G. C. VERNON-INKPEN.

CONCRETE PILE.

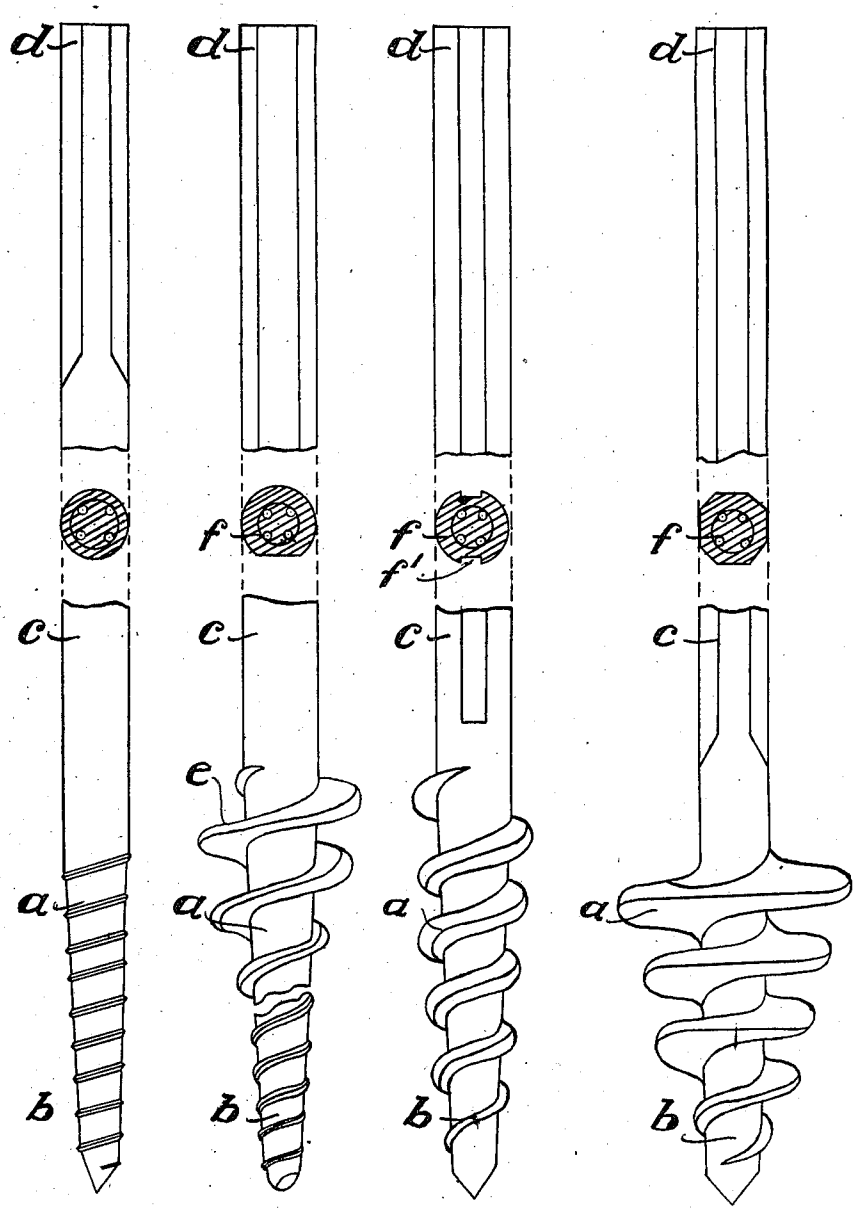
APPLICATION FILED OCT. 3, 1910.

996,688.

Patented July 4, 1911.

3 SHEETS—SHEET 1.

FIG. 1. FIG. 2. FIG. 3. FIG. 4.



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3 SHEETS—SHEET 2.

FIG. 5.

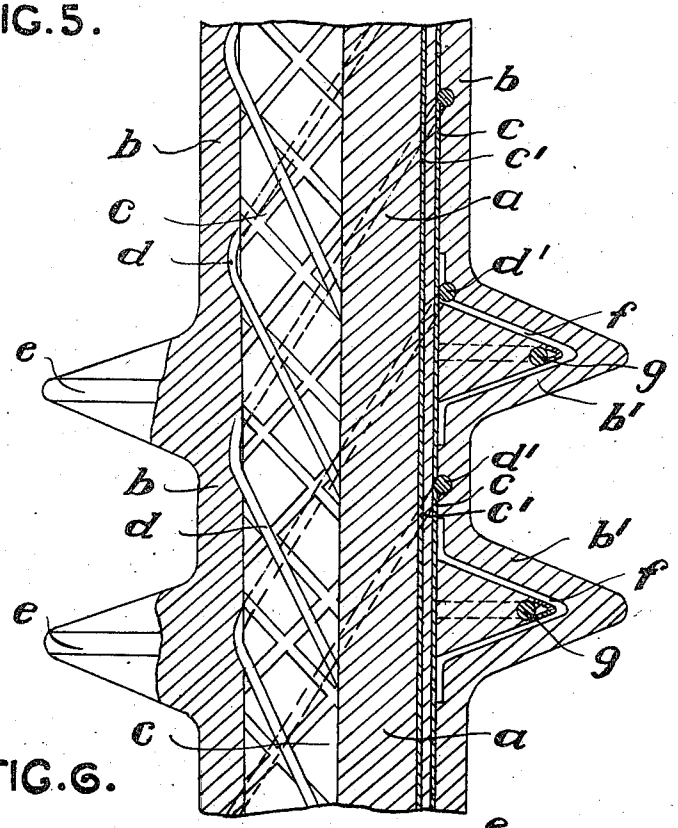
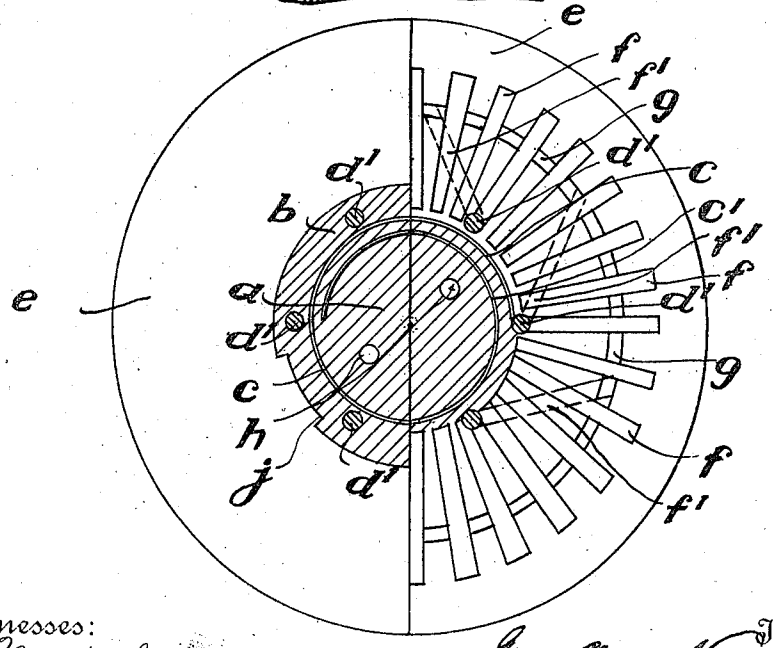


FIG. 6.



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3 SHEETS—SHEET 3.

FIG. 7.

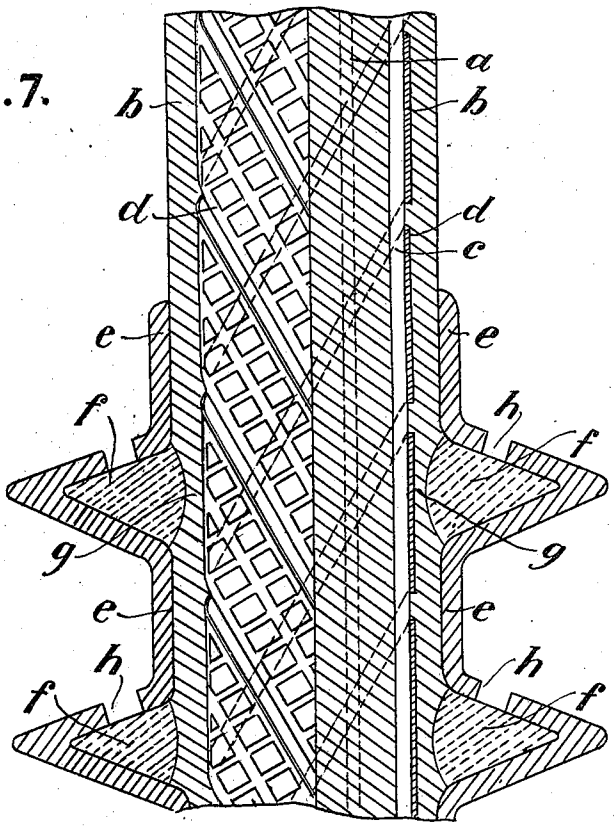
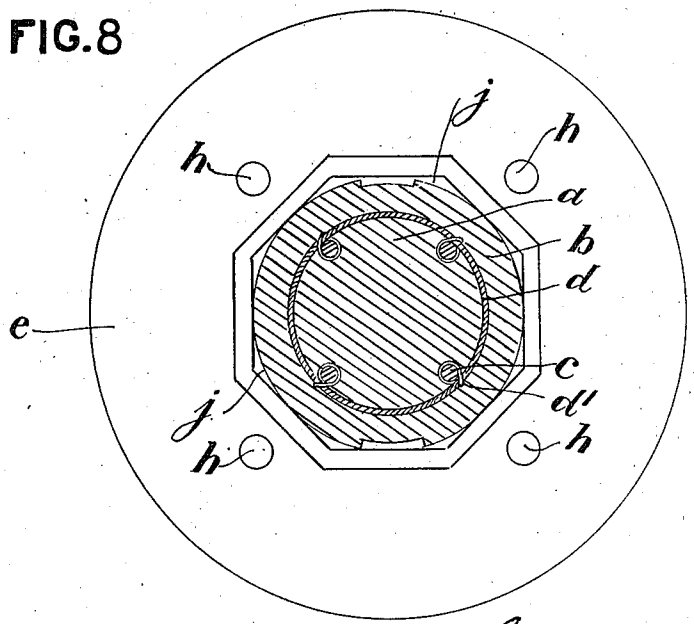


FIG. 8



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UNITED STATES PATENT OFFICE.

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CONCRETE PILE.

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Application filed October 3, 1910. Serial No. 585,032.

To all whom it may concern:

Be it known that I, GEORGE CHARLES VERNON-INKPEN, a subject of the King of Great Britain, residing in Portsmouth, Hants, England, have invented certain new and useful Improvements in Concrete Piles for Foundations and Similar Purposes, of which the following is a specification.

This invention has reference to piles made of reinforced concrete capable of a great supporting capacity for use in securing foundations for quays, walls, piers, columns, etc., either for works of a subaqueous nature or in soils above the surface of water particularly through marshy or boggy strata, mud, loose or running sand or other soft soils in order to secure a solid and firm foundation for carrying erections, works, superstructures, supports or the like. The invention is also applicable for use by being able to be screwed into any soils and secure and anchor foundations for holding down structures such as large sheds for aeroplanes, warehouses, stores, factories and similar buildings erected with light materials in exposed situations and subject to much wind pressure, also to columns and the like for carrying telegraphic wires, cables, signals or similar purposes requiring a firm foundation in the soil as would be obtainable by screwing in the base end of the column as hereafter set forth.

My invention consists in concrete screw piles in which reinforced concrete spiral flanges, worms, or blades around their circumference form an integral part of the concrete pile body or shaft and by the application of continuous helical metallic bars, rods, bands or wrappings embedded in the concrete and possessing strength and efficiency to resist a twisting or torsion strain in conjunction with a suitable continuous vertical reinforcement of the concrete pile shaft preferably as shown by the accompanying drawings and hereafter described to resist a lateral or breaking-off strain or fracture, such as might occur to a screw pile when being screwed into a compact mass for the uses and purposes set forth in this specification, also providing means for securing to the reinforced concrete pile shaft metal incasements or molds as protection to the concrete spiral flanges, worms or blades of the screw, as hereafter described.

For the purpose of this invention I employ concrete in combination with steel, as hereafter set forth in the construction of the piles which are capable of being formed and made, if desired, at or near the place they are required to be used, preferably where the materials for the concrete can be obtained cheapest and at the least cost for carriage.

In the construction of the pile either at its base, along its length or in both positions, if required, are to be molded and formed, in conjunction with the shaft, one or more blades or flanges formed as a screw, the pitch of the blades or the worm of the screw varying, the blades projecting more or less from the body of the shaft as the circumstances and uses for which the pile may be required and depth of soil or strata into which the pile is intended to penetrate, as shown in Figures 1, 2, 3 and 4.

In fixing screw piles into position they might penetrate a fairly solid stratum near the surface and afterward pass into a bed of running or soft sand before finding a lower solid foundation upon which the end of the pile might rest while the upper blades or flanges of the screw could also receive support from the upper stratum.

The method proposed for screwing the piles direct into the soil or into holes previously prepared to receive them and also removing them when so required, are those usually and customarily used, such as wheels, winches, capstans and the like, for which purpose it is intended to form along the length of the shaft of the pile one or more sunk keyways or form one or more flat sides or heads to receive a movable wheel or other contrivance which could be secured to the shaft for imparting a revolving motion to the pile and capable of being raised, lowered or removed as desired.

In order that my invention may be better understood, I append the accompanying drawings, which illustrate by way of example the various forms or designs for the pile and its reinforcement.

Figs. 1, 2, 3 and 4 are elevations of the

pile to suit varying circumstances and requirements. Fig. 1 is intended for penetrating stiff soils or compact bodies; Fig. 2, suitable for partly hard and partly loose soils; Fig. 3, for light soils; Fig. 4, for soft soils; Fig. 5 is a vertical section through a part of the pile, one half through the center of the shaft and the other half with the outer casing of concrete removed, showing the helical reinforcement in elevation; Fig. 6 is a half transverse sectional plan of Fig. 5 through worm of screw, and a half section through shaft of pile above; Fig. 7 is a vertical section through part of pile, showing an alternative arrangement for reinforcement and also a metal envelop or casing forming the blades of the screw, one half of the section showing the outer part of the concrete removed, with the helical reinforcement in elevation and the other half section through the center portion; and Fig. 8 is a sectional plan of Fig. 7 through the shaft, showing an alternative arrangement for its reinforcement, and a plan of the metal envelop or casing for the blades of the screw.

Referring to Figs. 1 to 4, *a* is the worm of the screw of any pitch or length. *b*, the point of the screw. *c*, shaft of the pile of any convenient length. *d*, one or more flat sides, as shown sectionally at *f* on Figs. 2 and 4, or one or more keyways, as Fig. 3. *e* on Fig. 2, projecting worms, flanges or blades for soft soils are intended to be placed in any convenient position along the length of the pile.

Referring to Fig. 5, *a*, is concrete center of shaft within the reinforcement. *b*, concrete outside the helical reinforcement of shaft. *b'*, concrete forming the blade of screw. *c*, outer coil reinforcement consisting of a wrapping of a sheet of expanded metal, perforated sheet steel, interlaced steel rods or the like. *c'*, inner coil reinforcement consisting of a wrapping of a sheet of expanded metal, perforated sheet steel, interlaced steel rods or the like. *d*, helical reinforcement rods in elevation wound around the cylinder *c* and *c'*. *d'*, helical reinforcement rods in section. *e*, blade of screw part in elevation. *f*, metal brackets with radiating and tangent arms as reinforcement to blade of screw secure to the reinforcement of shaft and band or ring *g*.

Referring to Fig. 6, *a*, is concrete of shaft within the reinforcement. *b*, concrete of shaft without the reinforcement. *c*, outer coil reinforcement consisting of a wrapping of a sheet of expanded metal, perforated sheet steel, interlaced steel rods or the like. *c'*, inner coil reinforcement consisting of a wrapping of a sheet of expanded metal, perforated sheet steel, interlaced steel rods or the like. *d'*, helical reinforcement rods in section. *e*, blade of screw. *f*, metal bracket with radiating and tangent arms *f'* as reinforcement of blade or screw. *g*, steel ring connected with the bracket *f* of T or V-shaped section. *h*, pipes embedded in the concrete for water pressure.

Referring to Fig. 7, *a* is concrete center of shaft of pile within the reinforcement. *b*, concrete outside the reinforcement. *c*, vertical rods the entire length of pile or shaft and connected with the base or shoe. *d*, helical band of expanded or perforated metal sheets or interlaced rods, bars, or strands of wire wound around the rods *c* and attached to them. *e*, metal envelop or casing for the blades or flange of the screw capable of being formed up with the shaft or attached to it afterward. *f*, concrete grout forming key, securing metal envelop to shaft. *g*, keyway around pile for concrete grout for forming key, securing metal envelop to shaft. *h*, hole in metal envelop for receiving concrete grout for securing the metal envelop or casing *e*.

Referring to Fig. 8, *a*, is concrete in center of shaft within the reinforcement. *b*, concrete outside of center of shaft within the reinforcement. *c*, vertical metal rods for reinforcement. *d*, helical band of expanded or perforated metal sheets, or interlaced rods, bars, or strands of wire wound around the rods *c*, and attached to them. *d'*, bindings connecting the vertical metal rods *c* and the helical band *d*. *e*, metal envelop or casing for the blades or flange of screw capable of being formed up with the shaft or attached to it afterward. *h*, holes for receiving concrete grout for securing the metal envelop or casing *e*. *i*, hexagonal or flat-sided part of pile engaging with a corresponding socket in metal envelop or casing.

The piles are to be carefully made with cement concrete mixed with materials of standard quality and proportions and thoroughly consolidated and rammed and formed into a solid mass surrounding a reinforcement of steel or other suitable material and of suitable design to resist torsion and compression. The arrangement of reinforcement, as shown on drawings Nos. 5 and 6 of the shaft of the pile, is intended to be formed with a wrapping *c* and *c'* of sheet expanded steel, perforated sheet steel, interlaced steel rods, or the like until its long sides overlie to a considerable extent, and arranging on the outside of the cylinder *c* and *c'* so formed a number of rods *d* and *d'*, Fig. 5, and *d'*, Fig. 6, wound around the cylinder *c* and *c'* in a continuous and helical direction so as to produce a helix of opposite signs to the helix of the sinking screw.

An alternate arrangement for the reinforcement of the shaft is shown on Figs. 7 and 8, in which a number of vertical metal rods *c* are embedded in the concrete *a* for

its entire length—from the shoe to the top of the head and around which a spiral band cylinder or wrapping *d* of sheet expanded metal, perforated sheet steel, interlaced steel rods, strands of wire or the like in a continuous and helical direction and secured by wire *d'* to the vertical rods *c* so as to produce a helix of opposite sign to the helix of the sinking screw, as described in reference to Figs. 5 and 6. The metallic continuity of the helical reinforcement in each arrangement to be maintained throughout the entire length of the pile so as to efficiently transmit the torsional strain necessary for screwing down the pile, bringing into compression the concrete forming the shaft of the pile, Figs. 5 and 6, etc., the helical reinforcement being in tension and exerting a strain in the opposite direction to that brought to bear in fixing or screwing the pile into position and counteracting any likely fracture by torsion of the shaft. The twisting strain to sink the piles is communicated direct from the shaft to the screw.

The blades or flanges, *e*, Figs. 5 and 6, forming the worms of the screws are intended to be reinforced and supported by the steel or other metal brackets *f*, either formed and secured separately to the cylinder *c* and *c'*, Figs. 5 and 6, or formed in a series from a sheet of steel or other metal partly cut, as radiating arms *f*, and wrapped spirally around the cylinder *c* and *c'*, Figs. 5 and 6, to which the ends of the arms or sheet are to be fixed. The apex of the arm is to be secured to a metal ring *g*, Figs. 5 and 6, of T or V section inside the radiating arms and keeping them equidistant and in regular position with the pitch of the screw. The ring *g*, Figs. 5 and 6, is to be attached by tangent arms *f'*, Figs. 5 and 6, to the cylinder *c* and *c'*, Figs. 5 and 6. The foregoing reinforcement encircles the shaft as a helix in the direction of the pitch of the sinking screw to resist a shearing or breaking off strain, as might occur if brought into contact with rock boulders or other hard substances. As an alternative arrangement, the blades or flanges forming the screw could be made of metal, *e*, Fig. 7, and either built up with the shaft of the pile as an envelop mold or casing, or could be attached thereto afterward and amalgamated with it by forming a key of grouted concrete, as shown on Figs. 7 and 8 at *f*, the concrete shaft *b* being formed with hexagonal sides, flats or keyways prepared to receive and engage with corresponding hexagonal sides, flats or keyways provided in the socket of the metal envelop *e*, Fig. 7, *j*, Fig. 8 and to be secured thereto on being placed together by cement concrete grout poured in through the holes, *h*, Figs. 7 and 8, and filling up the space, *f*, Fig. 7, between the inside of the metal envelop or casing and the sunk ways or hollows on the shaft of the pile at *g*, Fig. 7, and when set forming a solid bonding key integral with the pile which would prevent the shoe from slipping up or down the shaft while the hexagonal sides of the shaft and hole to receive it in the metal envelop would prevent a twisting or turning movement under the strain necessary in screwing the pile into position.

The piles are intended to be formed solid—but they could be formed with a hollow core within the reinforcement and also have means for providing water pressure to assist the screwing up or down of the piles.

The piles may be provided with a steel point in conjunction with the metal envelop or casing forming a mold, into which the lower part of the pile could be embedded or could be, if formed hollow, have the lower ends provided with metal rings having chisel-shaped beveled or serrated edges for cutting through soils and obstructions in the strata.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is performed, I wish it to be understood that I make no general claim to the use of steel or other metals either as rods, bars, or in perforated or expanded sheets for the reinforcement of concrete as piles or otherwise, or the combination of a plurality of vertical longitudinal metal rods with or without metal ties looped around them and embedded in the concrete to form a pile or pile-like structure, neither do I make any general claim to the use of metal flanges, blades or screws in the construction of such reinforced concrete piles, or pile-like structures either placed at their bases or along their vertical lengths, but

What I claim is:—

1. A pile column or the like comprising a shaft, screw threads formed thereon, and a helical coil reinforcement in said shaft and wound in a direction reverse to that of the screw thread.

2. A concrete pile column or the like comprising a shaft, screw threads formed on the lower end of the shaft, and a helical coil reinforcement in said shaft and wound in a direction reverse to that of the screw thread.

3. A concrete pile, column or the like comprising a shaft, concrete threads formed at the lower part thereof, and reinforcing means carried in said threads and extending near the outer edge of the same.

4. A pile column, or the like, comprising a concrete shaft, concrete screw-threads formed on the lower part thereof, and reinforcing brackets carried in the screw-threads and extending near the outer edge of the same.

5. A pile, column or the like comprising a concrete shaft having a key-way, a metal envelop on the lower end of the shaft and formed into screw-threads, and concrete grout between said envelop and shaft and forming a key therebetween engaging in said key-way.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

GEORGE CHARLES VERNON-INKPEN.

Witnesses:
R. VERNON-INKPEN,
A. E. MOORE.