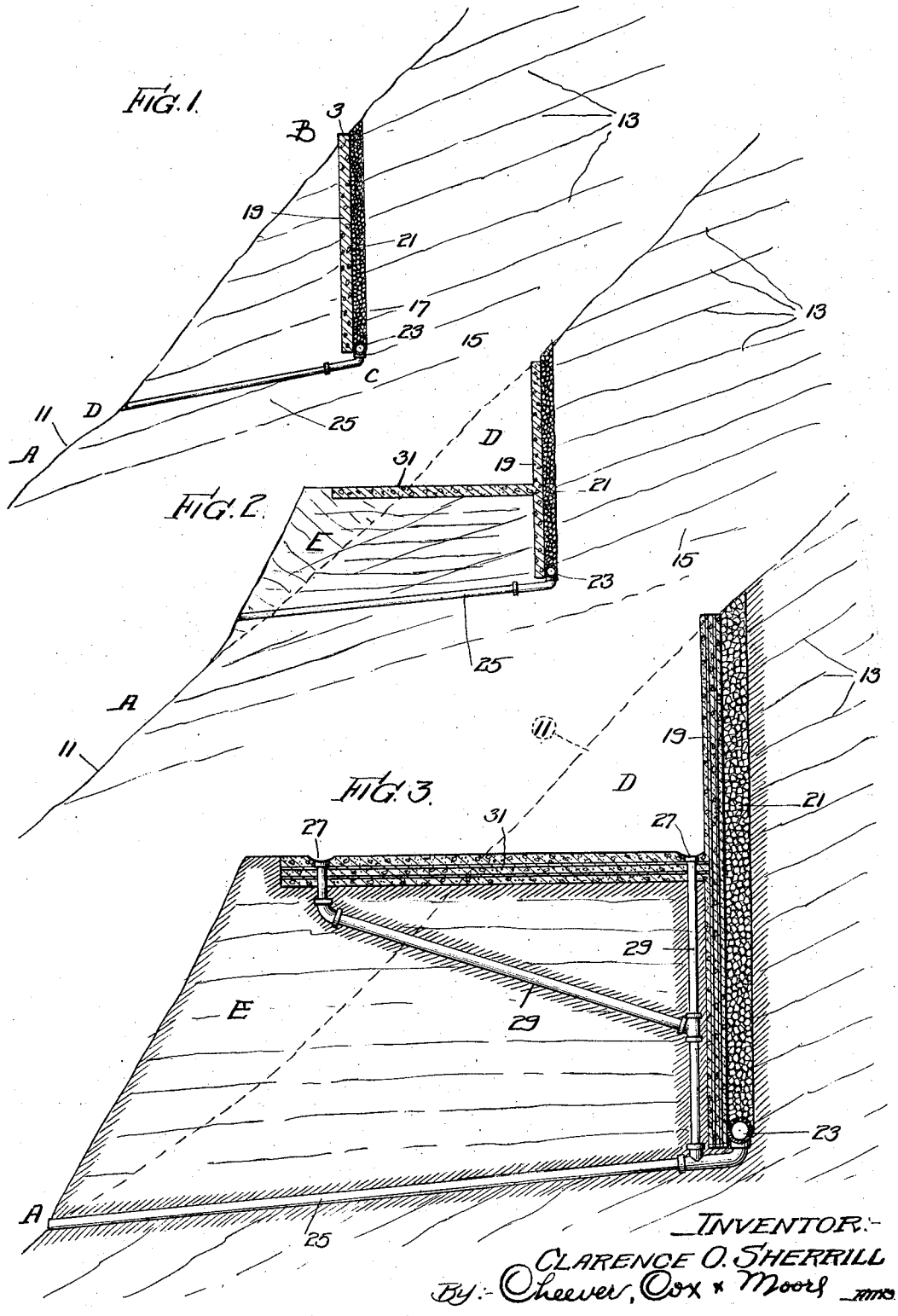
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EARTHWORK AND METHOD OF MAKING SAME

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EARTHWORK AND METHOD OF MAKING SAME

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My invention relates in general to earthworks and has more particular reference to a method and construction for controlling and preventing landslides, that is to say the downward movement of surface earth on side hills and similar locations where earthslides are apt to occur.

Dangerous and expensive slides may occur where earthy matter is piled up steeply enough to exceed the normal sliding angle of the piled material and sliding may occur on artificial embankments, or in naturally sloping terrain where the natural plane of sliding earth is exceeded.

Great difficulty is sometimes encountered in preventing land and earthslides of this general character and more particularly in places where the sub-soil and surface dirt of the slope is water logged as by springs and other sub-surface water.

Enormous expense is frequently required to excavate buried structures or to prop up or remove the sliding earth and an important object of my present invention is to employ a simple and relatively inexpensive, yet novel method and means to control and substantially prevent slides of this character and hence to avoid the concomitant expense and economic waste of uncontrolled landslides.

My present invention contemplates both the novel method of controlling landslides and the means for accomplishing the method and includes, as a part of the invention, a novel method of making earthworks in side hills and other sloping places to provide a horizontal surface in which superstructures such as roads, railroads, buildings, canals, etc., may be founded, and my invention also contemplates the resulting earthwork construction.

Other and important objects of the invention include the incorporation of a cantilever principle in building and bracing a road embankment; the employment of the roadbed itself as bracing means for the slide preventing construction; the provision of a dry earth prism at the upper edge of a steep slope in order to prevent the surface from sliding down the slope and numerous other objects all of which will become apparent as the invention is more fully understood from the following description which, taken in connection with the accompanying drawing discloses a preferred form of earthwork embodying my invention.

Referring to the drawing:

Figure 1 is a section through a side hill showing an earthwork construction embodying my invention at B for preventing landslides in the region A—A.

Figure 2 illustrates a further development of the invention wherein the construction is expanded to provide for a roadbed and embankment; and

Figure 3 is an enlarged view showing a refined modification and improvements in the construction shown in Figure 2.

To illustrate my invention I have shown in the drawing in Figure 1 a section through a side hill the surface of which is indicated by the sloping line 11.

The land forming the hill is usually stratified and exists in layers defined by lines of cleavage 13. Any water occurring in the hillside will gradually trickle through the layers, following the planes of cleavage to some extent, until a layer of hard pan 15 is reached. The layer 15 being relatively impervious to moisture, the water will accumulate and trickle down the upper surface of the hard layer 15.

Should the slope of the hillside 11 become steep enough as at A—A to create a potential landslide, I have found that the slide may be prevented by forming a trench 17 along the brow of the hill as at B above the region in which the slide is expected to occur. This trench is deep enough to intercept a substantial number of the planes of cleavage 13 and to isolate prism B—C—D from which the seepage of surface water is cut off. The trench is preferably made deep enough to extend to a layer of hard pan 15.

The invention therefore consists in creating a substantially dry prism of earth where the landslide is expected to occur by draining the surface and sub-surface moisture from the prism. I have found that such a dry isolated prism of earth will support a much larger quantity of the same material even when the protected portion is saturated with

water. The dry portion virtually forms a retaining wall which will not only support the hillside above the prism and so will prevent landslides from starting but also may be utilized for the purpose of supporting structures such as roads, railroads, buildings, etc., on the prism.

By employing the word "prism" in the present description and in the claims hereafter appended, I, of course, do not intend to limit my invention to a crystallographic definition of the word. The earth prism of my invention is merely an elongated column of earth lying in the hillside and of roughly prismatic shape. The earth column preferably has a substantially uniform cross sectional configuration but the cross sectional area of the prism is not necessarily uniform throughout its length, nor do the sides of the prism necessarily comprise flat unwarped planes as is the case in crystallographic prisms.

An impervious wall 19, preferably of reenforced concrete is built in the forward portions of the trench 17. The remaining rearmost portions of the trench are preferably filled up with porous material 21 such as coke, gravel, cinders, or even large stones or boulders. In fact, any filler material of porous nature through which the water, backed up by the wall 19, may flow, can be used. The wall 19 is of minimum thickness since its principal function is to divert the water and is not particularly for the purpose of supporting the hillside above the wall and since the wall 19 is relatively thin, it is extremely cheap to build and this is one of the principal advantages of my present invention wherein landslides and the like may be prevented without greater expense. It will be apparent that the water from the upper hillside which is diverted by the retaining wall 19 will accumulate in the bottom of the trench 17, and I prefer to arrange a conduit or drain 23 in the bottom of the trench 17, said conduit being provided with leaders 25 comprising pipes extending at spaced intervals in the conduit 23 to a point in the lower hillside substantially below the dry prism B—C—D for the purpose of draining off the accumulated moisture.

If it is desired to build a road or other structure on the dry prism, the earth D along the upper edge of the wall 19 may be excavated and filled in as at E to provide a horizontal surface on which the desired construction may be erected. If a building is to be constructed, the foundations may be set in the substantially dry earth of the prism isolated by the retaining wall 19. If a railroad is to be constructed, the ballast may be laid directly on the flattened surface provided, or the flat surface may be used as a road without further treatment, since the only moisture which can come to the isolated prism is the natural atmospheric moisture which is deposited from time to time, such as rain, snow or the like, and such deposits will not be sufficient to saturate the prism but will run off the surfaces of the prism.

In regions where the rainfall is excessive, however, it may be desirable to waterproof the upper horizontal surface of the prism, provide it with a slight camber and provide ditches 27 along the sides of the horizontal road bed, said ditches being provided at intervals with drain connections 29 leading into the main drains 25, which carry off the moisture from the bottom of the trench 17.

I find it desirable also to provide the upper horizontal surface of the dry prism with a layer of re-enforced concrete 31, said concrete extending outwardly adjacent the edge of the horizontal road bed and being formed at its inner edge integrally with the re-enforced concrete wall 19 so that the concrete strip 31 and the wall 19 comprise a monolithic structure. In this way the pressure on the upper portions of the retaining wall 19 above the concrete layer 31 which, since the earth at D has been removed to create the upper horizontal surface in the prism is now carried entirely by the relatively weak wall, is carried in part by the cantilever action of the cement layer 31. If the weight of the earth behind the wall 19 tends to rotate the wall forwardly about its low end as a pivot point, this tendency will be resisted by the upward pressure of the dry isolated prism exerted beneath the lower surface of the layer 31. In this way the retaining wall 19 may be supported firmly in place by the cantilever action of the horizontal monolithic portion 31, even when the earth at D behind the upper portions of the wall has been removed, as aforesaid.

My invention thus consists in isolating a prism of earth by collecting the water with which it would otherwise be saturated in the bottom of a trench by forming an impervious sheet or wall in the trench, so that the water is directed downwardly and in carrying off the water through suitable drains so that the prism of earth so isolated will gradually dry out to the desired depth and cross section. When the earth is thoroughly dry, it will have enough frictional resistance to lateral pressure from the upper hillside to prevent any movement as heretofore described. The result of this collection of moisture is to decrease the pressure that would otherwise be brought against the prism from the saturated hillside through hydrostatic pressure.

The drying out process is still further assisted when the upper surface of the prism is provided with means for preventing penetration of rainfall as by the formation of the layer 31. The layer 31 of course may be formed of any suitable material such as bitumen, tar or other form of waterproofing ma-

terial for the purpose of preserving the frictional resistance of the earth forming the prism, in order to accomplish the purpose of the invention. However, as aforesaid, I prefer to form the layer 31 of concrete and to form said layer integrally with the wall 19, in order to provide the cantilever means for assisting the wall 19 to maintain its vertical position. The function of the wall 19 is not to withstand or resist the pressure of the upper hillside, since this would require a massive expensive wall not contemplated in this invention, but the wall is primarily to cut off the flow of water from the prism and to transmit the pressure of the upper hillside uniformly to the prism, the prism itself acting as a retaining wall for the upper hillside, and also as a support for itself and for the structures which may be built thereon.

After the prism shall have been thoroughly dried, it is possible to excavate, at its foot A at a much steeper slope than before the application of the invention, the provision of the dried prism not only retaining the hillside above the structure, but also substantially preventing landslides in the lower hillside.

It is thought that the invention and its numerous attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction and arrangement of the various parts without departing from the spirit or scope of my invention or sacrificing any of its attendant advantages.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. Earthwork construction for preventing landslides and the like comprising a trench formed in the hillside to isolate a prism of earth in front of the trench and means in the trench for preventing moisture from the upper hillside from saturating the isolated prism, said means including a wall substantially impervious to moisture for the purpose of backing up sub-surface moisture and directing same to the bottom of the trench, and means in said trench for carrying off the accumulated water therein.

2. Earthwork construction for preventing landslides and the like comprising a trench formed in the hillside to isolate a prism of earth in front of the trench, a substantially impervious wall formed in the front portions of the trench, the rearward portions of the trench behind said wall being filled with porous material, whereby the wall will imbed the flow of water from the upper hillside and the porous filler will permit said imbedded water to flow to the bottom of the trench and a drain for removing the accumulated water from the trench.

3. Earthwork construction for preventing landslides and the like comprising a trench formed in the hillside to isolate a prism of earth in front of the trench, a relatively thin substantially water tight concrete wall in the forward portions of said trench, the rearward portions of the trench behind said wall being filled with porous material, whereby the wall will impede the flow of water from the upper hillside and the porous filler will permit said impeded water to gravitate to the bottom of the trench, a drain extending in the bottom of said trench and conduits connecting said drain at spaced points therein for drawing off the water.

4. Earthwork construction for preventing landslides and the like comprising a substantially vertical wall built in the hillside and comprising a forward impervious and a rearward layer of porous material, whereby water percolating from the upper hillside will be backed up by the impervious wall and permitted to gravitate downwardly through the pervious layer and to escape beneath the lower edge of the wall, whereby a substantially dry prism of earth in front of said wall may be created for the purpose of preventing earth slides.

5. Earthwork construction for preventing landslides and the like comprising a substantially vertical wall built in the hillside and comprising a forward impervious and a rearward layer of porous material whereby water percolating from the upper hillside will be backed up by the impervious wall and permitted to gravitate downwardly through the pervious layer, means at the lower end of the pervious layer for drawing off the accumulated water, whereby a substantially dry prism of earth in front of said wall may be created for the purpose of preventing earth slides.

6. Earthwork construction for hillsides and the like comprising a vertical wall formed in the hillside and extending downwardly to a substantial depth whereby to isolate a prism of earth in the hillside in front of the wall, the front portions of said wall being formed of substantially impervious material and the rearmost portions of said wall being formed of porous material whereby moisture from the upper hillside may be directed to the lower end of said wall without penetrating the isolated prism of earth in front of the wall, means to drain off the accumulated moisture at the lower end of the wall, said prism of earth in front of the wall being cut and filled to form a substantially horizontal surface on which superstructures may be erected.

7. Earthwork constructions for hillsides and the like comprising a vertical wall formed in the hillside and extending downwardly to a substantial depth whereby to isolate a prism of earth in the hillside in front of the wall, the front portions of said wall being formed of substantially impervious material and the rearmost portions of said wall being formed of porous material whereby moisture

from the upper hillside may be directed to the lower end of said wall without penetrating the isolated prism of earth in front of the wall, means to drain off the accumulated moisture at the lower end of the wall, said prism of earth in front of the wall being cut and filled to form a substantially horizontal surface, means forming a waterproof layer in said horizontal surface whereby to protect the isolated prism from atmospheric moisture.

8. Earthwork construction for hillsides and the like comprising a vertical wall formed in the hillside and extending downwardly to a substantial depth whereby to isolate a prism of earth in the hillside in front of the wall, the front portions of said wall being formed of substantially impervious material and the rearmost portions of said wall being formed of porous material whereby moisture from the upper hillside may be directed to the lower end of said wall without penetrating the isolated prism of earth in front of the wall, means to drain off the accumulated moisture at the lower end of the wall, said prism of earth in front of the wall being cut and filled to form a substantially horizontal surface, said horizontal surface being slightly cambered and provided with drains for carrying off atmospheric moisture which may be deposited on said surface.

9. Earthwork construction for hillsides and the like comprising a vertical wall formed in the hillside and extending downwardly to a substantial depth whereby to isolate a prism of earth in the hillside in front of the wall, said wall comprising a vertical layer of concrete, said prism of earth in front of the wall being cut and filled to form a substantial horizontal upper surface, a concrete layer formed in said upper surface and along one edge integrally with the vertical wall whereby to form a monolithic structure, wherein the horizontal layer acts as a cantilever brace to retain the vertical portion of the structure in position to brace the upper hillside behind the wall.

10. Earthwork construction for hillsides and the like comprising a vertical wall formed in the hillside and extending downwardly to a substantial depth whereby to isolate a prism of earth in the hillside in front of the wall, said wall comprising an impervious layer to cut off the percolation of water into the prism from the upper hillside, said prism of earth in front of the wall being cut and filled to form a substantial horizontal upper surface, a waterproof layer formed in said upper surface and means to drain the upper surface to prevent surface water from soaking into the prism.

11. Earthwork construction for preventing hillside landslides comprising a moisture-proof diaphragm extending longitudinally in the hillside and in a substantially vertical plane in order to isolate an earth prism on the lower side of the diaphragm against the inseepage of water from the upper hillside, and drain means at the foot of the diaphragm for discharging moisture collected at the base of the diaphragm upon the surface of the hillside substantially below the earth prism isolated by the diaphragm.

12. Earthwork construction for preventing hillside landslides comprising a substantially moisture-proof sheathing formed longitudinally in the hillside and extending to a substantial depth therein to screen a prism of earth on the lower side of the sheathing against the inseepage of moisture from the hillside above the sheathing, and means to drain the moisture collected at the lower end of the sheathing and discharge it at a point remote from the screened prism.

13. Earthwork construction for preventing hillside landslides comprising means forming a substantially moisture-proof diaphragm extending longitudinally in the hillside to screen a prism of earth below the diaphragm against the inseepage of moisture from the hillside above the diaphragm, and means to drain off the moisture collecting at said diaphragm and discharge it below the prism.

14. The method of preventing hillside landslides, which consists in isolating the hillside, where the landslide threatens to occur, against the inseepage of moisture from the upper hillside by means of a substantially vertical diaphragm placed longitudinally in the hillside and draining the said diverted moisture and discharging it at a point remote from where the side threatens.

15. The method of preventing hillside landslides, which consists in screening the hillside, where the slide threatens, against the inseepage of moisture from the upper hillside and draining off the moisture which is accumulated as a result of the screening operation and discharging it at a point substantially below the point where the slide threatens.

16. The method of preventing hillside landslides, which consists in screening the hillside, where the slide threatens, against the inseepage of moisture from the upper hillside and draining off the moisture which is accumulated as a result of the screening operation and discharging it at a remote point from which it cannot find its way into the screened hillside portion.

In witness whereof, I have hereunto subscribed my name.

CLARENCE O. SHERRILL.