

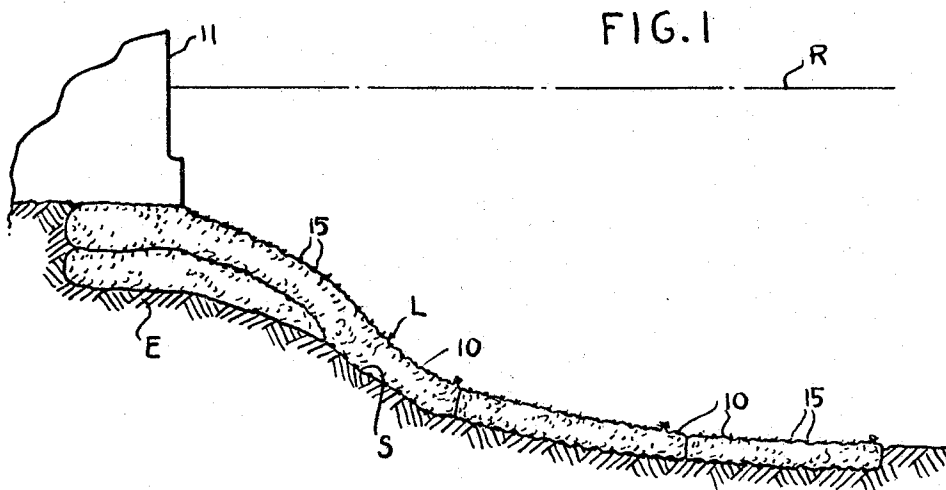
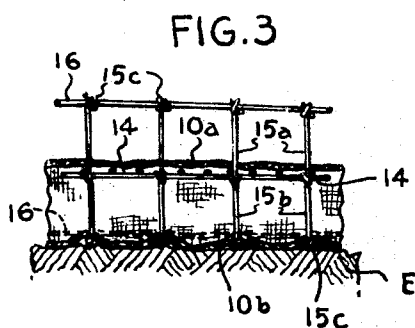
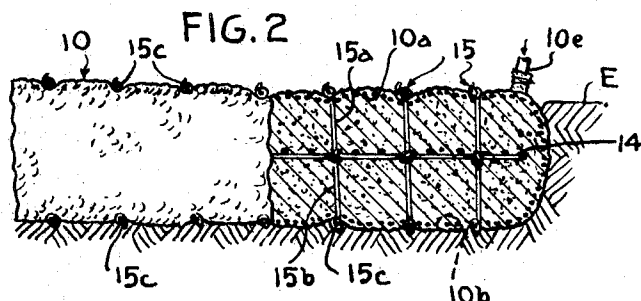
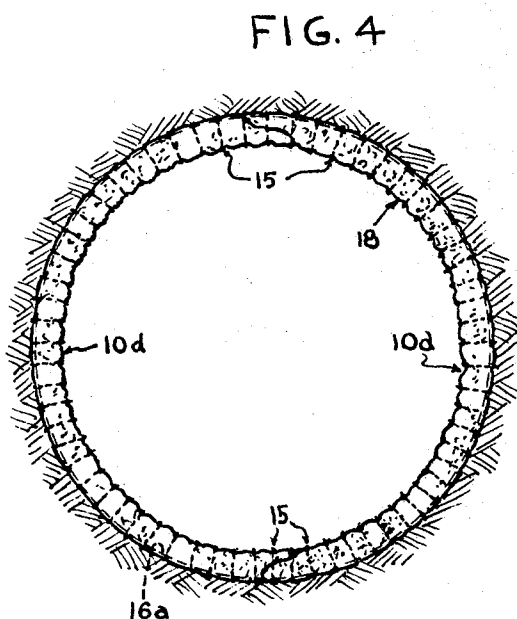
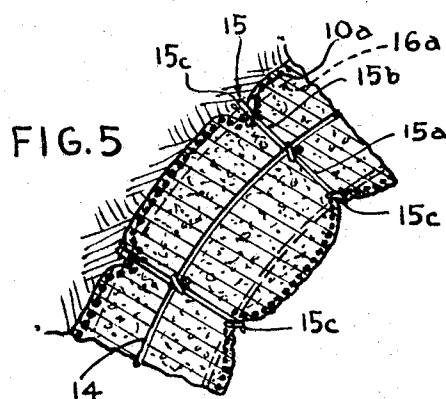
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METHOD OF PROTECTING AREAS OF AN EARTH SITUS AGAINST SCOUR

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1

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METHOD OF PROTECTING AREAS OF AN EARTH SITUS AGAINST SCOUR

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5 Claims

ABSTRACT OF THE DISCLOSURE

Method of protecting a scoured area of an earth situs by injection of pressurized liquid grout into a flexible fabric bag laid flatwise over said area, to expand opposing walls of the bag while simultaneously limiting expansion beyond a predetermined thickness of the bag. When the grout hardens, the bag has predetermined volumetric shape as well as thickness.

BACKGROUND OF INVENTION

This invention relates to grouting and concreting, and in particular relates to an improved method and means for protecting or lining areas of an earth situs by means of porous bag means filled with a hardenable grout liquid at the situs.

In the past, the prior art has disclosed various means for applying protective liners or blankets over scoured areas along canal or river banks, and likewise various means have been provided for forming the same into retaining walls of various shapes and configurations. These prior art methods, however, have not been entirely satisfactory because they were either uneconomical for practical purposes, or provided no means for accurately controlling the thickness of the grout-filled liners or retaining walls, especially where walls were required to be of shapes other than flat, such as tubular.

SUMMARY

In accordance with the present invention, flexible-walled bag means in unexpanded condition is positioned at or on the surface area of the situs, for example, and is injected with self-hardenable concreting material, such as hydraulic cement grout under pressure to expand the bag means while opposing walls of the same are predeterminedly restrained against expansion beyond predetermined variable thickness or thicknesses. By this means, the shape of the bag means can be controlled so that it will have predetermined thickness, shape, and form upon hardening of the grout.

One object of the invention is to provide an improved means for installing protective bag means of various controlled shapes and predetermined wall thicknesses in situ, without necessarily using a special sheet piling, rigid sheeting, or other temporary or permanent retaining means.

Other objects of the invention will be manifest from the following brief description and the accompanying drawings.

Of the accompanying drawings:

FIG. 1 is a vertical cross-section of a sloping bank of a river or waterway, illustrating a protective lining made by the method of the invention to protect the earth situs against scour, and to reinforce and support a bridge upright which has been damaged by scour.

FIG. 2 is an enlarged fragmentary cross-section, partly broken away, illustrating the internal construction of the completed protective lining of FIG. 1.

FIG. 3 is a fragmentary cross-section taken on the line 3—3 of FIG. 2, but illustrating the collapsed condi-

2

tion of bag means and restraining means for the same during an initial stage of the method.

FIG. 4 is a vertical cross-section illustrating an installation of the improved liner means to line a sewer or like tunnel bore in an earth situs.

FIG. 5 is an enlarged fragmentary view of a portion of FIG. 4, partly broken and in section.

Referring to FIGS. 1 and 2, there is illustrated an installation of a protective liner or sheeting L at the foot of a bridge upright 11 over river R designed to prevent scouring or erosion which may cause severe damage to the bridge. The liner L may include one or a plurality of generally flat, rectangular bags 10, 10 laid flatwise on a sloping area of an earth situs, surrounding the base of the bridge upright. Each bag may be of porous fabric, such as burlap, containing hardened concrete 12, some of which has to a relatively small extent extruded through the pores of the bag to form a thin layer of concrete on the outside of the bag walls for bonding extension into pores, crevices, and voids in the earth of the situs contacted by the liner. Where a plurality of bags 10 are used they may be laid in edge-to-edge relationship to be bonded together by oozed-out, hardened grout.

In supplying grout under pressure to fill closed bags 10, the bag walls tend to be expanded with equal pressure in all directions and, therefore, tend to balloon out non-uniformly under certain conditions. Such expansion may be controlled to maintain the bags 10 in substantially flat, uniformly thick condition, by use of the following method of lining the slope S:

Each bag 10 may be laid flatwise on the earth surface, preferably after smoothing the same over as much as possible with a sheet of heavy gauge wire, square-mesh screen material 14 interposed between the upper and lower walls of the bag, inserted through suitable opening means (not shown). Before the bag is sewn closed with a conduit 10e from a source of pressurized, hydraulic cement grout, connected to the interior thereof, a plurality of suitably spaced and positioned tie-wires 15, 15 are looped, twisted or otherwise anchored, intermediate opposite ends thereof, to crossed wire portions of the screen 14 to have opposite extensions 15a and 15b of the tie-wires extended through the top and bottom walls 10a and 10b of the bag, respectively, as shown in FIGS. 2 and 3.

While the bag 10 is still retained in collapsed condition, outer portions of the tie-wire extensions 15a, 15b may be looped, twisted or otherwise anchored, as indicated at 15c, 15c to rigid metal bars or wires 16, 16 serving as stop elements outside of the bag walls to be at predetermined spacing from each other and from the internal mesh wire screen 14, somewhat as shown in FIG. 3. Some or all of the stop elements 16 may be elongated to extend through series of loops or twisted portions 15c in a plurality of tie-wire extensions 15a, 15b. The stop elements 16, however, may be incorporated in wire mesh screen material similar to screen 14. It is readily apparent from the foregoing that various operations and adjustments are necessarily performed within bag 10 prior to sewing the opening means therein closed.

Upon closing the bag 10, as by sewing shut the opening means, such as an open end in the bag, with wire or heavy cord, in known manner, pressurized hydraulic cement grout is pumped or injected into the bag to expand and fill the same with the grout. Expansion is allowed to continue until the spacing of said top and bottom walls of the closed bag is limited by stop engagement thereof with the respective stop elements 16, as from the relative relationship shown in FIG. 3 to the fully expanded bag conditions shown in FIGS. 1 and 2.

When the bag 10 is fully expanded, as shown in FIGS. 1 and 2, injection of pressurized grout may be continued until a relatively small fraction of the volume of grout

within the bag oozes through the pores of the same to form an outer coating 17 of grout on the bag. Portions of the coating 17 extend into pores, voids, and crevices in the earth situs, whereby upon subsequent hardening of the grout, the bag is bonded anchoringly to the situs.

As the proportionate lengths of the tie-wire extensions 15a, 15b may be easily adjusted at the situs, allowances can be made for expansion of the bag into larger pockets or irregularities in the earth situs, or otherwise to control the expansion of the bag means 10, and thereby to provide the same with requisitely uniform contour and thickness.

FIG. 4 illustrates a vertical cross-section through a horizontal bore in an earth situs, wherein the above-described method is utilized to provide a tubular concrete liner 18, or segment, composed of connecting liner bags 10d, 10d. As best shown in FIG. 5, however, the bag means 10a may best be maintained in tubular shape by providing longitudinally spaced, circular anchoring rings 16a, 16a of rigid metal around the tubularly arranged bags next to the earth situs. The rings 16a, however, may be included within a self-supportingly rigid wire mesh form. With such an arrangement, the tie-wires 15 can readily be adjusted, as before, to hold the inner walls of the bag means properly spaced with reference to the outer walls of the bags during the grout injecting and hardening cycles of the method.

The method described provides an effective, economical way to protect an earth surface above or below the water line against scouring or erosion, or to provide a strong durable lining for waterways, underground conduits, and the like.

Modifications of the invention may be resorted to without departing from the spirit thereof or the scope of the appended claims.

What is claimed is:

1. A method as for covering a surface area of an earth situs with concrete lining for protecting or containing the same, comprising: mounting a flexible-walled bag means of broad lateral area in unexpanded condition against a corresponding broad lateral extent of a said surface area of the situs to have inner and outer flexible walls of the bag means in separably superposed relation over said surface area extent, with a multiplicity of tension-resistant tie-elements discretely disposed throughout said broad lateral area of the unexpanded bag means and each arranged between freely separable said superposed portions of the bag walls and connected to the respective said inner and outer walls; injecting flowable cement grout into said bag means under pressure to expand the bag means, including the separable said superposed portions, and thereby form a protective concrete liner of predetermined substantially uniform, but variable overall thickness thereof against said surface area, determined by restraint of said separable superposed wall portions against stop portions provided on the respective tie-elements; and permitting said flowable grout of the formed protective concrete liner to solidify within the expanded bag means.

2. A method as in claim 1, wherein said bag means is generally porous-walled, and said grout is injected under pressure until a small fraction of the flowable grout oozes

through the pores of the porous walls to solidify in contact with the contacted said surface areas.

3. A method of lining surface areas of an earth situs with concrete sheet piling for protecting or containing the same, comprising: mounting flexible-walled bag means in unexpanded condition upon the surface area to have flexible top and bottom walls of the bag means in superposed relation with an openwork grid therebetween and a plurality of elongated tie-elements anchored to the grid to extend end portions of the elements outwardly through said top and bottom walls of the bag means; injecting flowable cement grout into said bag means under pressure, to expand the superposed walls thereof against expansion beyond predetermined variable thickness of the bag means determined by stop engagement of the superposed walls with stop portions provided on the tie-elements; and permitting said flowable grout to solidify within the expanded bag means.

4. A method of lining surface area of an earth situs with concrete lining for protecting or containing the same, comprising: mounting flexible-walled bag means in unexpanded condition upon a substantially broad lateral extent of the surface area to have inner and outer flexible walls of the bag means in superposed relation over said broad lateral extent with a plurality of tie-elements each arranged between separable superposed portions of the bag walls; injecting flowable cement grout into said bag means under pressure to expand the bag means to predetermined variable thickness thereof, determined by restraint of said separable superposed wall portions against stop portions on the respective tie-elements; and permitting said flowable grout to solidify within the expanded bag means against said broad lateral extent of surface area; said extent of surface area against which the bag means is disposed being arcuate, and said tie-elements being anchored to anchoring means affixed to the situs.

5. A method as in claim 4, wherein said bag means is generally porous-walled, and said grout is injected under pressure until a small fraction of the flowable grout oozes through the pores of the porous walls to solidify in contact with the contacted said surface areas.

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JACOB SHAPIRO, Primary Examiner

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