 height of the flood wall when the wall unit is in  
2 the raised position. The flood wall 314 includes an  
3 abutment portion 336 which abuts against the  
4 abutment lever arm 321 when the unit is in the  
5 raised position. Sealing means (not shown) may be  
6 provided on the abutment portion, as described above  
7 with reference to Figs. 1 to 4. The flood wall 314  
8 also includes a seat 339 which supports the wall  
9 unit 312 when it is in the lowered position.

10

11 The wall unit may be manufactured from steel,  
12 aluminium, polypropylene, glass reinforced plastic  
13 or other suitable material. The counterweight may  
14 be of solid metal.

15

16 As can be seen in the front elevation view of Fig.  
17 8, which shows the flood defence apparatus 310 in  
18 the lowered position, the apparatus comprises a  
19 plurality of tiltable cope wall units 312 hingedly  
20 attached to the support structure 314 arranged to  
21 form a continuous wall when in the raised position.  
22 There are two types of cope wall unit, first 312A  
23 and second 312B units. First units 312A and second  
24 units 312B are arranged alternately, such that a  
25 first unit 312A is adjacent to two second units  
26 312B. The first units 312A are provided with  
27 increased buoyancy relative to the second units  
28 312B, so that as the wall is raised the first units  
29 312A are raised first. The second units 312B have  
30 cover plates 392 with laterally extending flanges  
31 394 against which recessed portions 396 of the first  
32 units 312A can seal when the first units 312A are

1 raised. Because of the increased buoyancy of the  
2 first units 312A, the first units 312A urge the  
3 second units 312B upwards as they are raised,  
4 thereby sealing between the flanges 394 and the  
5 recessed portions 396. Any suitable sealing means  
6 (not shown) can be fixed to the flanges 394 of the  
7 second units 312B to provide a substantially  
8 watertight seal between the first and second units  
9 312A, 312B when the cope wall units are in the  
10 raised position.

11  
12 This embodiment offers an opportunity to provide  
13 increased flood protection on an existing or new  
14 flood wall 314 without detracting visually. A fixed  
15 flood defence wall may be of limited height so that  
16 the fixed wall does not disrupt views of the river;  
17 typically a fixed wall is not higher than about 1.2m  
18 above the landward ground level adjacent to the  
19 wall. In the normal lowered position the wall units  
20 312 appear as a cope sitting on top of the wall 314.  
21 The wall units 312 may be provided with surface  
22 treatment such that the cope blends with the wall  
23 and appears as an integrated part of the fixed  
24 structure. The effective level of the fixed flood  
25 wall may then be raised during flood or extreme high  
26 water level conditions by up to about 0.6m. This is  
27 a significant amount as it would enable allowance  
28 for climate change to be incorporated into many  
29 flood defence designs without the disadvantage of  
30 disruption of visual amenity.

31

1 The buoyant nature of the water retaining lever arm  
2 20, 320 of the wall units of the invention allows  
3 automatic operation of the apparatus as the water  
4 level rises. To avoid accidental tipping from the  
5 lowered position an actuated locking bolt mechanism  
6 (not shown) could if required be provided at the  
7 landward side of flood defence apparatus. The  
8 locking bolt mechanism could be released either by  
9 remote signal from a flood warning system or an  
10 operations centre or manually. Similarly the  
11 optional locking member 390 which holds the wall  
12 units in the raised position may be actuated  
13 manually or by a remote signal.

14  
15 Rather than rely on automatic tipping the invention  
16 allows positive tipping of the wall units by any  
17 suitable actuating means in all embodiments.  
18 Actuating means envisaged by the invention is not  
19 limited to the ram assembly 41 shown in Fig. 1 or  
20 the inflatable membrane 82 shown in Fig. 6. Any  
21 other suitable actuation means may be used, for  
22 example an actuating arm operated hydraulically or  
23 by a gearing mechanism. The actuation means can be  
24 operated remotely by a flood warning signal, or from  
25 an operations centre, or locally as a manual over-  
26 ride. This arrangement would have the advantage of  
27 slower controlled closure during the later stages of  
28 tipping and positive closure of the sealing  
29 arrangement when the water head against the water  
30 retaining lever arm is low. An early warning signal  
31 can be provided to warn pedestrians and other

1 persons on the walkway before the locking mechanism  
2 (if used) is released and the wall units raised.

3

4 The invention is not limited to particular materials  
5 or dimensions. Any suitable hinge mechanism may be  
6 used to hingedly attach the tiltable wall units to  
7 the support structure.

## 1 CLAIMS

2

3 1. Flood defence apparatus comprising a support  
4 structure and at least one tiltable wall unit  
5 hingedly attached about a pivot axis to the support  
6 structure, wherein each wall unit comprises a water  
7 retaining lever arm and an abutment lever arm  
8 arranged on opposite sides of the pivot axis, and  
9 wherein the support structure is provided with  
10 abutment means adapted to abut against the abutment  
11 lever arm to hold the wall unit in a raised position  
12 in which the water retaining lever arm extends  
13 substantially upwards when the water retaining wall  
14 is subject to hydrostatic pressure on its water  
15 facing side.

16

17 2. Flood defence apparatus according to claim 1,  
18 wherein the support structure comprises a retaining  
19 wall or flood wall.

20

21 3. Flood defence apparatus according to claim 1 or  
22 2, wherein the pivot axis extends close to the  
23 centre of gravity of the wall unit.

24

25 4. Flood defence apparatus according to any  
26 preceding claim, wherein the wall unit includes a  
27 counterweight arranged on the abutment lever arm,  
28 the counterweight and pivot axis being arranged such  
29 that under the action of gravity alone the wall unit  
30 is urged towards a lowered position.

31

- 1     5. Flood defence apparatus according to any  
2 preceding claim, wherein the abutment means  
3 comprises a structural element of the support  
4 structure provided below the hinge.  
5
- 6     6. Flood defence apparatus according claim 5,  
7 wherein the abutment means includes an abutment  
8 surface adapted to engage sealingly with a  
9 corresponding abutment surface on the abutment lever  
10 arm.  
11
- 12    7. Flood defence apparatus according to any  
13 preceding claim, wherein the wall unit includes one  
14 or more buoyant portions in or adjacent to the water  
15 retaining lever arm and arranged such that rising  
16 water urges the wall unit to the raised position.  
17
- 18    8. Flood defence apparatus according to any  
19 preceding claim, wherein the apparatus comprises a  
20 plurality of tiltable wall units hingedly attached  
21 to the support structure arranged to form a  
22 continuous wall when in the raised position.  
23
- 24    9. Flood defence apparatus according to claim 8,  
25 wherein the wall units comprise first units and  
26 second units arranged alternately, such that a first  
27 unit is adjacent to two second units, and wherein  
28 the first units are adapted to be raised first and  
29 are provided with laterally extending flanges  
30 against which the second units can seal, while the  
31 second units are adapted to be raised after the  
32 first units have been raised.

- 1  
2 10. Flood defence apparatus according to claim 9,  
3 wherein the lateral edges of the second units are  
4 provided with sealing means adapted to sealingly  
5 engage with corresponding sealing means provided on  
6 the laterally extending flanges of the first units.  
7
- 8 11. Flood defence apparatus according to any  
9 preceding claim, wherein the lateral edges of the  
10 water retaining lever arms are provided with slots  
11 adapted to accommodate a stop log.  
12
- 13 12. Flood defence apparatus according to any  
14 preceding claim, wherein the water retaining lever  
15 arm is provided with a traffic bearing surface on  
16 its side opposite to its water facing side.  
17
- 18 13. Flood defence apparatus according to claim 12,  
19 wherein the outer edge of the water retaining lever  
20 arm is provided with a barrier means adjacent to the  
21 traffic bearing surface.  
22
- 23 14. Flood defence apparatus according to any  
24 preceding claim, wherein the support structure  
25 includes a recess adapted to house the abutment  
26 lever arm and/or counterweight in both the raised  
27 and lowered positions.  
28
- 29 15. Flood defence apparatus according to claim 14,  
30 wherein the support structure includes a curtain  
31 wall adapted to prevent access to the underside of

1 the wall unit while the wall unit is in the lowered  
2 position.

3

4 16. Flood defence apparatus according to claim 15,  
5 wherein the curtain wall includes a cover portion  
6 adapted to prevent access to the recess and/or to  
7 cover the abutment lever arm while the wall unit is  
8 in the lowered position.

9

10 17. Flood defence apparatus according to any  
11 preceding claim, wherein the apparatus includes  
12 actuation means operable to raise the wall unit from  
13 the lowered position towards the raised position.

14

15 18. Flood defence apparatus according to any  
16 preceding claim, wherein the apparatus includes  
17 releasable locking means to hold the wall unit in  
18 the lowered position.

19

20 19. Flood defence apparatus according to any  
21 preceding claim, wherein the apparatus includes  
22 releasable locking means to hold the wall unit in  
23 the raised position.

24

25 20. Flood defence apparatus according to any of  
26 claims 1 to 10, wherein the water retaining lever  
27 arm is in the form of a cope and the support  
28 structure is a flood wall, the cope being adapted to  
29 provide an effective increase in height of the flood  
30 wall when the wall unit is in the raised position.

31

- 1 21. Flood defence apparatus according to claim 20,  
2 wherein the abutment means is provided at the rear  
3 of the flood wall.  
4
- 5 22. Flood defence apparatus according to claim 21,  
6 wherein the front of the flood wall is provided with  
7 a seating means adapted to support the wall unit  
8 when it is in the lowered position.  
9
- 10 23. Flood defence apparatus according to any of  
11 claims 20 to 22, wherein the wall unit is of a  
12 material selected from steel, aluminium,  
13 polypropylene and glass reinforced plastic.  
14
- 15 24. Flood defence apparatus as hereinbefore  
16 described with reference to the accompanying  
17 drawings.



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Application No: GB0605074.4

Examiner: Richard Collins

Claims searched: 1 to 24

Date of search: 3 July 2006

### Patents Act 1977: Search Report under Section 17

#### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1,3-8,12,14,15	EP0741205 A1 (TRAINER) see figure 1 and abstract.
X	1,3-8,12,14,15	EP0802285 A1 (TRAINER) see figures and abstract.
X	1-8,14	DE1033596 A1 (CRONAU) see all of the figures.
X	1,3-5,7,8,14,17	GB2371324 A (BRACKETT) see the whole document.
X	1,3,5,7,8,14	FR829558 A1 (CHERR) see figure 1 especially.
X	1,7,8,14	DE19539611 A1 (SIRAKY) see the figures and abstract.
X	1,2,7,8	US4377352 A (GOODSTEIN) see figure 2 and related description.

#### Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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#### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

E1H

Worldwide search of patent documents classified in the following areas of the IPC

E02B

The following online and other databases have been used in the preparation of this search report



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EPODOC, WPI