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(54) **HOOK FACILITY FOR CONCRETE STRUCTURE**

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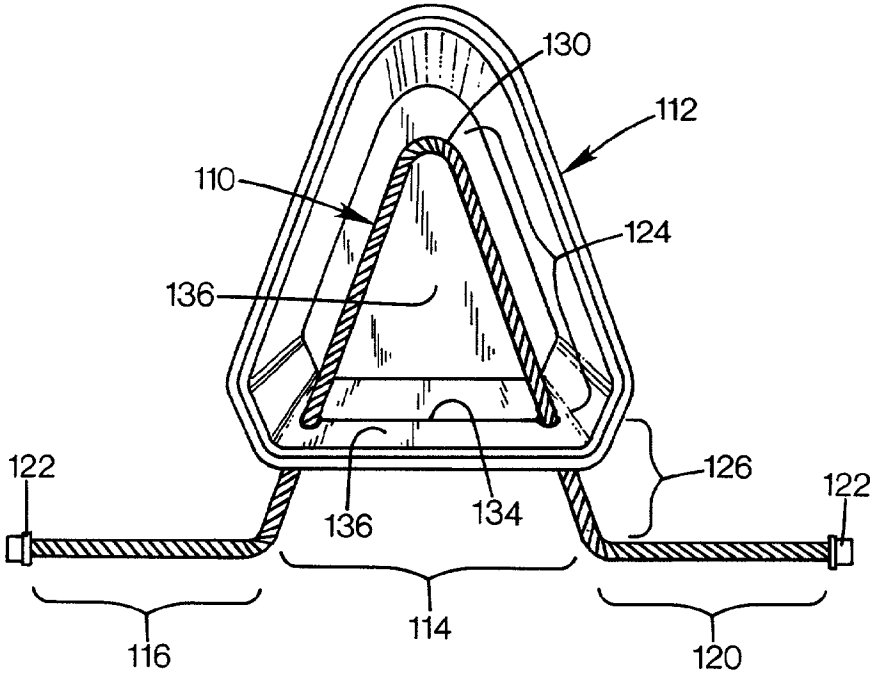
(57) **ABSTRACT**

A lifting facility for encapsulation in a concrete wall includes a bowl element forming a cavity and having a rim occupying a rim plane. The bowl element has a side wall defining an elongated aperture, which includes a pair of spaced-apart openings connected by a slit. An articulated bar having a constant cross section has a loop portion within the cavity, and intermediate portions occupying the openings.



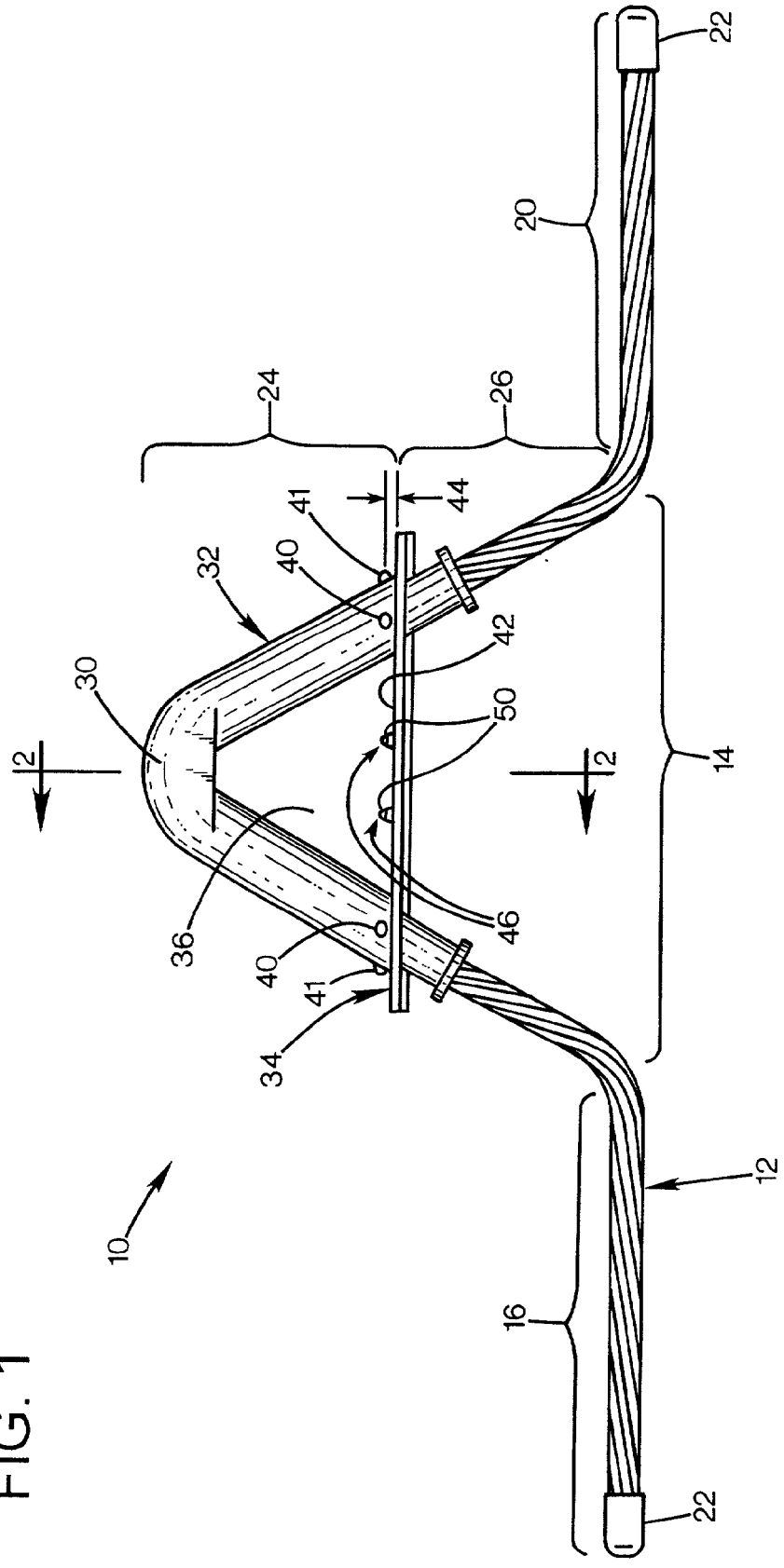
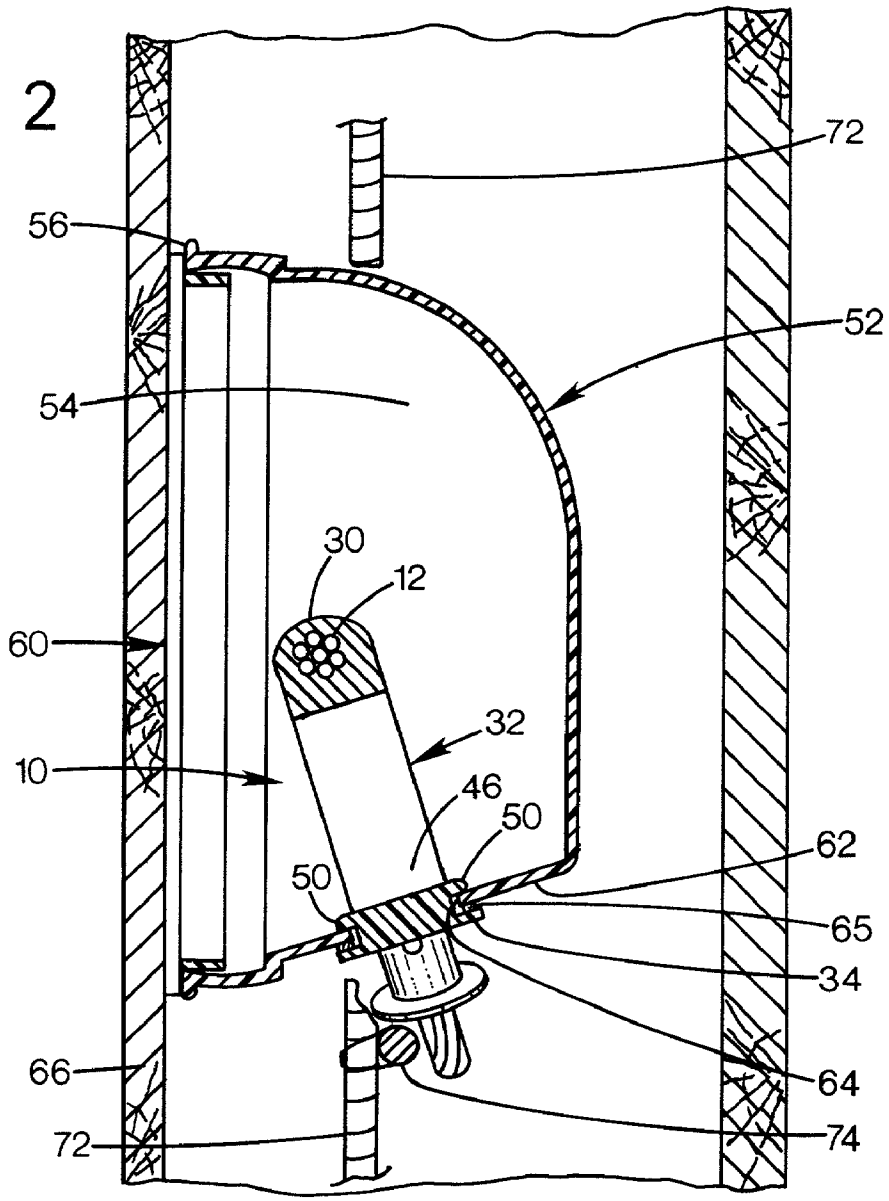


FIG. 1

FIG. 2



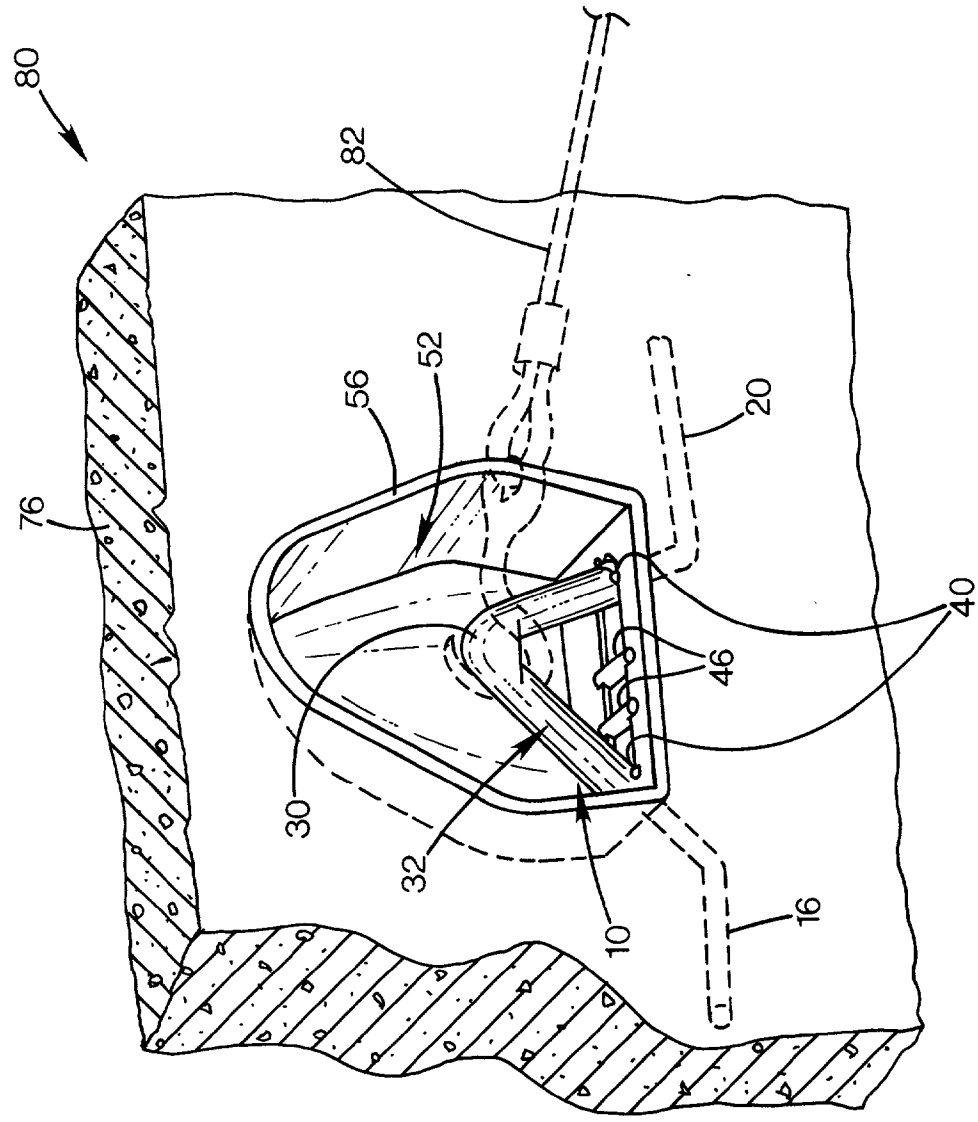


FIG. 3

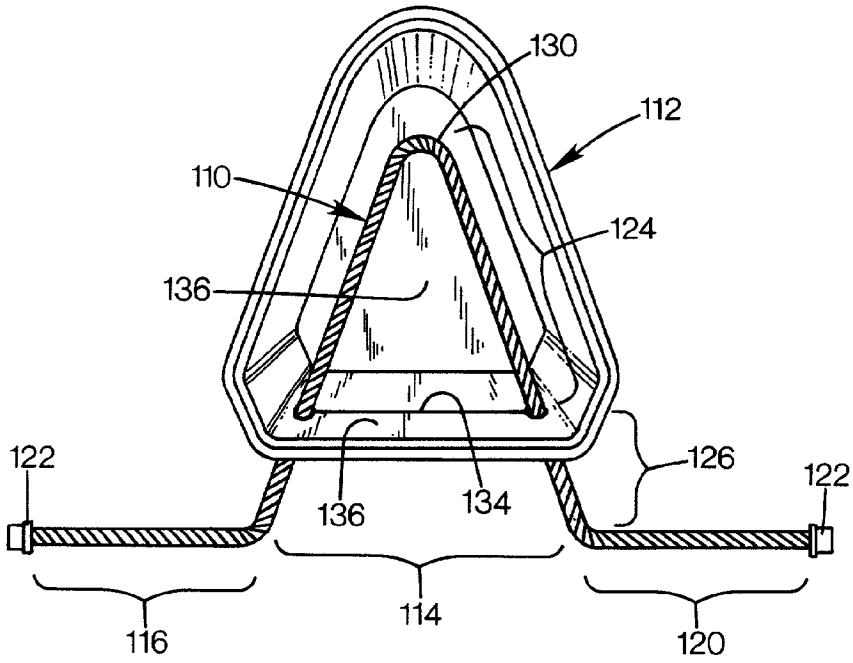

130
112
110
124
136
122
136
134
126
122
116
114
120

FIG. 4

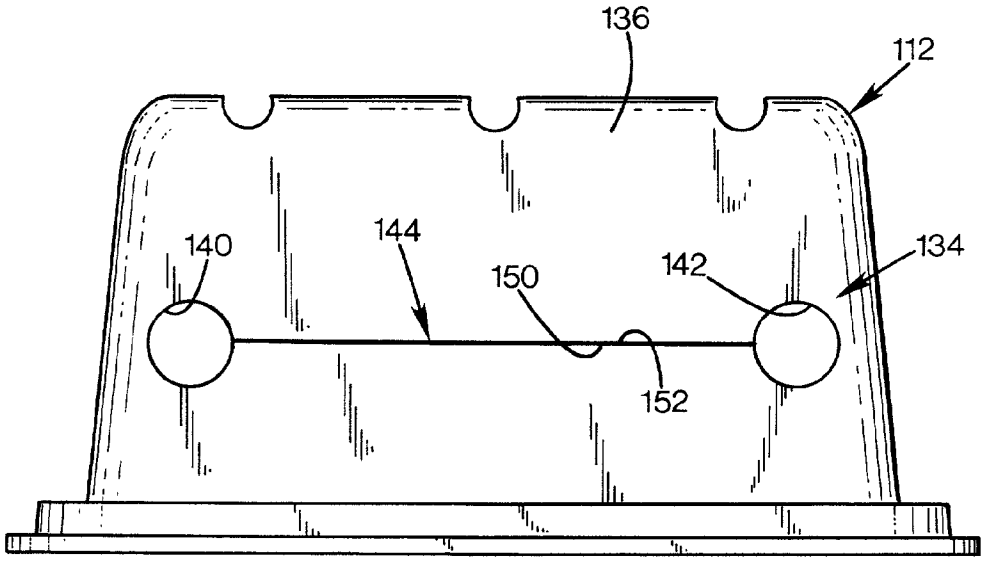

136
112
140
144
150
142
134
152

FIG. 5

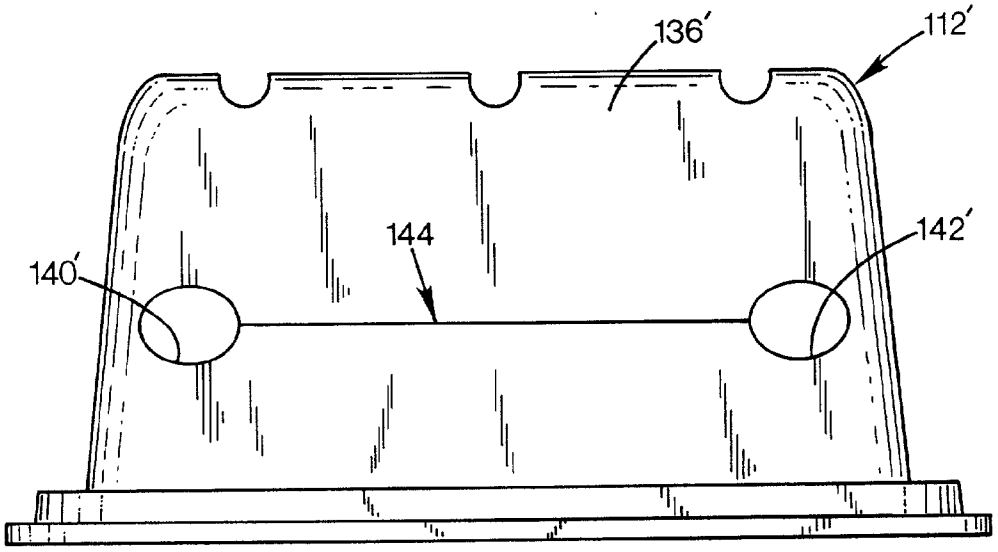


FIG. 6

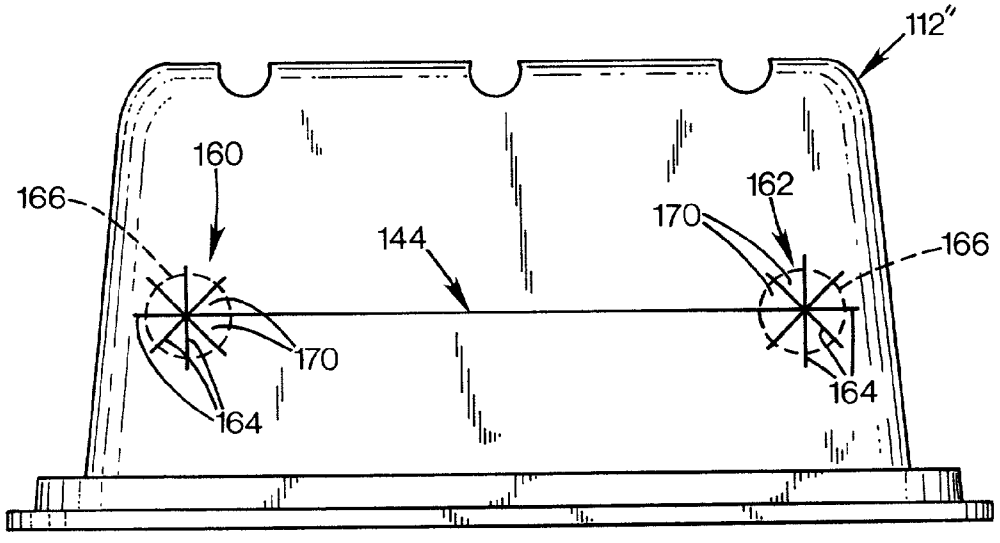


FIG. 7

HOOK FACILITY FOR CONCRETE STRUCTURE

REFERENCE TO RELATED APPLICATION

[0001] This is a Continuation-In-Part of U.S. patent application Ser. No. 10/066,522, filed Jan. 31, 2002, entitled HOOK FACILITY FOR CONCRETE STRUCTURE.

FIELD OF THE INVENTION

[0002] The invention relates to facilities cast into concrete structures, and more particularly to pulling irons or hooks for such structures.

BACKGROUND AND SUMMARY OF THE INVENTION

[0003] Lifting hooks or pulling irons are facilities embedded in concrete structures. They are engaged by devices that require a solid mount to generate tension. Such devices may include tensioners used to pull wires and cables, or lifting apparatus such as the hook of a crane's cable used to support a structure for installation. One such structure is a concrete utility vault, which is an open-topped box that is placed in an excavation, and which has apertures in the side walls to receive utility lines. Several pulling irons are normally embedded in the interior wall surfaces, so that wire pulling devices may be used to pull utility lines.

[0004] To facilitate construction, especially casting of the structures, the pulling irons are recessed within the volume of the wall, and do not protrude beyond the plane of the wall. The hooks are kept accessible by the use of pocket elements that are essentially bowls whose rims are positioned at the wall surface where the hook is to be accessed. The hook is an articulated bar, such as of rigid cable, with an inverted V-shaped loop portion that has a vertex extending into the bowl's cavity, and with legs of the V and laterally extending end portions embedded in the concrete, attached to reinforcing bars within the structure.

[0005] While functional, this configuration has several disadvantages. The bar's loop extends through a slot in the bowl. Prior to the structure being cast, the bar must be held in the desired position, and the bowl must be maintained with its rim against the surface of the form that will define the resulting wall surface. To prevent the bowl from pivoting and becoming misaligned during pouring of the concrete, the bowl and bar must be secured to each other. In existing designs, this is typically achieved by strapping the two elements together with duct tape, a time consuming and imprecise process. Moreover, even if the two are secured to each other to prevent concrete incursion into the bowl cavity, some angular misalignment may still result even when the bowl is flush to the form surface. This can occur when the bar ends are displaced, causing the bar loop to be closer of farther from the wall than is desired.

[0006] Another concern is that any gaps between surfaces of the bowl and bar can allow leakage of concrete into the bowl's cavity. Normally, any gaps are sealed with an application of duct tape, slowing production, especially where the gaps are large or numerous.

[0007] The embodiment disclosed herein overcomes these disadvantages by providing a lifting facility for encapsulation in a concrete wall. The facility includes a bowl element forming a cavity and having a rim occupying a rim plane. The bowl element has a side wall defining an elongated aperture, which includes a pair of spaced-apart openings connected by a slit. An articulated bar having a constant cross section has a loop portion within the cavity, and intermediate portions occupying the openings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] **FIG. 1** is a plan view of a pulling iron element according to a preferred embodiment of the invention.

[0009] **FIG. 2** is a sectional side view of a pulling iron facility taken along line **2-2** of **FIG. 1**.

[0010] **FIG. 3** is a perspective view of the facility as installed in a structure, according to the preferred embodiment.

[0011] **FIG. 4** is a side elevation view of a pulling iron facility, according to a first alternative embodiment of the invention.

[0012] **FIG. 5** is a bottom elevation view of the bowl of **FIG. 4**.

[0013] **FIG. 6** is a bottom elevation view of a bowl according to a second alternative embodiment of the invention.

[0014] **FIG. 7** is a bottom elevation view of a bowl according to a second alternative embodiment of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0015] **FIG. 1** illustrates a pulling iron bar **10**. The iron includes an articulated single length of rigid steel cable **12**. The cable has an intermediate portion **14** with the shape of an inverted V, with straight, co-linear end portions **16, 20** extending laterally from the lower spread ends of the V. The end portions are oriented horizontally as illustrated, and as installed in a typical application. Each end portion terminates at a free end covered with a safety cap **22**.

[0016] The intermediate portion has an upper portion **24** and a lower portion **26**. The upper portion includes the vertex **30** of the V, and the lower portion includes the lower halves of the legs of the V. The entire upper portion and upper parts of the lower portion are overmolded or encapsulated by a sleeve element **32**. The sleeve is a rigid plastic body that includes a flat rectangular horizontal flange **34** that spans between mid points of the opposite legs of the V, essentially defining the boundary between the upper portion **24** and lower portion **26** of the intermediate portion **14**. Together, the upper portion legs **24** and the flange **34** define an enclosed triangular aperture or loop **36**.

[0017] The sleeve includes several protrusions **40, 41** that protrude laterally from the sleeve at locations just above the upper surface **42** of the flange. The protrusions occupy a common plane, and have lower edges spaced apart from the upper flange surface **42** by a gap **44**. Side protrusions **40** extend from the faces of the sleeve in opposite directions perpendicular to the plane of the bar in opposed pairs, while end protrusions **41** extend from the sleeve in directions parallel to the end portions of the bar. A pair of latch elements **46** extends above the flange surface **42** at intermediate portions. The latch elements are elongated ridges

that extend partly across the width of the flange, and have protrusions **50** at each end at the same spacing from the flange, and in line with the side protrusions **40**.

[**0018**] In the preferred embodiment, the bar has an end-to-end length of 27", and a height from the line of the end portions to the vertex of 9". The flange is 8" long, 1-⅝" wide, and ⅛" thick. The sleeve is 1-⅛" thick at the upper portion **24**, and the vertex extends 4-½ inches above the upper surface of the flange. The protrusions each protrude 1/16" from their respective surfaces, so that the tip-to-tip dimension of each pair of side protrusions **40** or protrusions **50** is 1-¼". The cable is ½" diameter 7-strand steel cable that resists appreciable bending under moderate loads.

[**0019**] **FIG. 2** shows the bar **10** as installed for casting in a concrete wall of a structure. A plastic pocket or bowl **52** defines a cavity **54**, and has a planar rim **56**. A removable flat lid **60** mates with the bowl's rim to enclose the cavity. The bowl has a flat lower surface panel **62** that defines a rectangular slot **64**. The slot is 1-⅛" wide and 6-⅛" long. The slot width is the same as the width of the sleeve upper portion for a snug fit, and is thus narrower than the span of the protrusions **40** and **50**, so that the protrusions serve as latches to resist extraction or angular displacement of the bar. The length of the slot is sized similarly, so that it is smaller than the span between the tips of the end protrusions **41**. A compressible closed cell foam gasket **65** is adhered to the exterior surface of the lower surface panel **62**, to entirely surround the aperture **64**. This prevents concrete from seeping into the cavity during casting. The wall thickness of the bowl at the lower panel is ⅛", including the thickness of the compressed gasket, which is the same as the gap between the protrusions and the flange upper surface. This tight fit prevents the bar from shifting with respect to the bowl.

[**0020**] The bar and bowl are latched together, and installed as shown before casting a concrete wall of the structure. Opposed wall form panels **66**, **70** define what will be the wall surfaces. The lid and rim rest flush against the interior surface of panel **66**. A set of vertical reinforcing bars **72** is positioned between the forms, and a cross bar **74** is wired to span between a pair of vertical bars. The bar end portions **16** and **20** are wired to the cross bar. Thus suspended, the lid rests flat against the form surface **66**.

[**0021**] **FIG. 3** shows a concrete wall portion **76** of a structure **80**, with the bar **10** and bowl **52** installed. The lid **60** has been removed for reuse, and the bowl rim **56** is exposed, surrounding the cavity. A hook-terminated pulling tackle **82** is shown attached to the bar.

[**0022**] **FIG. 4** shows an alternative assembly **100** having a simplified bar **110** and alternative bowl **112**. The bar is shaped and formed the same as bar **10** of **FIG. 1**, except that it lacks the overmolded features, including the flange. The bar is a single articulated length of resilient and nearly rigid steel cable, as above, with protective end caps. In further alternative embodiments, the bar may include some overmolded features as desired, as long as the portions that interact with the bowl as discussed below are kept as shown, or the bowl features sized for compatibility.

[**0023**] The bar has an intermediate portion **114** with the shape of an inverted V, with straight, co-linear end portions **116**, **120** extending laterally from the lower spread ends of the V. The end portions are oriented horizontally as illustrated, and as installed in a typical application. Each end portion terminates at a free end covered with a safety cap **122**. The intermediate portion has an upper portion **124** and a lower portion **126**. The upper portion includes the vertex **130** of the V, and the lower portion includes the lower halves of the legs of the V. Together, the upper portion **124** of the legs define a triangular aperture or loop **36** that is open below.

[**0024**] Thus, the bar is simpler and more cost effective to manufacture compared the first embodiment above, even with primitive bending facilities lacking plastic molding capability. This avoids the need for expensive tooling, and permits fabrication of a wide range of alternative shapes and sizes for different needs without significant tooling costs.

[**0025**] The bowl **112** is essentially the same as bowl **52** of the preferred embodiment, except that it has a differently shaped opening **134** in its lower panel. **FIG. 5** shows the bowl **112** from below, illustrating the details of the opening **134**. The opening includes a pair of widely spaced-apart circular holes **140**, **142**, connected by a straight slit **144** aligned with the centers of the holes. The slit lacks a substantial gap, with opposed side portions **150**, **152** of the lower panel **136** abutting each other along their entire lengths, to prevent the leakage of concrete during a pour. In the preferred embodiment, there is a minimal gap of 0.062 inches necessitated by the molding process to provide a thin wall in the tool to avoid the opposite sides from knitting or welding together during molding. This functions as if it were no gap at all, because the concrete material normally blocked by the bowl has adequate thickness and large enough particles to be effectively blocked. With the slit being equal to or narrower than the wall thickness, the wall edges are considered for purposes of this disclosure to be abutting. In alternative embodiments, the bowl may be molded without a slit, and the slit cut in a second step for fully abutting sides. Also, the slit may be molded to a partial depth that facilitates the gap being torn or ruptured along the line upon insertion of the bar.

[**0026**] **FIG. 6** shows an alternative bowl **112'** that differs from bowl **112** in that it has holes **140'**, **142'** that are oval, elliptical, or oblong, to closely accommodate the bar when installed. Because the bar passes through the plan of the panel **136'** at an angle offset from perpendicular, the cross section of the bar defined by the plane is an ellipse, which corresponds to the illustrated hole. The embodiment of **FIG. 5**, with circular holes, accommodates the angle by some flexure of the panel **136** immediately surrounding the holes.

[**0027**] **FIG. 7** shows an additional alternative bowl **112"** that differs from bowls **112** and **112'** in that its slit is terminated at each end by a pattern **160**, **162** of intersecting slits. Each pattern has the configuration of an asterisk or star, with a central point defined by the end of the slit **144**, and an array of small slits **164** radiating out from that point to form the pattern. Each pattern has a radius based on the diameter **166** of the bar, so that when the bar is installed, each wedge shaped sector **170** defined by adjacent slit segments deflects into the cavity. The compression of the deflected sectors against the bar surface helps to form a partial gasket against leakage of concrete into the cavity.

[**0028**] While the disclosure is made in terms of preferred and alternative embodiments, the invention is not intended to be so limited.

1. A lifting facility for encapsulation in a concrete wall comprising:

a bowl element defining a cavity and having a rim occupying a rim plane;

the bowl element having a side wall defining an elongated aperture; and

the aperture comprising a pair of spaced-apart openings connected by a slit.

2. The facility of claim 1 including an elongated strength member having a loop portion within the cavity, and penetrating the side wall at the openings.

3. The facility of claim 2 wherein the strength member is closely received within the openings, such that concrete does not readily flow through the openings.

4. The facility of claim 2 wherein the strength member is an articulated member having a constant cross section.

5. The facility of claim 2 wherein the strength member is a bare bar.

6. The facility of claim 5 wherein the bar is a cable formed of a plurality of cable strands.

7. The facility of claim 2 including a concrete wall structure encapsulating at least a portion of the facility, the structure having a surface co planar with the rim plane, the bowl cavity being free of concrete such that the loop portion is accessible.

8. The facility of claim 7 wherein the end portions of the strength member are imbedded in the concrete.

9. The facility of claim 1 wherein the openings are circular.

10. The facility of claim 1 wherein the openings are elliptical.

11. The facility of claim 1 wherein the openings are a pattern of radially arranged slits.

12. The facility of claim 1 wherein the slit comprises opposed panel portions abutting each other, such that concrete does not readily flow through the slit.

13. A lifting facility for encapsulation in a concrete wall comprising:

a bowl element defining a cavity and having a rim occupying a rim plane;

the bowl element having a side wall defining an elongated aperture;

the aperture comprising a pair of spaced-apart openings connected by a slit;

a unitary elongated articulated member having a constant cross section and having a loop portion within the cavity; and

the articulated member having intermediate portions occupying the openings.

14. The facility of claim 13 wherein the articulated member has end portions extending laterally beyond the bowl element.

15. The facility of claim 13 wherein the opening are sized to closely receive the articulated member, such that concrete does not readily flow through the openings.

16. The facility of claim 13 including a concrete wall structure encapsulating at least a portion of the facility, the structure having a surface co planar with the rim plane, the bowl cavity being free of concrete such that the loop portion is accessible.

17. The facility of claim 13 wherein the openings are circular.

18. The facility of claim 13 wherein the openings are elliptical.

19. The facility of claim 13 wherein the openings are a pattern of radially arranged slits.

20. The facility of claim 13 wherein the slit comprises opposed panel portions abutting each other, such that concrete does not readily flow through the slit.

* * * * *