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(54) **REPAIR JACKET FOR PILINGS AND METHOD**

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(58) **Field of Classification Search** 405/211.1, 405/216, 211
See application file for complete search history.

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(57) **ABSTRACT**

Repair jacket is adapted for repairing or reinforcing elongate structures such as pilings, especially in marine environments. Jacket includes a cylindrical body of fiber-reinforced plastic (FRP) material that is about 0.5 to 3.5 inches greater in diameter than the piling. The body is wrapped around the piling and sealed. Centering/damping springs keep the body centered on the piling and damp the blows of waves so the body is not damaged. A bottom seal is a resilient tube within an abrasion-resistant tube attached to the bottom of the body for sealing the gap. The resilient tube is filled with expanding grout to create a rigid seal at the bottom of the gap. The gap volume between piling and cylindrical body is then filled with grout to permanently attach repair jacket to piling and repair the surface of the piling.

14 Claims, 1 Drawing Sheet

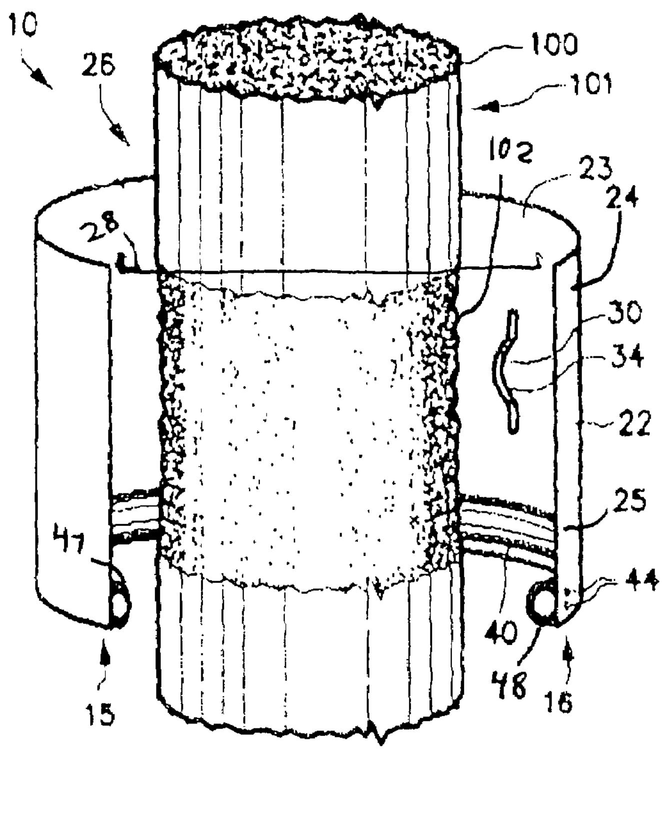


FIG. 1

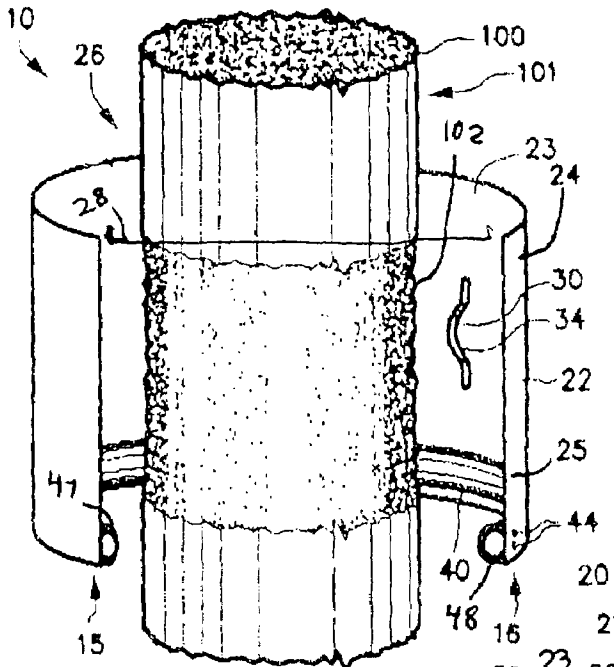
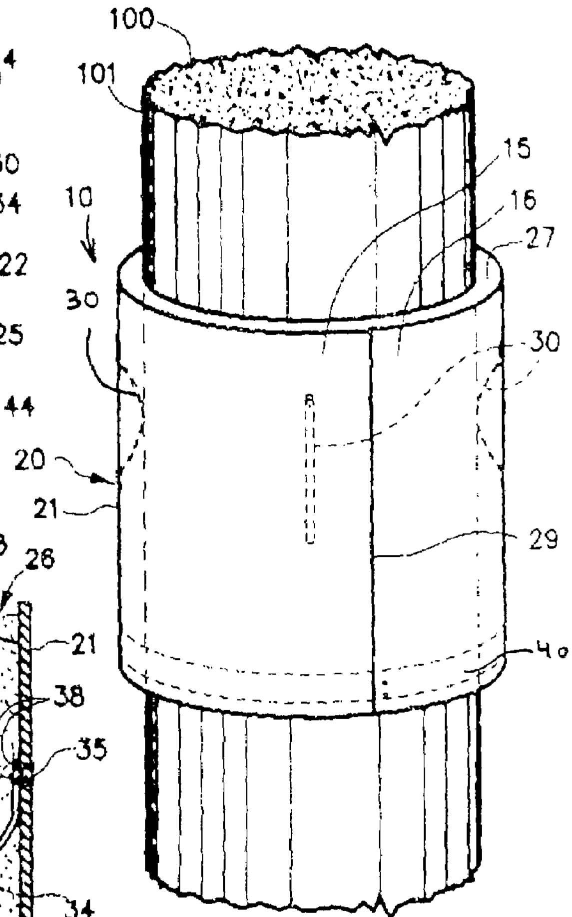


FIG. 2



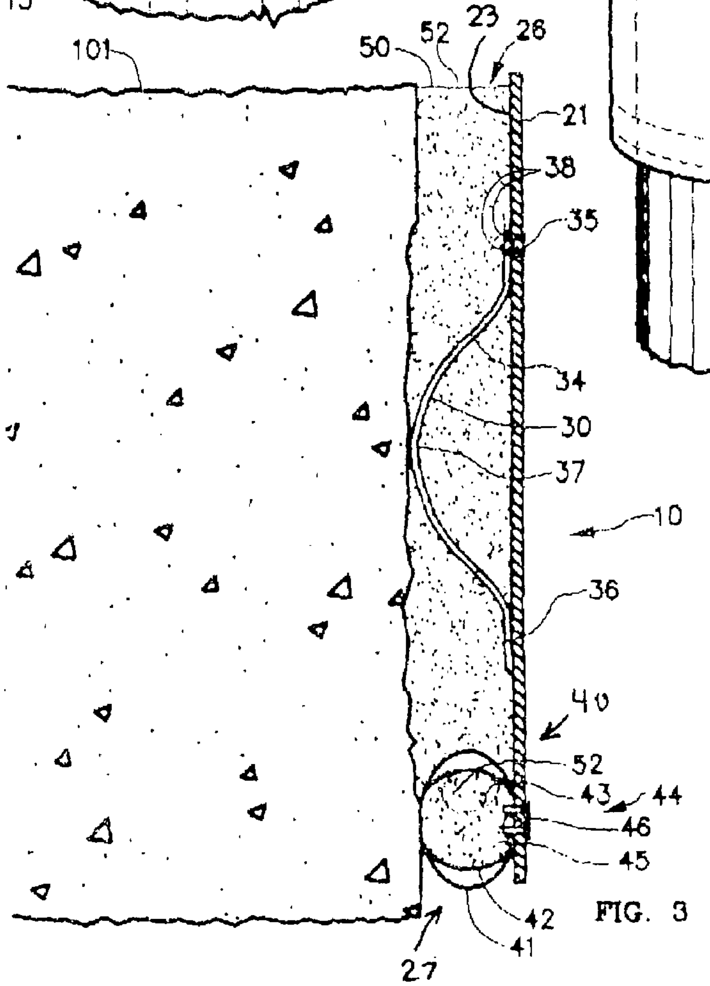


FIG. 3

REPAIR JACKET FOR PILINGS AND METHOD

FIELD OF THE INVENTION

This invention relates to repair devices for damaged structures and more particularly to a repair jacket for a column or piling.

BACKGROUND OF THE INVENTION

Structures are often repaired or reinforced by wrapping them in a composite of high-strength fiber in a polymer matrix. Sheets of textile fabric may be dipped in liquid resin then layered onto or wrapped around a structure. Sometimes panels of cured or partially cured fiber-reinforced plastic (FRP) are prepared in advance, then the panels are glued or mechanically attached to the surface of the structure.

For some applications it is more efficient to pre-fabricate FRP into a repair device with a shape similar to the surface of the structure. At the worksite, the roughly shaped repair device is quickly installed upon the structure. This approach is especially useful for elongate structures such as columns or pilings, and in difficult working conditions where mixing and using liquid resins is impractical.

Pier pilings set in water and extending above it are an example of elongate structures that often need to be repaired or reinforced, yet are difficult to work on. Structures partly under water suffer accelerated damage near the interface of water and air, for both mechanical and chemical reasons. Forces from breaking waves are strongest at the water's surface, boats typically strike a piling near the surface, and exposure to both water, especially sea water, and air drives electrochemical corrosion of metals and rotting of wood. Repairing a piling generally requires working near breaking waves and partially under the water.

Pre-fabricated repair jackets are thus often used to repair or reinforce pilings in marine environments. A jacket is wrapped or otherwise installed on the piling, then grout or epoxy is typically poured into the space between the jacket and the piling to affix the jacket permanently and rigidly to the piling. A problem with this repair method is that it is not always possible to grout the gap immediately after installing the jacket. During the time between installation and grouting, a jacket may be exposed to tides, breaking waves, and boat wakes. Because the ungrouted jacket can shift and rattle on the piling, the jacket can be itself damaged and need replacing before it is grouted.

Conventional repair jackets employ resilient material such as strips of rubber to protect the jacket from buffeting by waves and to form a bottom seal to prevent the grout from leaking out the bottom of the jacket. The rubbery materials used are sometimes torn or dislodged by wave action.

Therefore, there is a need for a repair jacket that is less susceptible to wave damage during the tine between preliminary installation and grouting. There is further a need for a repair jacket that can be easily installed by a worker who remains above the surface of the water. There is a need for a repair jacket with a robust bottom seal that is not torn or deformed by wave or tidal forces.

SUMMARY OF THE INVENTION

The present invention is a repair jacket for strong and efficient repair or reinforcement of damaged structures, especially columns and pilings. The jacket is a sheath of fiber-reinforced plastic, preformed on a mandrel, with a tubular bottom seal along the bottom edge and centering/damping springs around the inside. The sheath is designed to be larger in diameter than the piling to be repaired. The bottom seal is preferably a two-ply tube, including a rubbery inner tube-like channel and an outer abrasion-resistant layer.

The ends of the jacket are wrapped around the damaged portion of a piling and sealed together. The ends of the tubular bottom seal are connected so as to form a continuous torus. A circular gap of 0.5 to 3.5 inches remains between the jacket and the piling. The centering/damping springs keep the jacket centered on the piling and damp the lateral forces from waves crashing against the jacket. The centering/damping springs prevent the jacket from being ripped or dislodged by waves in the hours or days before final attachment.

The bottom seal is filled with expanding grout to make it rigid and also to seal it firmly against the piling. Then more grout is pumped or otherwise dispensed into the gap between the jacket and the piling. The bottom seal holds the gap grout from leaking out the bottom of the jacket. This grout permanently attaches the jacket to the piling and makes the jacket rigid. The rigid grout and tough FRP jacket combine to restore the piling to its nominal dimensions and prevent further erosion.

Other features and many attendant advantages of the invention will become more apparent upon a reading of the following detailed description together with the drawings wherein like reference numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective environmental view of a repair jacket opened for installation on a damaged piling.

FIG. **2** is a front perspective view of the repair jacket of FIG. **1** installed upon the damaged piling.

FIG. **3** is a sectional, cut-away view of the repair jacket of FIG. **2** installed on the piling.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a perspective environmental view of a repair jacket **10** opened for installation on a damaged portion **102** of a column **100** such as piling **101**. FIG. **2** is a front perspective view of repair jacket **10** installed upon the damaged piling **101**.

It is typical for a piling **101** that is partially submerged in water to be heavily damaged in a band a few feet above the mean high tide level to just below the mean low tide level. Repair jacket **10** includes a body **20** including generally cylindrical sheath **21** of fiber-reinforced plastic (FRP). Repair jacket **10** may be modified easily to suit many applications, including various elongate structures such as bridge columns, buttresses, beams, or freeway overpass support columns, as well as lake or marine pilings. Repair jacket **10** is most simply described and illustrated as having a circular transverse cross-section, but repair jacket **10** may be square, rectangular, or polygonal, as needed to fit various structures, without sacrificing the ease of manufacture and use, or any other of its benefits. Repair jacket **10** may alternatively be of other suitable materials, such as steel, ABS, and so on.

Sheath **21** is preferably formed by wrapping sheets of high-strength textile material, such as fiberglass or graphite, wetted with a resin such as epoxy or polyurethane precursor, around a mandrel (not shown) that has the general shape as the piling **101** to be repaired and a diameter typically three to seven inches greater than the diameter of piling **101**. After the resin is cured, sheath **21** is released form the mandrel by slitting an opening **28**, creating a first end **15** and a second end **16** on either side of opening **28**. Opening **28** is stretched wide enough that sheath **21** can be removed from the mandrel. Because the resin used to form sheath **21** typically shrinks during curing, after sheath **21** is removed from the mandrel, sheath **21** relaxes to a diameter smaller than that of the mandrel and first end **15** overlaps second end **16** slightly. Sheath **21** thus forms a hollow cylinder defining central chamber **26** and including an outer face **22**, inner face **23**, top **24**, and bottom **25**.

Sheath **21** as shown in FIG. **1** was formed over a cylindrical mandrel. Sheath **21** is sufficiently flexible that it can be used in a repair jacket **10** for repairing cylindrical pilings **21** or columns **100** that are hexagonal or octagonal. To pre-fabricate a repair jacket **10** for repairing a square column **100**, a mandrel that is square in cross-section would be used and opening **28** would typically be slit along one of the vertices. In this description and in the claims, body **20** and sheath **21** are most often referred to as "generally cylindrical" and as having a diameter; however, this should be understood to include other geometrical forms, such as square, rectangular, or octaganal prisms, in which case, "diameter" of body **20** or sheath **21** should be understood as meaning the longest internal distance perpendicular to the longitudinal axis. Column **100** and piling **101** may similarly be understood as having a shape somewhat different from cylindrical.

FIG. **2** is a front perspective view of repair jacket **10** of FIG. **1** preliminarily installed upon damaged piling **101**. FIG. **3** is a sectional, cut-away view of repair jacket **10** of FIG. **2** fully installed on piling **101**.

Body **20** includes centering/damping means **30** attached to inner face **23** for maintaining body **20** generally concentric to piling **101** and with a uniform gap between body **20** and piling **101** during installation of repair jacket **10**; and for damping lateral impulsive forces, such as from waves, during installation of jacket **10**.

In the preferred embodiment illustrated, centering/damping means **30** is a plurality of springs, such as at least three bow springs **34** spaced around the inside circumference of inner face **23**. Bow springs **34** each include a first end, such as attached end **35**, a second end, such as free end **36**, and a central bow **37** therebetween. Attached end **35** is typically a flange structure that is disposed parallel to and in contact with inner face **23** and attached to inner face **23** by suitable means, such as adhesive or screws **38**. Free end **36** may be a similar flange structure that is parallel to, but not attached to, inner face **23**, or free end **36** may simply be the unflanged tip of central bow **37**. Free end **36** may be initially disposed in contact with, or up to 0.75 inches from, inner face **23**.

Bow springs **34** may be fabricated from FRP material or may be of springy non-corroding metal, such as thin strips of marine grade stainless steel. When lateral force is applied to central bow **37**, central bow **37** is made flatter and bow spring **34** increases in length from first attached end **35** to second free end **36**. When the force is removed, bow spring **34** returns to its nominal shape.

Central bow **37** is generally in the range of 0.5 to 3.5 inches in height, with 2 inches being the nominal value. Central bow **37** may be curved throughout its length, or it may have a flat centermost portion (not shown). The purpose of bow springs **34** will be discussed more fully below.

Body **20** further includes a bottom seal **40** attached to bottom **25** of inner face **23**. Bottom seal **40** is generally a hollow, resilient, abrasion-resistant tube having an interior channel **43**. Bottom seal **40** preferably includes a dual-layer structure, as shown in the preferred embodiment of FIG. **3**. Tough outer layer **41** is a flexible tube of abrasion resistant material, such as used for firefighting hose. Inside tough outer layer **41** is resilient tube **42**, having a lengthwise interior chamber **43**. Resilient tube **42** may be of synthetic rubber or other suitable material. Bottom seal **40** may alternatively consist of a single tube fabricated of a material that is sufficiently resilient to form a good seal against piling **101** and tough enough to withstand large waves after preliminary installation.

Preferably, there are seal ports **44**, such as grout inlet port **45** and displaced fluid escape port **46**, to provide means for filling bottom seal **40** with filler, such as grout, so as to seal between sheath **21** and piling **101**. Seal ports **44** pierce resilient tube **42** and tough outer layer **41**, and extend through holes in sheath **21** to be available on the outside of repair jacket **10** after preliminary installation. Seal ports **44** are preferably closeable.

The method of using repair jacket **10** includes three main processes, which will be set forth in greater detail below. First, body **20** is assembled by attaching bow springs **34** and bottom seal **40** to sheath **21**. This step may be done in a shop, on the work site near piling **101**, or adjacent piling **101**, such as on a scaffold above the water surface. Second, body **20** is preliminarily installed upon piling **101**. Opening **28** is stretched wide enough to allow passage of piling **101** into central chamber **26**. Opening **28** is sealed by sealing means **29**, described below, to form a generally cylindrical sleeve around piling **101**. The two open ends of bottom seal **40** are attached together to create a torus with continuous interior channel **43**. Third, repair jacket **10** is rigidified and permanently installed on piling **101** by being filled with filler material **50** in two steps. Initially, interior channel **43** is filled to create a snug seal between piling **101** and inner face **23**, then gap volume **27** between inner face **23** and piling **101** is filled with filler material **50**.

The three processes of repair will now be disclosed in greater detail. The first process of assembling body **20** may be modified as needed to suit different sizes or shapes of piling **101**. A suitable size and shape of sheath **21** is selected such that the gap between inner face **23** and piling **101** is 0.5 to 3.5 inches, that is, the inside diameter of sheath **21** after opening **28** is sealed is typically 0.25 to 1.75 inches greater than the nominal (undamaged) diameter of piling **101**.

Bow springs **34** are attached to inner face **23**. For a piling **101** of up to about 30 inches diameter, two or three bow springs **34** are used, spaced roughly equally around inner face **23**. To repair a larger piling **101**, four or more bow springs may be used. Only first attached end **35** is attached to inner face **23**, by any suitable means including adhesive or screws. Second free end **36** is left unattached, either lightly in contact with inner face **23** or spaced away from inner face **23** up to about 0.5 inch. Generally, it is preferable that first attached end **35** be disposed closer to top **24** of sheath **21** than is second free end **36**, so that gravity does not create a torque on the attachment of first attached end **35**. Centering/damping means may be other suitable types of spring as are well-known to one skilled in the art, such as a standoff pin (not shown) biased toward the center of central chamber **26** by a coil spring coaxial with the standoff, or a leaf-type spring (not shown) attached at its center and with two free ends extending upward from inner face **23**.

Bottom seal **40** is then attached to sheath **21**. In the preferred embodiment illustrated in the drawings, a length of firefightinig hose material the same length as the circumference of sheath **21** is attached to bottom **25** of sheath **21** by suitable means, such as by adhesive or by screws **38** that are slightly shorter than the combined thicknesses of sheath **21** and one wall of the firefighting hose material. This hose material forms tough outer layer **41**.

The hose material may be slit along its length before being attached to bottom **25**. In this case, screws **38** are inserted into the interior of the hose material, that is, tough outer layer **41**, and screwed through the wall of tough outer layer **41** that is in contact with bottom **25** and into bottom **25**. Tough outer layer **41** is typically attached such that the lengthwise slit is oriented toward top **24** or 180 degrees away from top **24**, that is, so that the slit does not face directly inward toward central chamber **26**. The next step is then to insert resilient tube **42** inside tough outer layer **41** by urging tube **42** through the slit.

Alternatively, tough outer layer **41** may be attached to bottom **25** without being slit along its length. In this case, screws **38** are started in outer face **22** of bottom **25** and screwed inwardly through outer face **22** and tough outer layer **41**. In this case, it is preferable that resilient tube **42** be inserted into tough outer layer **41** before attaching tough outer layer **41** to bottom **25**. In either case, adhesive, such as epoxy, or other suitable attachment means may alternatively be used to attach tough outer layer **41** to bottom **25**.

Resilient tube **42** includes two seal ports **44**, such as filler port **45** and escape port **46**. Seal ports **44** are preferably closeable. As resilient tube **42** is inserted into tough outer layer **41**, seal ports **44** are aligned with and pressed through corresponding holes in tough outer layer **41** and sheath **21**, such that interior channel **43** is in fluid communication with the exterior of body **20** when seal ports **44** are open.

In the second part of installation, body **20** is wrapped around piling **101**, either directly around damaged portion **102** or optionally above it, if damaged portion **102** is partly or completely under water. Due to the springiness of sheath **21**, as mentioned above, opening **28** tends to spontaneously close such that body **20** retains itself generally in place around piling **101**.

Resilient tube **42** is at this point a length of tube bent generally into an incomplete hoop with a first open end **47** and second open end **48**. Next, the two ends **47**,**48** are attached together so as to form tube **42** into a closed torus. Ends **47**,**48** are attached such as by applying adhesive to the outer portion of first end **47**, then gathering or pleating first end **47** so that it can be inserted into second end **48**. The adhesive-coated first end **47** will adhere to the inside of second end **48** due to the resilience of tube **42** causing gathered first end **47** to spring, back to its tubular shape inside second end **48**. To assure a complete seal, air may be introduced into resilient tube **42** through filler port **45**, keeping escape port **46** closed, to press the adhesive-coated portion firmly against the inside of the other end of tube **42**. Only sufficient air to restore the original cylindrical shape of resilient tube **42** may be introduced, so as to avoid overly distending resilient tube **42**.

After resilient tube **42** is sealed to form a continuous torus, the ends of tough outer layer **41** are attached together similarly. Because it is less important that tough outer layer **41** be fluid-tight, the ends of tough outer layer **41** are attached together as an adhesive butt joint.

Sealing means **29** are then used to seal opening **28** such that body **20** forms a continuous sleeve around piling **101**. Sealing means **29** may consist of attachment means such as adhesive, screws, or pop rivets. First end **15** and second end **16** may be adapted to enhance sealing, such as by tapering the ends **15**, **16** to allow a smooth lap joint, or by shaping ends **15**, **16** such that ends **15**, **16** cooperate to latch together mechanically. Sealed opening **28** may be further reinforced or smoothed, such as by overlaying an additional panel of FRP material (not shown).

During the time that body **20** is preliminarily installed, but not yet infilled with filler material **50**, body **20** would be vulnerable to damage by waves or other forces without centering/damping means **30**. It has been found that jacket bodies without centering/damping means **30** can be torn or bottom seal **40** can be damaged or torn off by the action of waves and tide. Because gap volume **27** has not yet been filled with filler material **50**, body **20** has free play to rattle and twist upon piling **101** and be abraded by roughness of damaged portion **102**. It is not uncommon for a preliminarily installed body **20** to remain in position for two or three days before being filled, rigidified, and permanently attached to piling **101** by filler material **50**. To prevent damage during this time, centering/damping means **30** are included in repair jacket **10**.

Centering/damping means **30**, such as bow springs **34**, maintain body **20** upright on piling **101** with an equal gap around the circumference of piling **101**. When a wave or floating object strikes body **20**, bow springs **34** are deflected such that central bow **37** is flattened and second free end **36** slides vertically along inner face **23**. The deflection of bow springs **34** absorbs the lateral force, then releases it harmlessly as bow springs **34** spring back to their original geometry. Bow springs **34** as described herein have been found to prevent wave damage to body **20** when used in test installations. Bottom seal **40** helps with maintaining body **20** centered upon piling **101**, but is not able to sufficiently dampen wave forces.

The third and final process of installation of repair jacket **10** is filling interior channel **43** and gap volume **27** with filler material **50**, preferably a solidifiable fluid that expands during solidification, such as expanding grout **52** or a foaming polymer. After body **20** is fully sealed, seal ports **44** are opened. Filler port **45** is connected to a source (not shown) of expanding grout **52**. Sealed body **20** is now moved into place around damaged portion **102**, if it is not already there.

Grout **52** is introduced into interior channel **43**, pressurized by gravity, compressed air, or by a suitable pump. Fluid displaced by grout **52**, such as air or water, escapes through escape port **46**. Sufficient grout **52** is added to interior channel **43** that resilient tube **42** is distended enough to cause tough outer layer **41** to touch piling **101** at all points along the circumference of piling **101**, which may be determined by observation or by previous calculation. The tubing or other means used to provide grout **52** to filler port **45** is either detached from filler port **45** or else left attached. If filler port **45** is farther than arm's reach under the surface of water, it may be found preferable to sacrifice the length of tubing rather than to have a diver retrieve it. Expansion of grout **52** during set-up will further compress bottom seal **40** between bottom **25** and piling **101**. Other filler materials **50**, such as epoxy or polyurethane, may be used in place of expanding grout **51**, provided resilient tube **42** is filled to a greater initial pressure. More careful observation of the distension of resilient tube **42** is required in this case.

Grout **52** is also used to fill gap volume **27** between sheath **21** and piling **101**. Grout **52** may be introduced into gap volume **27** through an optional grout port (not shown) near bottom **25** and above bottom seal **40**. Alternatively, grout **52** is introduced through a tremi tube that is withdrawn as the level of grout **52** rises. In either case, an escape port is typically not needed because air or water being displaced escapes from gap volume **27** by rising through the open top of gap volume **27**. It is also possible to simply pour grout **52** into the top of gap volume **27**; however, simple pouring is more likely to result in pockets of water or air being trapped within grout **52**, which would weaken repair jacket **10**. As grout **52** solidifies and expands, grout **52** contacts the surface of piling **101** completely and repairs or reinforces it. Also, jacket **10** is stressed in tension by the expansion, further stiffening jacket **10**.

Although particular embodiments of the invention have been illustrated and described, various changes may be made in the form, composition, construction, and arrangement of the parts herein without sacrificing any of its advantages. Therefore, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense, and it is intended to cover in the appended claims such modifications as come within the true spirit and scope of the invention.

We claim:

1. A repair jacket for repairing a piling, including:
- a generally cylindrical body, having a longitudinal axis and including:
  - an outer face;
  - an inner face;
  - a top; and
  - a bottom; and
  - a lengthwise opening from said top to said bottom;
- centering/damping means attached to said body; for maintaining said body generally concentric to the piling and with a substantially uniform gap between said body and the piling; and for damping lateral impulsive forces against said body during installation of said jacket; and
- a bottom seal attached to said bottom of said body for sealing between the piling and said body; such that said bottom seal is adapted to cooperate with said inner face to support filler material for filling the gap between the piling and said inner face when said jacket is installed upon the piling and said opening is sealed; said bottom seal comprising:
  - a flexible tube defining an interior channel for accepting filler material; including:
    - a filler port piercing said flexible tube for accepting filler material into said interior channel; and
    - an escape port piercing said flexible tube for allowing displaced fluid to escape from said interior channel.

2. The repair jacket of claim **1**, wherein said bottom seal comprises:
- a flexible resilient inner layer; and
- an abrasion-resistant outer layer for contacting the piling.

3. The repair jacket of claim **1**, said bottom seal further including:
- an abrasion-resistant outer layer for surrounding and protecting said flexible tube.

4. A repair jacket for repairing a piling, including:
- a generally cylindrical body, having a longitudinal axis and including:
  - an outer face;
  - an inner face;
  - a top; and
  - a bottom; and
  - a lengthwise opening from said top to said bottom;
- centering/damping means attached to said body; for maintaining said body generally concentric to the piling and with a substantially uniform gap between said body and the piling; and for damping lateral impulsive forces against said body during installation of said jacket; and
- a bottom seal attached to said bottom of said body for sealing between the piling and said body: such that said bottom seal is adapted to cooperate with said inner face to support filler material for filling the gap between the piling and said inner face when said jacket is installed upon the piling and said opening is sealed said centering/damping means comprising:
- a plurality of springs attached to said inner face such that said springs bias said body away from the piling such that said body is maintained concentric to the piling; and such that the gap between said piling and said inner face is of generally equal width around the perimeter of the piling; and such that said springs damp energy from waves impacting said repair jacket during installation of said jacket upon a piling.

5. The repair jacket of claim **4**, said plurality of springs comprising:
- at least three bow springs spaced around said body; said bow springs including:
- a first attached end for attachment to said jacket body;
- a second free end disposed adjacent said jacket body and not attached to said body; and
- a bow portion between said first attached end and said second free end, adapted for deflection by a force normal to said longitudinal axis of said body and return to nominal dimensions upon removal of the force.

6. The repair jacket of claim **5**, said bow springs consisting of FRP material formed so as to have a bow height of 0.5 to 3.5 inches.

7. In combination:
- an elongate piling; including:
  - a portion in need of repair; including:
    - an outward-facing surface; and
  - a longitudinal axis; and
- a repair jacket for repairing said piling; including:
  - a elongate body wrapped around said portion of said piling such that a gap remains between said body and said outward-facing surface; including:
    - an outer face;
    - an inner face defining a hollow chamber for accepting said portion of said piling;
    - a top;
    - a bottom; and
  - centering/damping means attached to said body; for spacing said inner face apart from said outward-facing surface and maintaining said body generally concentric to said longitudinal axis of said piling; and for damping lateral impulsive forces during installation of said jacket;

said centering/damping means comprising:
- a plurality of springs attached to said inner face such that said springs damp forces from waves impacting said repair jacket during installation of said repair jacket;
- and
  - a bottom seal attached to said bottom of said body for sealing between said piling and said body; said bottom seal comprising:
    - a closed tube defining an interior channel adapted for accepting filler material and wherein:

said inner face and said bottom seal cooperate with said outward-facing surface of said portion of said piling to define a gap volume adapted for receiving filler material;

and wherein: said bottom seal and said body are adapted to maintain the filler material within said gap volume.

8. The combination of claim **7**, wherein said bottom seal comprises:

a flexible resilient inner layer; and

an abrasion-resistant outer layer for contacting said piling.

9. The combination of claim **7**, said bottom seal comprising:

a flexible closed tube defining an interior channel; and said closed tube is adapted to expand upon filling such that said bottom seal is compressed between said bottom of said body and said outward-facing surface of said portion of said piling.

10. The combination of claim **7**, wherein said gap volume has a radial thickness in the range of 0.5 to 3.5 inches.

11. In combination:

an elongate piling; including:

a portion in need of repair; including:

an outward-facing surface; and

a longitudinal axis; and

a repair jacket for repairing said piling; including:

a elongate body wrapped around said portion of said piling such that a gap remains between said body and said outward-facing surface; including:

an outer face;

an inner face defining a hollow chamber for accepting said portion of said piling;

a top;

a bottom; and

centering/damping means attached to said body; for spacing said inner face apart from said outward-facing surface and maintaining said body generally concentric to said longitudinal axis of said piling; and for damping lateral impulsive forces during installation of said jacket;

a bottom seal attached to said bottom of said body for sealing between said piling and said body; said bottom seal comprising:

a flexible closed tube defining an interior channel; and said closed tube is adapted to expand upon filling such that said bottom seal is compressed between said bottom of said body and said outward-facing surface of said portion of said piling and wherein:

said inner face and said bottom seal cooperate with said outward-facing surface of said portion of said piling to define a gap volume adapted for receiving filler material; and wherein: said bottom seal and said body are adapted to maintain the filler material within said gap volume, said flexible closed tube including:

a filler port piercing said closed tube for filling said interior channel with filler material; and

an escape port piercing said closed tube for allowing displaced fluid to escape from said interior channel.

12. A repair jacket for repairing a piling, including:

a generally cylindrical body, having a longitudinal axis and including:

an outer face;

an inner face;

a top; and

a bottom; and

a lengthwise opening from said top to said bottom;

centering means attached to said body; for maintaining said body generally concentric to the piling and with a substantially uniform gap between said body and the piling;

damping means attached to said body, for damping lateral impulsive forces against said body during installation of said jacket; said damping means comprising:

a plurality of springs attached to said inner face such that said springs damp forces from waves impacting said repair jacket during installation of said repair jacket; and

a bottom seal attached to said bottom of said body for sealing between the piling and said body; including:

a flexible resilient closed tube defining an interior channel adapted for accepting filler material;

said bottom seal being adapted to cooperate with said inner face to support filler material for filling the gap between the piling and said inner face when said jacket is installed upon the piling and said opening is sealed.

13. The repair jacket of claim **12**, said bottom seal further including:

an abrasion-resistant outer layer for contacting the piling.

14. The repair jacket of claim **12**, said plurality of springs comprising:

at least three bow springs spaced around said body; each said bow spring including:

a first attached end for attachment to said jacket body;

a second free end disposed adjacent said jacket body and not attached to said body; and

a bow portion between said first attached end and said second free end, adapted for deflection by a force generally normal to said longitudinal axis of said body and return to nominal dimensions upon removal of the force.

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