

Sept. 4, 1951

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2,566,748

RESTRAINING WALL DECKING

Filed Aug. 5, 1946

6 Sheets-Sheet 1

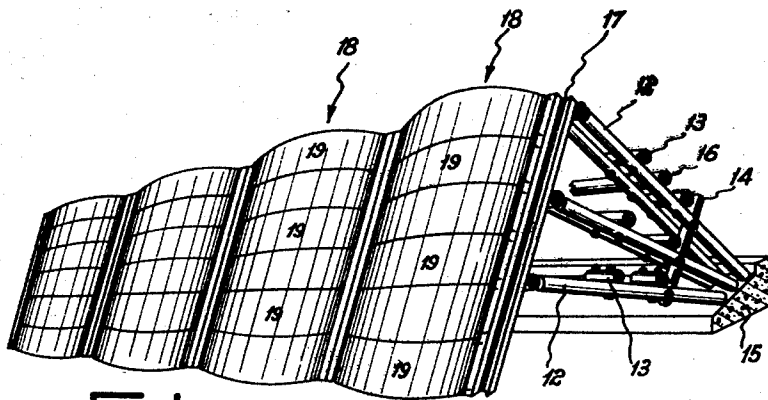


Fig. 1.

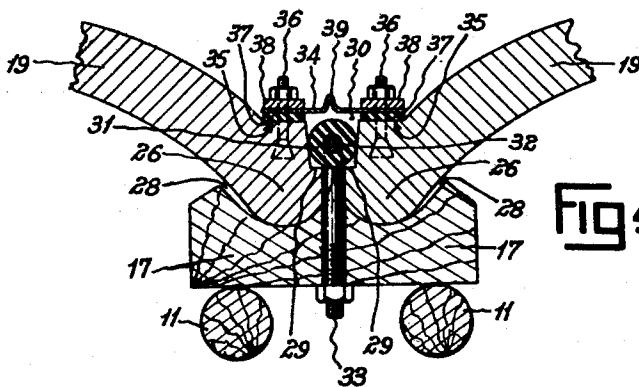


Fig. 4.

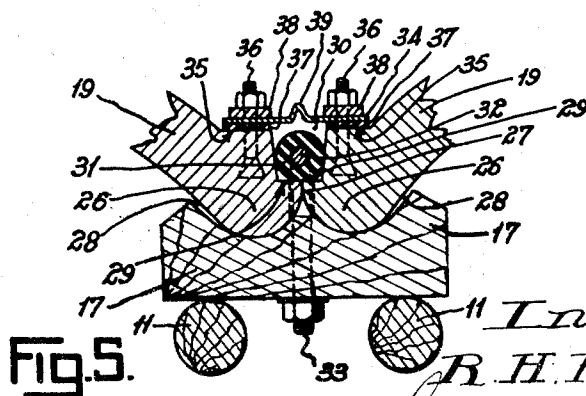


Fig. 5.

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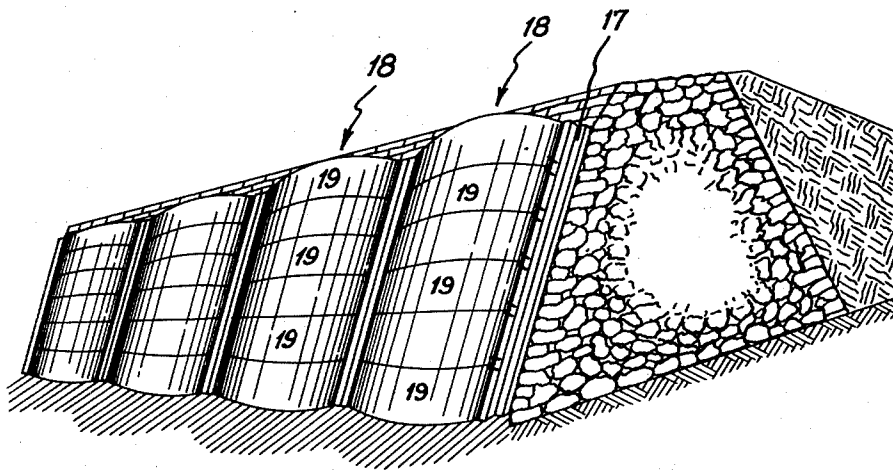


FIG. 1A.

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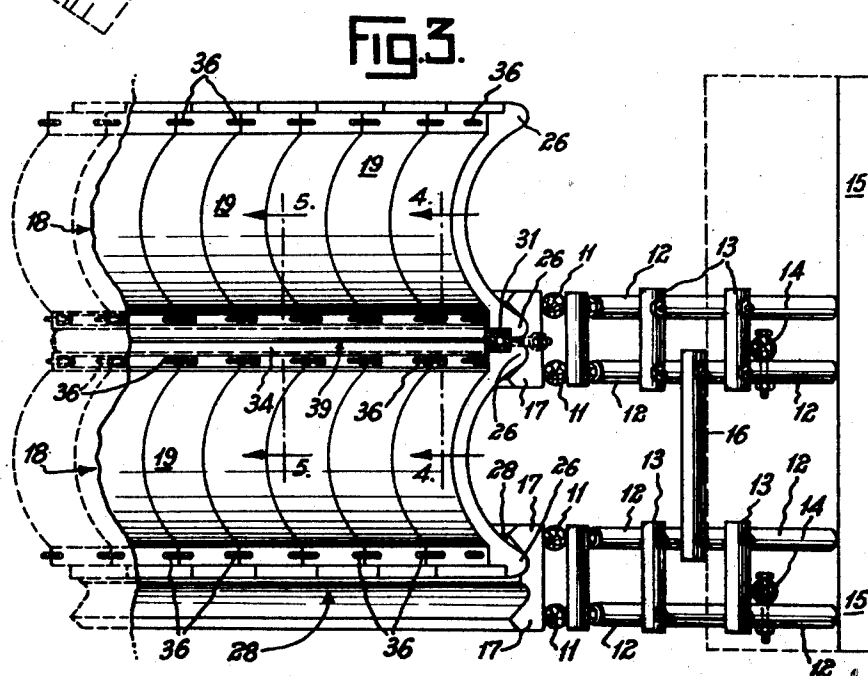
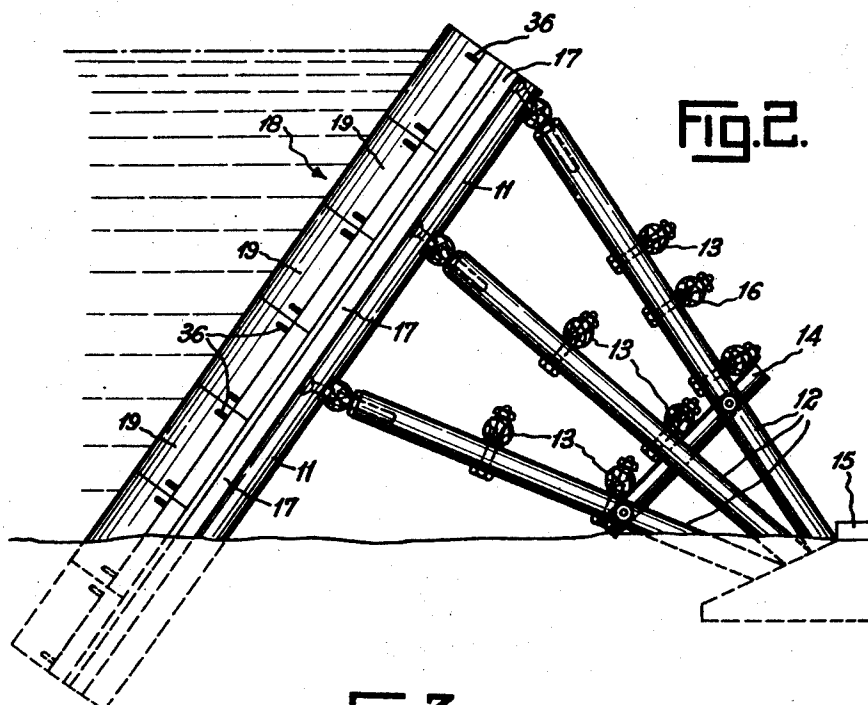
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6 Sheets-Sheet 4

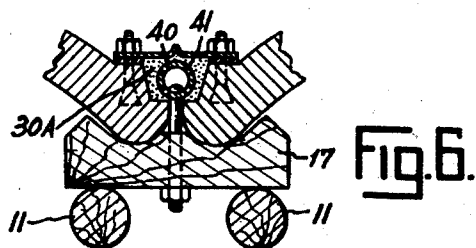


Fig. 6.

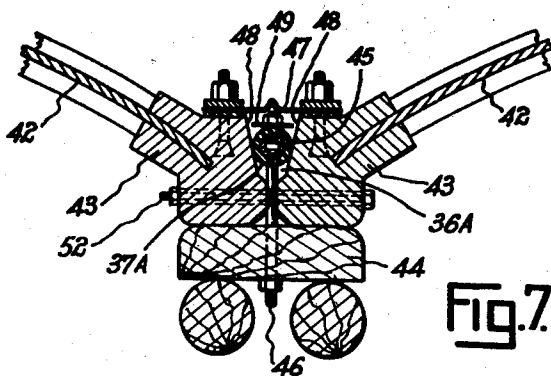


Fig. 7.

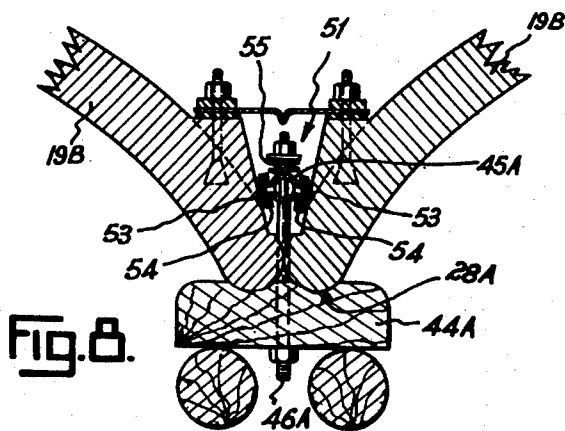


Fig. 8.

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6 Sheets-Sheet 5

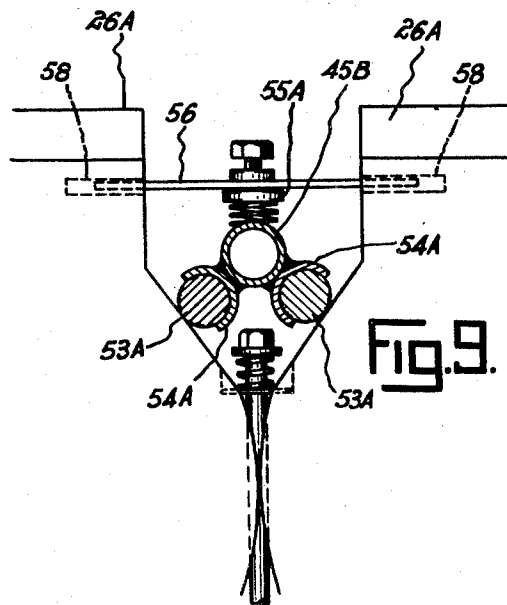


Fig. 9.

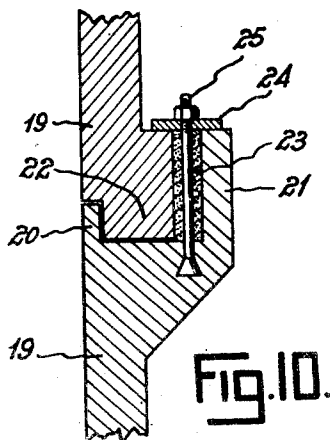


Fig. 10.

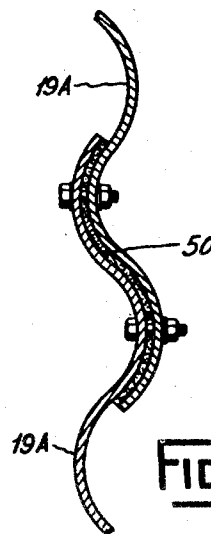


Fig. 11.

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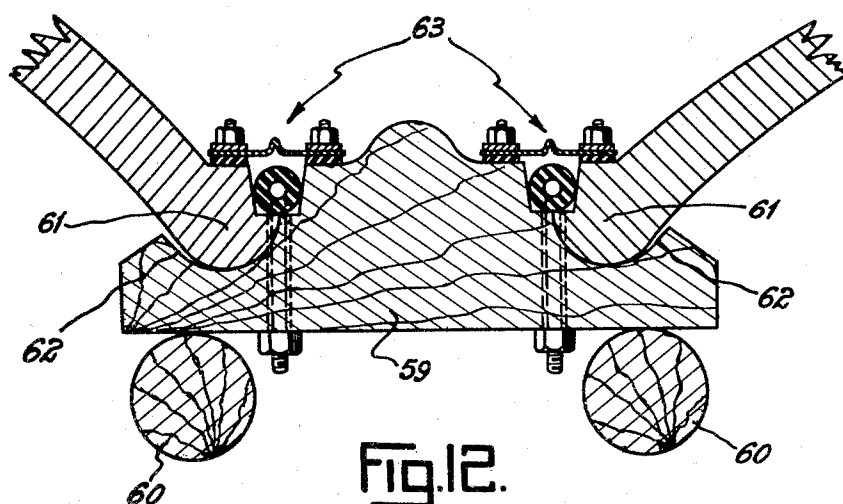


Fig. 12.

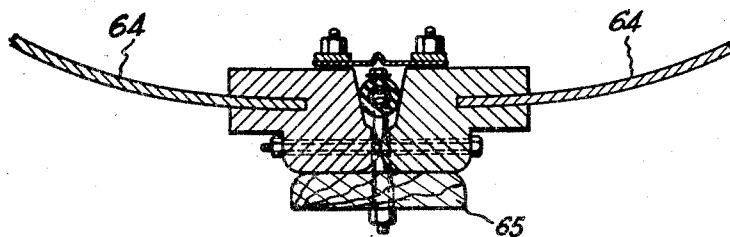


Fig. 13.

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UNITED STATES PATENT OFFICE

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RESTRAINING WALL DECKING

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AustraliaApplication August 5, 1946, Serial No. 688,469
In Australia May 22, 1946

14 Claims. (Cl. 61—30)

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This invention relates to deckings for restraining walls; namely, those walls which are designed to withstand a distributed load applied to one side face thereof. While the invention is applicable in a general way to deckings for restraining walls of all kinds, such as side walls for silos, bins, and other containers, and the like; it is mainly intended for restraining walls in which the distributed load on one face of the decking is a hydrostatic load. Examples of such hydrostatically loaded deckings are those of dams for rivers and streams, and side walls for reservoirs and the like. In short, the invention is particularly directed to the provision of deckings for small scale dam constructions but is not limited thereto.

A restraining wall used to hold back any material generally consists of two main parts; firstly the decking which is in contact with the supported material and is required to be impervious or substantially impervious thereto and, secondly, a buttress assembly to hold the decking in required position. For example, a rock-fill dam is characterized by the placement of a rock or other mass to form an embankment or buttress support and watertightness is obtained by an impervious membrane or decking which is borne by said buttress support and is connected to a "cut-off" wall extending into the foundation material. An earth dam is similarly constructed except that earth is used for the buttress assembly.

A "buttress" dam is characterized by buttresses generally of concrete, and a water supporting up-stream face or decking carried across the buttresses.

The main object of this invention is to provide a flexible load transmitting and impervious decking for restraining wall constructions, which is statically determinate, and is able to transmit the loads imposed thereon to the main structural supporting elements, while at the same time being sufficiently flexible to enable settlement or other movements of the wall without impairing its load-withstanding ability and its imperviousness. An advantage due to the present invention is that the decking subject thereof may be easily extended downwardly into a river bed or the like to constitute a cut-off wall to prevent seepage around, under or through the structure.

Another object of the invention is the provision of a restraining wall construction in which the wall decking elements are capable of lateral movement, thus causing the deck loads to be directly transmitted to the buttress assembly, the foundations and the earth.

A still further object of the invention is to provide a form of restraining wall decking construction which may be built up easily and cheaply from simple mass produced elements or

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sections substantially irrespective of the size and shape of the required decking.

The present invention may be shortly summarised in terms of a preferred embodiment thereof, as consisting in a restraining wall decking composed of a plurality of bolsters able to rest uprightly against a buttress assembly without restraint against lateral movability relative thereto, a plurality of deck face panels having side portions able to seat upon said bolsters, and means for sealing the adjacent side portions of neighbouring pairs of panels.

Examples of the invention are illustrated in the accompanying drawings:

Figure 1 is a small-scale perspective view of a restraining wall construction incorporating a structurally "built-up" buttress assembly.

Figure 1A is a similar view to Figure 1 showing a restraining wall construction incorporating a "rock-fill" (or "earth-fill") buttress assembly.

Figure 2 is a side elevation of the construction shown in Figure 1.

Figure 3 is an incomplete plan projected from Figure 2.

Figures 4 and 5 are fragmentary sectional views taken on lines 4—4 and 5—5 respectively in Figure 3.

Figures 6, 7, 8 and 9 are fragmentary views (similar to Figure 4) showing slightly modified arrangements.

Figures 10 and 11 are incomplete sectional elevations showing methods of joining between deck panel components.

Figures 12 and 13 are fragmentary views (similar to Figure 4) showing slightly modified arrangements.

As previously stated herein, a restraining wall decking requires to be supported uprightly by a buttress assembly. The term "uprightly" is not used herein in the limited sense of indicating vertically upright disposition of the decking, because deckings according hereto may be disposed with the deck face making an angle with the horizontal of from 90° down to about 45° or even less. Thus the term "uprightly" is used herein as indicating a deck face having a substantial inclination from the horizontal, or in other words, a wall face whereof the angular disposition includes a vertically upright component relative to horizontal.

An essentiality in the erection or installation of a decking according hereto is the provision of a buttress assembly to provide the necessary backing or support for the decking. The buttress assembly may be of known and conventional form or design; for example, it may consist of a plurality of buttress members each built as a structural steel truss, or of a plurality of solid concrete buttress members; or merely of a hilled

up mass of rock, earth or the like as shown in Figure 1A.

In Figures 1 and 2 to 5 there is shown one simple form of built-up buttress assembly. This assembly consists of a plurality of buttress members each being a roughly triangular frame composed of bearers 11, struts 12, ties 13 and stays 14. The buttress members are conventionally adapted for stationary erection on the site. In the illustrated arrangement, the lower ends of the bearers 11 are simply deeply embedded in the earth and the lower ends of the struts 12 are embedded or socketed in a concrete base member 15. It will be appreciated that the constructional details of the deck supporting buttress assembly may be varied considerably (according to requirements of the site and the nature of structural materials readily available in the site vicinity), provided it consists of a stationary structure having a frontal bearer face, such as that constituted by the bearers 11, against which the bolsters forming part of the decking structure may rest uprightly and without restraint against lateral movability relative to the buttress assembly. The illustrated forms of buttress assemblies are suitable for small scale dams in which timber logs or rock or earth filling are readily available in the site vicinity. The Figure 1 buttress assembly is also a type which, once the several members have been shaped and drilled or otherwise conditioned, may be readily erected on the site by bolting or other clamping together of the various parts.

The several buttress members are preferably cross-tied by brace members such as 16. The bearer faces of the buttress members constitute a seating for bolsters 17. These bolsters are not fixed in any way to the buttress members and, therefore, are capable of lateral movement relative thereto. The bolsters constitute seatings for the side or longitudinal edge portions of decking panels indicated generally by 18. Each panel may consist of a single slab or sheet or of a plurality of slab elements 19 which are assembled together to constitute a panel with their meeting ends sealed with concrete, bitumen or other sealing material. One form in which these ends may be sealed is shown in Figure 10. Referring to that figure, the upper end of each element 19 is formed as a channel socket by provision of walls 20 and 21. The lower end of each element 19 has a tongue 22 able to enter the channel socket and leave space 23 within which sealing, packing or caulking material may be placed by pouring, tamping or the like. If the sealing medium is of compressible or plastic nature it may be compressed or squeezed tightly into the joint by means of cover plates 24 and bolts and nuts 25. Where a panel such as 18 is made up of elements such as 19 the edge portions are of course applied to the engaging joint portions after assembly thereof in order to make the side portions continuous from top to bottom of the panel.

The adjacent longitudinal edge portions of side beads 26 of each neighbouring pair of panels preferably abut one against the other as shown at 27 in Figure 5, thus ensuring that all lateral forces are transmitted from panel to panel. The lateral movability of the bolsters 17 relative to the bearers 11 ensures that the only forces imposed on the buttress assembly are directed thereon truly normal to the bearer surfaces thereof.

The surfaces meeting at 27 are preferably rounded, as shown, in order that good rolling contact may be established notwithstanding slight misalignment of the buttress members. At

the points of contact the edge portions may be reinforced with metal or otherwise to meet the stress concentration at that point. The bolsters 17 may be provided with cradle grooves 28 for the reception of the side beads 26. Said bolsters may be made (for example) of timber, reinforced concrete or metal.

Means for sealing the side portions of the panels may take various forms. For preference these means consist, or primarily consist in providing the beads 26 with stepped portions as at 29 so as to provide a packing space 30. Space 30 may be filled or tamped with any conventional packing or sealing material but preferably it is provided with a grummet 31 which extends for the full length of the panel side joint. The grummet may be made of rubber or other sealing medium and it incorporates a rod 32 which extends throughout the length of the grummet. The rod 32 has a plurality of studs 33 fixed thereto. These extend through slots in the bead sides and holes in the bolster 17. The studs 33 are furnished with nuts whereby the grummet may be pressed against the steps 29, and/or the step side surfaces which partly define the space 30. The sealing assemblies are preferably protected by cover plates 34 held on seatings 35 formed on or as part of the beads 26 by means of bolts 36. The plates 34 are bedded on the seatings by way of gasket strips 37 and bolt pressure is spread along the plates by inflexible clamping strips 38. The cover plates 34 have one or more longitudinal corrugations such as 39 or other provision therein to provide for lateral flexibility.

The joint shown in Figure 6 is substantially the same as that shown in Figures 4 and 5 with the exception that a rod such as 32 (Figures 4 and 5) is replaced by a tube 40 having feed-holes 41 therein. With this arrangement the space 30A may be tightly packed with hemp or the like and then permeated (or from time to time re-permeated) with tar, pitch, bitumen, tallow, grease or other fluid or semifluid imperviating material fed thereto under pressure through the tube 40 and holes 41. To facilitate this feeding the upper end of the tube 40 may be fashioned as a nipple or union, with or without a non-return valve therein, to which a "grease-gun" or other force feed device may be applied.

The panels, or the constituent sections or elements 19 thereof, illustrated by Figures 1 to 6, are made of concrete preferably reinforced in conventional manner. The panels or elements may, however, consist of plain or corrugated or fluted metal plates 42 (Figure 7) having their side edges embedded in side beads 43. Figure 7 also illustrates a slightly modified bolster 44 from which cradle grooves (such as 23—Figure 4) have been omitted; the joint bolts 46 being relied on to maintain required disposition of the beads 43 in relation to the bolster 44. Loose bolts 52 may be provided to hold the panels together. The grummet rod 45 (which may be a solid rod such as 32 in Figure 4, a holed tube such as 40 in Figure 6, or a plain tube as shown) has the joint bolts 46 and additional bolts 47 anchored thereto. These bolts may be anchored to the rod 45 by being welded thereto, or if said rod is tubular it may be furnished with key-hole slots which enable the bolt heads to be entered therinto. In this arrangement the grummet 37A is adapted to seat against the side surfaces 48 which partly define the space 36A. The additional bolts 47 carry clamping strips 49 whereby additional spreading load is applied to the grummet 37A.

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Panels such as 42 may be made from single sheets of plate metal or they may be made from a plurality of sheet elements. If a plurality of elements are employed they may be joined together by welding or otherwise. For example, they may be joined as shown in Figure 10, in which two elements 19A are lapped and bolted together with a gasket 50 therebetween. Where a panel such as 42 is made up of elements such as 19A, the beads 43 are, of course, applied to the lapping joint portions after assembly thereof, in order to make the beads continuous from bottom to top of the panel.

Figure 8 illustrates slightly modified means for sealing and abutting side edges of a pair of panels. This construction, to some extent, incorporates features of the two forms shown in Figures 4 and 7, in that it includes a bolster 44A which is similar to that numbered 44 in Figure 7 but has shallow cradle grooves 28A therein. Again, the grummet type sealing devices 51 are substantially similar to those shown in Figure 7, with the main exception that the grummet is in two strips 53 held in shoes 54 mounted on a grummet rod 45A furnished with joint bolts 46A. The shoes 54 may be of channel cross-sectional shape as shown, or they may be of semi-circular or other cross-sectional shape. The pull of the joint bolts 46A is preferably resiliently applied through springs such as 55.

Figure 9 shows a modification of the grummet type sealing devices. These are substantially the same as those shown in Figure 8 in comprising two grummet strips 53A, shoes 54A and a grummet rod 45B. The rod 45B in this arrangement is loaded by compression spring 55A bearing against a bridge plate 56, and is capable of load adjustment by operation of loading bolt 57 threaded in the bridge plate 56 which is free to move in holes 58 in side portions 26A. This arrangement is particularly useful where it is required to set or adjust the grummet loading from the front of the restraining wall instead of from the back as is necessary with the arrangement shown in Figure 8.

It will be appreciated that by the use of cradle grooves in the bolsters it is not essential for the panel beads to abut one against the other, as, with such grooves present, panel side thrusts may be transmitted from one panel to another per medium of the grooved bolster. The width of the bolster may in fact be made as wide as required for stability of the buttress assembly as shown in Figure 12, where a bolster 59 laterally movable relative to a buttress assembly (60) accommodates the adjacent side portions 61 in a pair of cradle grooves 62, and sealing of portions 61 is effected as indicated (for example) at 63.

Although the panels may be flat between the side beads thereof, the concrete panels are preferably arched or convex in the direction of load pressure as shown in Figures 1 to 6 and 8 of the drawings, and the plate panels are preferably similarly arched or convex, as well as preferably being corrugated as shown in Figures 7 and 10. For circular reservoirs the panels may be concave in the direction of load pressure as indicated at 64 in Figure 13, thus causing them to be in tension. With this arrangement a buttress assembly as previously described herein may be employed to support the bolsters (65). Alternatively the bolsters 65 may be extended upwardly beyond the tops of the panels, and the buttress assembly therefor may then consist of radial tie rods connected to a post in the centre of the reservoir, and

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to the bolster extensions. Again, diametrical tie rods extending between diametrically opposite bolsters may be employed.

It will be understood that the illustrated embodiments of the invention are primarily directed to a dam construction. However, the invention is generally applicable for use in restraining wall construction, for example, the panels may be stood vertically upright (instead of inclined as shown) for the building of a cylindrical or rectangular silo or water holding vessel. Again, the wall panels may be wedge shaped to enable conical retaining walls to be built therewith.

What I claim is:

1. A restraining wall comprising a plurality of bolsters, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having side portions rollably seated upon said bolsters, and resilient means for sealing the adjacent side portions of each neighbouring pair of said panels.

2. A restraining wall comprising a plurality of bolsters, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having side portions rollably seated upon said bolsters with the adjacent side portions of each neighbouring pair of side panels in abutment, and resilient means for sealing said abutting side portions.

3. A restraining wall comprising a plurality of bolsters having cradle grooves formed therein, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having rounded side beads rollably seated in said cradle grooves, and resilient means for sealing the adjacent side portions of each neighbouring pair of said panels.

4. A restraining wall comprising a plurality of bolsters having cradle grooves formed therein, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having rounded side beads rollably seated in said cradle grooves with the adjacent side beads of each neighbouring pair of said panels in abutment, and resilient means for sealing said abutting side portions.

5. A restraining wall comprising a plurality of bolsters, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having side beads rollably seated upon said bolsters and having longitudinal steps in said beads to form packing spaces between said beads, and grummet sealing means in said packing spaces.

6. A restraining wall comprising a plurality of bolsters, a buttress assembly for supporting said bolsters uprightly and without restraint against lateral movability thereof, a plurality of inflexible panels having side beads rollably seated upon said bolsters, seatings formed on said beads, flexible cover plates which rest on neighbouring pairs of said seatings, means for liquid-tightly clamping said cover plates on said neighbouring seatings, steps in said beads to form packing spaces therein, and grummet sealing means disposed in said packing spaces.

7. A restraining wall according to claim 3 wherein said panels have said beads moulded integrally therewith.

8. A restraining wall according to claim 3

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wherein said panels consist of plates having their side edges embedded in said beads.

9. A restraining wall according to claim 1 wherein each of said panels consists of a plurality of elements and means for sealing the meeting ends of said elements.

10. A restraining wall according to claim 1 wherein each of said panels consists of a plurality of elements and means for sealing the meeting ends of said elements comprising channel sockets on the upper ends of said elements and tongues on the lower ends of said elements.

11. A restraining wall according to claim 3 wherein each of said panels consists of a plurality of plate elements having their side edges embedded in said beads and means for sealing the meeting ends of said elements comprising overlapping portions of said elements and devices for clamping said overlapping portions together with a gasket therebetween.

12. A restraining wall according to claim 5 wherein said grummet sealing means each comprise a grummet and means for compressing said grummet within its said packing space.

13. A restraining wall according to claim 5 wherein said grummet sealing means each comprise a grummet and means for compressing it within its said packing space comprising a pair of grummet strips, shoes to hold said strips, a grummet rod whereon said shoes are mounted,

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joint bolts which pass through said grummet rod and said bolster and springs which resiliently bear on said grummet rod sleeved on said joint bolts.

14. A decking according to claim 5 wherein said grummet sealing means each comprise a grummet and means for compressing it within its said packing space comprising a pair of grummet strips, shoes to hold said strips, a grummet rod whereon said shoes are mounted, compression springs able to bear against said grummet rod, loading bolts for said springs and bridge plates for supporting said loading bolts in relation to said panel beads.

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