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(54) **CLAMP SYSTEMS AND METHODS FOR PILE DRIVERS AND EXTRACTORS**

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(57) **ABSTRACT**

A clamp member for use in securing a vibratory device to a pile comprises a structural portion and a surface layer. The structural portion defines peaks and valleys. The surface layer is formed on the structural portion and defines an engaging surface. The surface layer defining a thickness dimension of at least approximately 0.0025 inches and a grit of at least approximately 180 Emery.

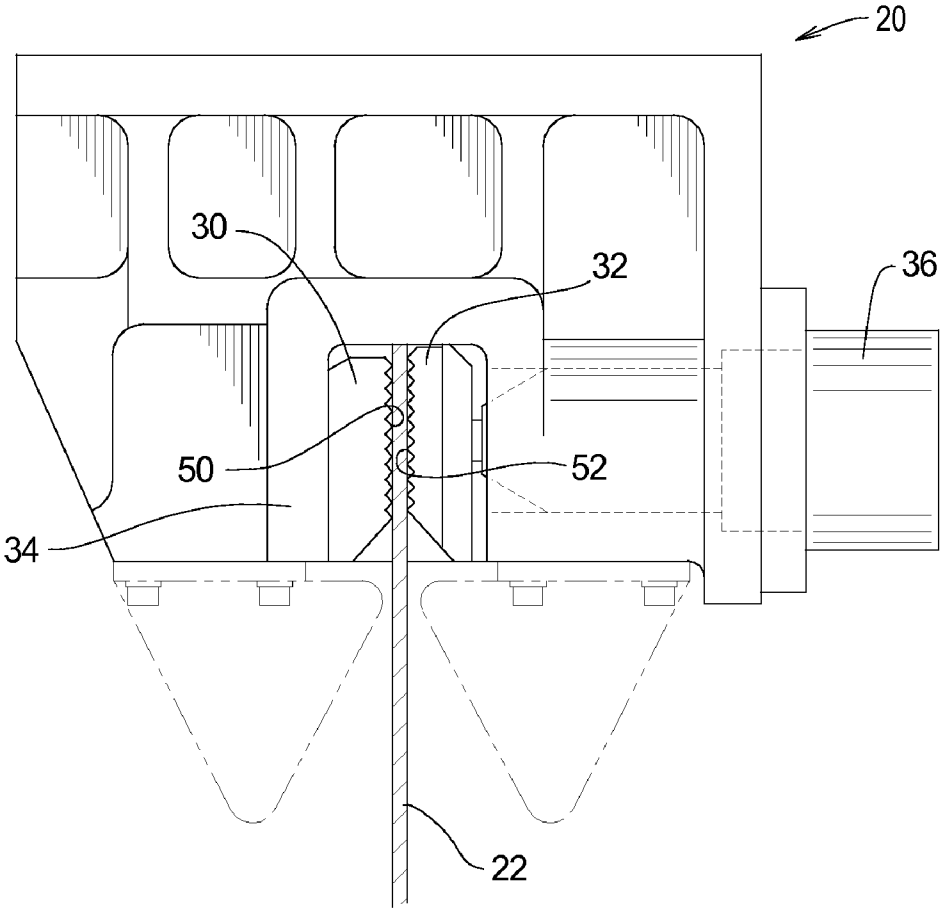


FIG. 1

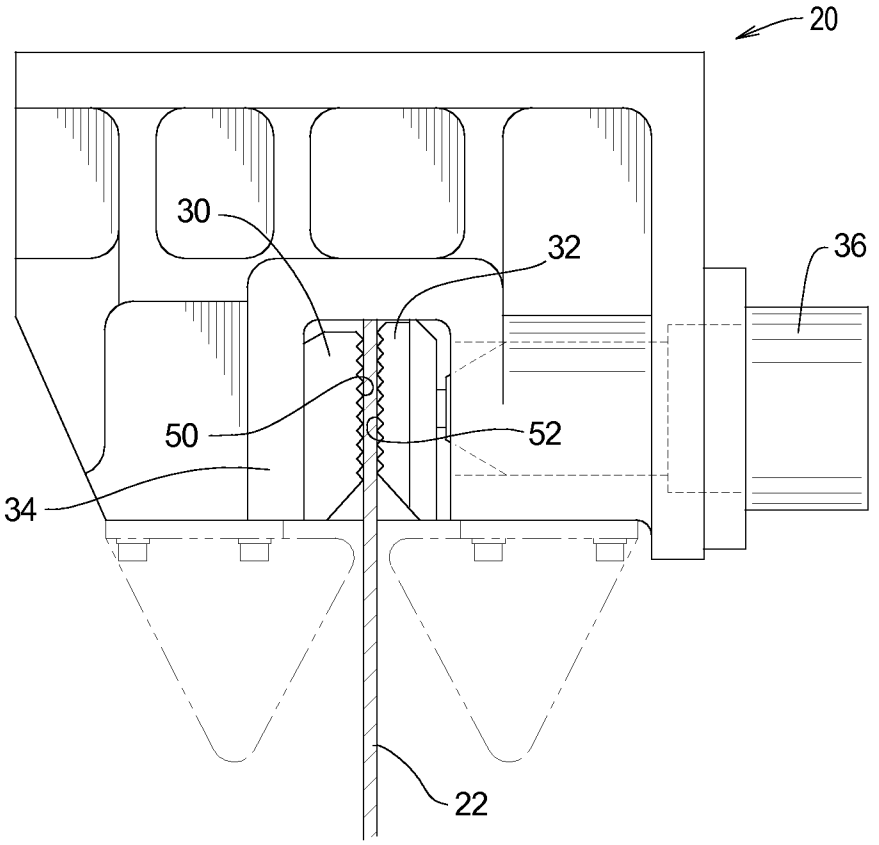


FIG. 2

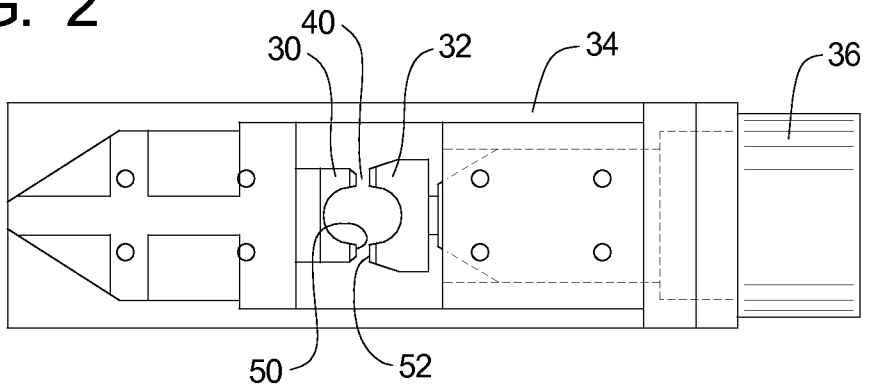


FIG. 3

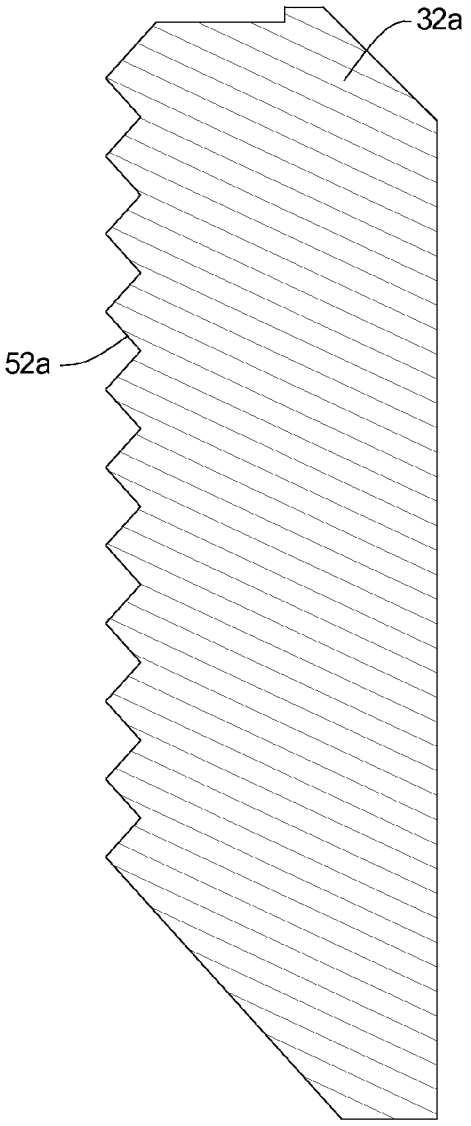
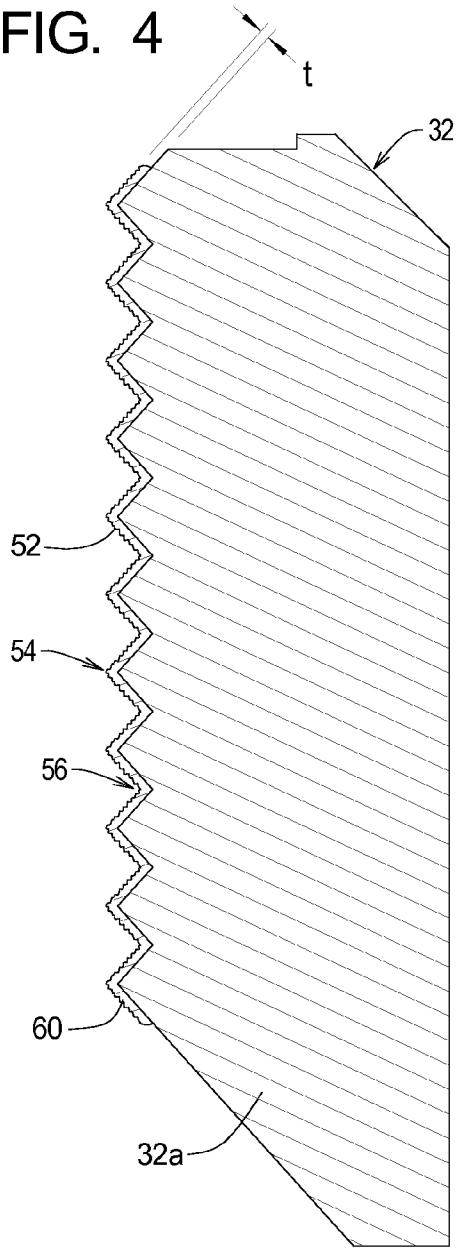


FIG. 4



CLAMP SYSTEMS AND METHODS FOR PILE DRIVERS AND EXTRACTORS

RELATED APPLICATIONS

[0001] This application (Attorney's Ref. No. P217360) is a continuation of U.S. patent application Ser. No. 13/116,919 filed May 26, 2011.

[0002] U.S. patent application Ser. No. 13/116,929 is a continuation of U.S. patent application Ser. No. 12/772,335 filed May 3, 2010, now U.S. Pat. No. 7,950,877, which issued May 31, 2011.

[0003] U.S. patent application Ser. No. 12/772,335 is a continuation of U.S. patent application Ser. No. 11/294,141, filed Dec. 5, 2005, now U.S. Pat. No. 7,708,499, which issued May 4, 2010.

[0004] U.S. patent application Ser. No. 11/294,141 claims benefit of U.S. Provisional Application Ser. No. 60/641,289 filed Jan. 3, 2005.

[0005] The contents of all related applications listed above are incorporated herein by reference.

TECHNICAL FIELD

[0006] The present invention relates to methods and apparatus for inserting rigid members into or extracting rigid members from the earth and, more particularly, to clamp systems and methods that attach a pile driver/extractor to a pile to be driven and/or extracted.

BACKGROUND

[0007] For certain construction projects, rigid members, such as piles, anchor members, caissons, sheet pile barriers, and mandrels for inserting wick drain material, must be placed into the earth. The term "piles" will be used herein to refer to the rigid members typically driven into the earth during construction projects. It is well-known that such rigid members may often be driven into or extracted from the earth without excavation by applying a driving or extracting force on an upper end of the pile.

[0008] When applying a downward driving force to a pile, it is not necessary, although perhaps desirable, to clamp the pile driver to the pile. However, when a pile is extracted from the earth, a clamp system must be used to transmit an upward extracting force to the pile to pull the pile from the earth. In addition, during both pile driving and pile extracting, a reciprocating vibratory force, typically up and down, may be applied in addition to the driving or pulling force. The use of vibratory forces also requires a clamp system to ensure that the vibratory forces are effectively transmitted to the pile.

[0009] A clamp system typically comprises first and second clamp members that engage the pile. A clamping force may be applied to one or both of the clamp members such that the pile or a portion of the pile is securely gripped between the clamp members. The clamp members may be contoured to accommodate the shape of the pile or portion of the pile to be gripped. The clamp members may be otherwise textured in some form to increase friction between the clamp members and the pile.

[0010] A primary point of failure of a pile driving or extracting system is when the driving, pulling, and/or driving forces are not adequately transmitted to the pile. The need thus exists for improved clamp systems for pile extractors and for pile drivers and extractors that employ vibratory forces.

SUMMARY

[0011] The present invention may be embodied as a clamp member for use in securing a vibratory device to a pile comprises a structural portion and a surface layer. The structural portion defines peaks and valleys. The surface layer is formed on the structural portion and defines an engaging surface. The surface layer defining a thickness dimension of at least approximately 0.0025 inches and a grit of at least approximately 180 Emery.

[0012] The present invention may also be embodied as a method of forming a clamp member for clamping a vibratory device to a pile comprising the following steps. A clamp member comprising peaks and valleys is provided. A surface layer is formed on the peaks and valleys of the clamp member such that the surface layer defines an engaging surface. The surface layer defines a thickness dimension of at least approximately **0.0025** inches and a grit of at least approximately **180** Emery.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** is a side elevation view of one example embodiment of a clamp system of the present invention;

[0014] FIG. **2** is a bottom plan view of the clamp system of FIG. **1**; and

[0015] FIGS. **3** and **4** are side, elevation sectional views of a clamp member of the present invention before and after, respectively, application of a surface layer.

DETAILED DESCRIPTION

[0016] Referring to FIG. **1** of the drawing, depicted at **20** therein is a clamp assembly constructed in accordance with, and embodying, the principles of the present invention. The clamp assembly **20** is adapted to be connected to a vibratory device (not shown) and engages a pile **22** such that vibratory forces generated by the vibratory device are transmitted to the pile **22**. The present invention is of particular significance in the context of a clamp assembly for sheet piles such as the clamp assembly **20** depicted and described herein, but a clamp assembly constructed in accordance with the present invention can be adapted to engage piles of different shapes and materials as will generally be described below.

[0017] The clamp assembly **20** comprises first and second clamp members **30** and **32**. The first clamp member **30** is fixed relative to a clamp frame **34**. The second clamp member **32** is mounted on an actuator **36** supported by the clamp frame **34**. The actuator **36**, which is operated by a hydraulic system (not shown), displaces the second clamp member **32** relative to the clamp frame **34** and thus relative to the first clamp member **30**. The first clamp member **30** and the actuator **36** are supported by the clamp frame **34** such that the actuator **36** moves the second clamp member **32** towards and away from the first clamp member **30**. When the clamp assembly **20** is arranged such that the pile **22** is in a clamp space **40** (FIG. **2**) between the first and second clamp members **30** and **32**, operation of the actuator **36** causes the pile **22** to be clamped between the clamp members **30** and **32** as shown in FIG. **1**.

[0018] The first and second clamp members **30** and **32** define first and second engaging surfaces **50** and **52**, respectively. The example second clamp member **32** is depicted in further detail in FIG. **4** of the drawing. FIG. **4** illustrates that the second engaging surface **52** defines peaks **54** and valleys **56** and is defined by a surface layer **60**. The first engaging

surface **50** may optionally be defined by a similar surface layer formed on the first clamp member **30**.

[0019] To fabricate the example second clamp member **32**, FIG. **3** illustrates that the second clamp member **32** is originally constructed in a generally conventional manner in a pre-coated form **32***a*. In the pre-coated form **32***a*, the second clamp member **32** defines an uncoated surface **52***a*. The surface layer **60** is deposited or otherwise formed on the uncoated surface **52***a* to create the second engaging surface **52** of the second clamp member **32**. The surface layer **60** is formed using a carbide alloy coating that is sprayed or otherwise deposited on the uncoated surface **52***a*. One example process for forming the surface layer **60** is marketed under the brand name CARBINITE Metal Coatings. Other processes for applying metal coatings similar to the CARBINITE process may be used instead or in addition. The surface layer **60** defines a "build-up" dimension generally corresponding to the thickness "t" of the layer **60** and also a texture or "grit" that generally defines the friction of the second engaging surface **52**. The thickness "t" of the surface layer 60 is typically within a first preferred range of 0.006" and 0.017", may be within a second preferred range of 0.0025" and 0.017", and in any event is within a third preferred range of at least 0.0025". The grit of the surface layer is typically within a first range of substantially between 100 Emery and 36 Emery, may be within a second preferred range of substantially between 180 Emery and 36 Emery, and in any event should be within a third preferred range of at least 180 Emery.

[0020] The exact thickness "t" and grit of the surface layer **60** should be determined based on the character of the pile being driven. With the example metal sheet pile **22**, the grit is preferably within approximately 180 Emery and 100 Emery. For a clamp assembly that will be used to extract a wooden pile that is coated with slime, barnacles, and/or the like, the grit is preferably greater than 60 Emery to enhance friction. For a plastic sheet pile, the grit is preferably in the range of approximately smooth to 180 Emery to reduce damage to the plastic material from which the pile is made.

[0021] The thickness "t" can also be increased to increase the wear resistance of the second engaging surface **52**. For example, the pre-coated form **32***a* of the second clamp member **32** may be made of relatively soft material that is inexpensive and easy to machine. The surface layer **60** may be applied by building up the thickness "t" thereof using several applications of the coating material to increase the thickness of the surface layer **60** on the pre-coated second clamp member **32***a* and thus protect the engaging surface **52**.

[0022] From the foregoing, it should be clear that the present invention may be embodied in forms other than the form described above. The above- described embodiment is therefore to be considered in all respects illustrative and not restrictive.

What is claimed is:

1. A clamp assembly for use in securing a vibratory device that generates vibratory forces to a pile comprising:
- first and second clamp members, where each of the clamp members comprises a structural portion defining peaks and valleys;
- a surface layer is formed on each of the structural portions, where the surface layer defines an engaging surface, the surface layer defining
- a thickness dimension of at least 0.0025 inches; and
- a grit of at least 180; and
- a hydraulic actuator for displacing the second clamp member relative to the first clamp member such that the engaging surfaces of the first and clamp members engage the pile to transmit at least the vibratory forces generated by the vibratory device to the pile.

2. A clamp assembly as recited in claim **1**, in which the surface layer is formed of carbide alloy material.

3. A clamp assembly as recited in claim **1**, in which the surface layer defines a thickness dimension of substantially between 0.0025 inches and 0.017 inches.

4. A clamp assembly as recited in claim **1**, in which the surface layer defines a thickness dimension of substantially between 0.006 inches and 0.017 inches.

5. A clamp assembly as recited in claim **2**, in which the surface layer defines a thickness dimension of substantially between 0.0025 inches and 0.017 inches.

6. A clamp assembly as recited in claim **2**, in which the surface layer defines a thickness dimension of substantially between 0.006 inches and 0.017 inches.

7. A clamp assembly as recited in claim **1**, in which the surface layer defines a grit of substantially between 180 and 36.

8. A clamp assembly as recited in claim **1**, in which the surface layer defines a grit of substantially between 100 and 36.

9. A clamp assembly as recited in claim **2**, in which the surface layer defines a grit of substantially between 180 and 36.

10. A clamp assembly as recited in claim **2**, in which the surface layer defines a grit of substantially between 100 and 36.

11. A clamp assembly as recited in claim **1**, in which the surface layer comprises at least one coating layer of coating material.

12. A clamp assembly as recited in claim **11**, in which the surface layer comprises a plurality of coating layers of coating material.

13. A clamp assembly as recited in claim **2**, in which the surface layer is formed by at least one coating layer of coating material.

14. A clamp assembly as recited in claim **13**, in which the surface layer is formed by a plurality of coating layers of coating material.

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