June 18, 1940. C. G. CAPPEL 2,204,924

PILE

Filed Feb. 18, 1939 2 Sheets-Sheet 1

Fig. 1.

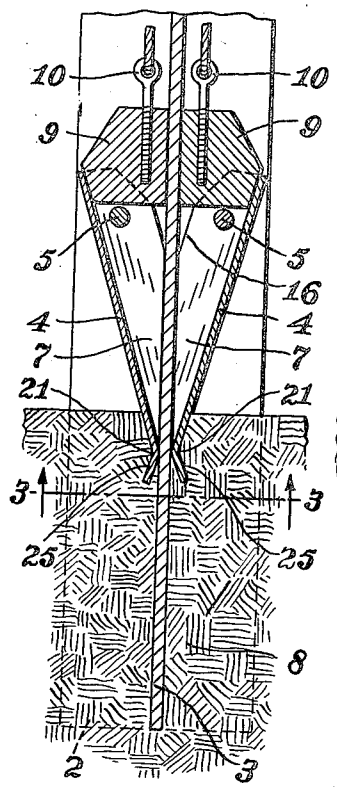


Fig. 2.

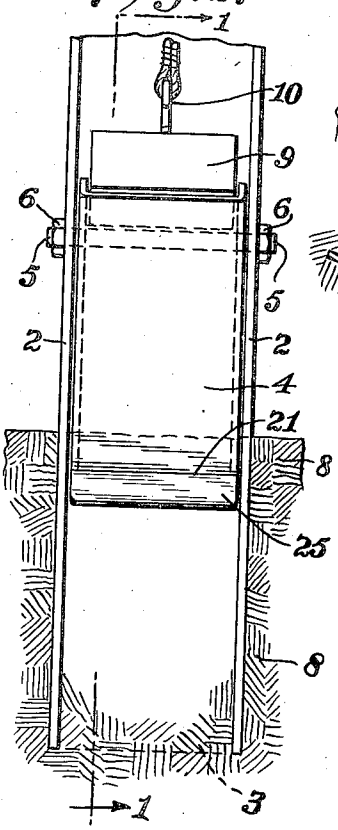


Fig. 4.

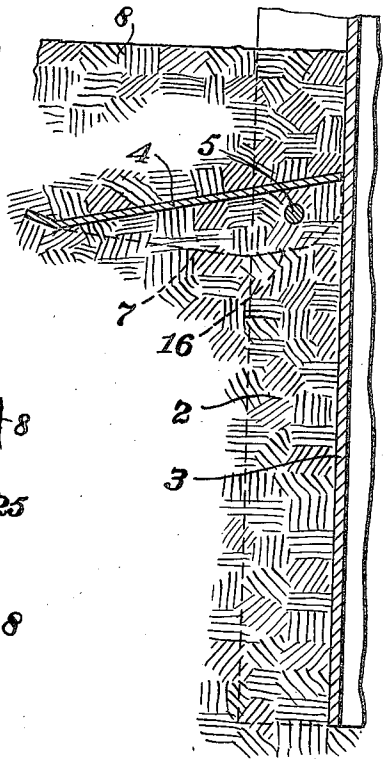


Fig. 3.

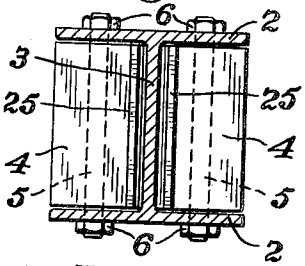


Fig. 6.

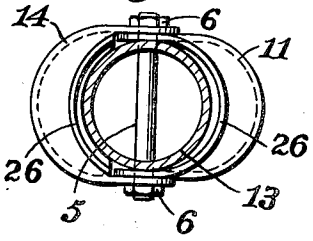


Fig. 5.

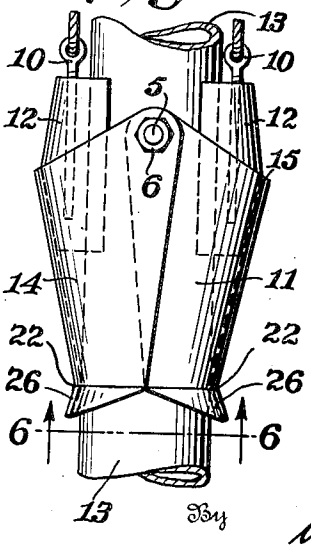
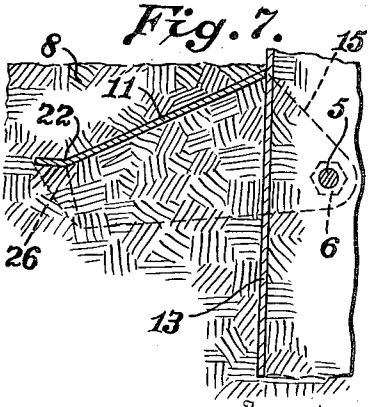


Fig. 7.



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Fig. 8.

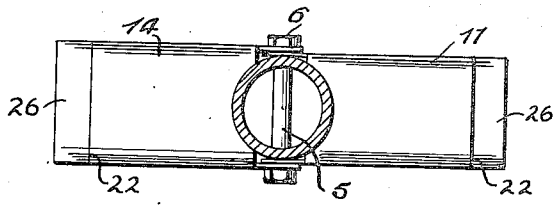


Fig. 9.

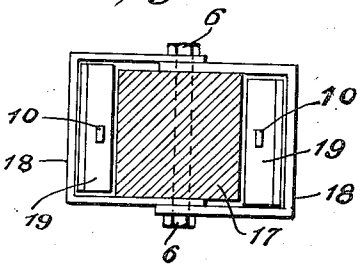


Fig. 10.

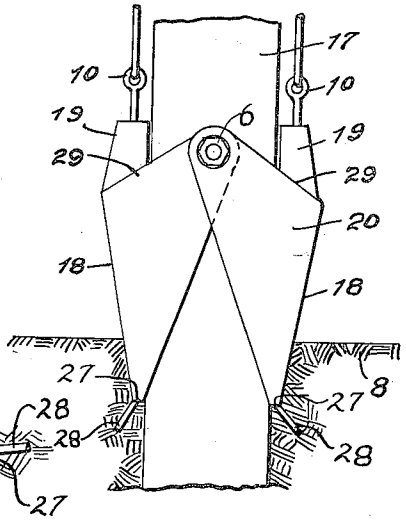
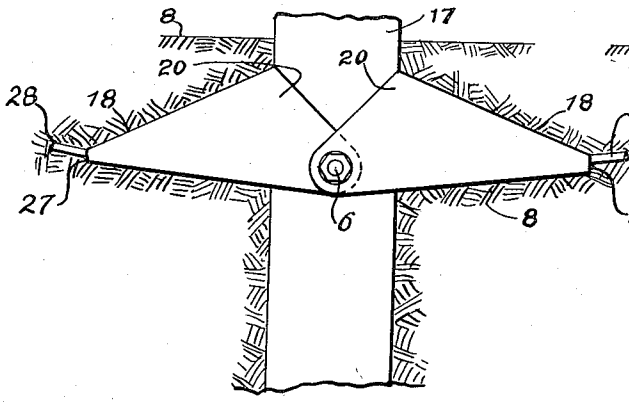


Fig. 11.



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Patented June 18, 1940 2,204,924

UNITED STATES PATENT OFFICE

2,204,924

PILE

Curry Glenn Cappel, New Orleans, La.

Application February 18, 1939, Serial No. 257,244

10 Claims. (Cl. 61—53)

The present invention relates to foundation supporting devices, all of which are broadly covered by the term "piles" and more specifically to piles, the sliding resistance to surrounding earth of which can be increased when so desired. This application is a continuation in part of my copending application Serial No. 242,618, filed November 26, 1938, now Patent No. 2,174,436, granted September 26, 1939.

It has been found by experience that piles which are driven into earth strata, which of its own characteristics does not support the piling when the weight of a foundation structure is applied thereto, can only be used in this particular strata by increasing the sliding resistance of the pile to the earth and in order to increase the resistance, said pile must displace and compact the earth through which it is driven. Many types of piles of varying materials and shapes have been developed in an attempt to increase the load bearing qualities of piling in such strata as does not supply a fixed base or support for the end of the pile. The well known steel H-beam pile could carry no appreciable load except when it reached some hard stratum like rock or when driven a considerable length into materials such as sand or gravel. However, in ordinary soils, the H-beam pile did not displace sufficient earth to develop enough frictional resistance for supporting a load. Steel plates, timbers and other devices were permanently mounted through steel piles at right angles thereto to increase the cross section thereof at those points with a hope that by this means, the sliding resistance of the pile would be increased but such scabbing increased the size of the passage through the earth to an area equal to the outside dimensions of the pile plus the scabbing and this increased projected area caused the loss of supporting earth to some sections of the pile and further increased the difficulty in driving the pile. Other known piling of a tubular type has had apparatus mounted therein which could be driven outwardly through openings of the pile to engage the surrounding earth in an attempt to stabilize the pile. This type is expensive to construct and, further, due to the clogging effect of earth or rocks at the openings of the pile, was frequently inoperative. The present invention has for its principal object to provide a pile with stabilizing apparatus therewith and which combination eliminates the drawbacks and failures of known piles.

An object of the present invention is to provide a pile which can be stabilized when desired to increase its load carrying capacity without greatly increasing the size of the earth penetration normally required for like piles minus the stabilizing means.

Another object of the present invention is to provide a pile having means in conjunction therewith which will, when in a given position relative to said pile, add no substantial increase in the resistance of the pile to the earth being penetrated and yet will, when desired, readily and quickly assume another position through contact with said earth for stabilizing said pile therein.

Another object of the present invention is to provide means to be used in connection with pile stabilizers of the type which are rotatable relative to the pile for assisting them by contact with the earth being penetrated to readily and quickly rotate as desired.

A further object of the present invention is to provide a pile having stabilizing means in conjunction therewith, which stabilizing means are not limited in area by their connection to the said pile.

Another equally important object is to provide a pile with a stabilizing means in connection therewith, which combination provides a sufficient increase in the size of the penetration into the earth relative to the size of the pile to permit the withdrawal of apparatus along the sides of the pile but without noticeably increasing the resistance of the pile to its surrounding earth while being driven.

Another important object of the present invention is to provide a stabilizing means, the principle of which can be readily applied to piles of all shapes and sizes.

Further objects of the present invention will be in part obvious and in part pointed out in the following detailed description of the accompanying drawings wherein are disclosed several modifications, by way of example, of applying the present invention.

In the drawings:

Fig. 1 is a cross section taken on line 1—1 of Fig. 2.

Fig. 2 is a side elevation of an H-beam pile with stabilizers mounted thereon in a closed position.

Fig. 3 is a cross sectional bottom view taken upon and looking in the direction of line 3—3 of Fig. 1 but showing the device as a whole.

Fig. 4 is a broken away cross section of a portion of the H-beam pile having the stabilizers mounted thereon in open position beneath the surface of the ground.

Fig. 5 is a side elevation of a tubular pile with stabilizers mounted thereon in a closed position.

Fig. 6 is a bottom view of Fig. 5, taken on line 6—6.

Fig. 7 is a broken away cross sectional view of the tubular pile with one of the stabilizers in its released and open position, positioned at a point beneath the surface of the ground.

Fig. 8 is a top view of the modification shown in Fig. 5 but with the stabilizers in the open position.

Fig. 9 is a top view of a square pile with the stabilizers mounted thereon in closed position.

Fig. 10 is a side elevation of Fig. 9 with the piling and stabilizers being driven into the earth, and

Fig. 11 is a side elevation of the modification shown in Fig. 10 with the stabilizers in an opened or released position as they would be beneath the surface of the earth.

Referring now more particularly to the accompanying drawings wherein like and corresponding parts are designated by similar reference characters throughout the several views, I have herein illustrated several modifications, by way of example, for carrying out the present invention. Referring to Figs. 1 to 4 inclusive, reference numeral 1 designates an H-beam pile consisting of a pair of side walls 2 and an intermediate connecting wall 3. Mounted across and through said side walls are a pair of bolts 5, one of which is mounted on either side of said intermediate wall 3. Said bolts 5 are threaded at both ends and retained in their respective positions by means of nuts 6 in threaded engagement therewith. Pivotally mounted upon said bolts 5 are a pair of stabilizers 4, which stabilizers consist primarily of a broad plate capable of fitting between side walls 2 of the pile and a pair of sides 7 which are substantially at right angles to the plate and which have bolts 5 passing through diametrically opposite openings formed along the outer edge of said sides 7 in the upper portion thereof for comprising the pivotal connection of the stabilizer upon said bolts. A portion of said side walls 7 is tapered as at 16 in order to permit the stabilizer to pivot without the same contacting intermediate wall 3 until the stabilizer 4 is in an open position, that is, when it is projecting laterally from said pile. Formed contiguous with and extending from the lower end 21 of each of said stabilizers 4 is a flared portion or lip 25. Lip 25 diverges sufficiently from stabilizer 4 for said lip to extend away from wall 3 upon the contact therewith of said lower end 21. Interposed between the upper end of said stabilizers 4 and the intermediate wall 3 are a pair of blocks 9 expressly shaped to snugly fit therebetween in order to retain said stabilizers 4 in their closed position. Connected to said blocks 9 are a pair of eyebolts 10 to each of which is connected a cable or rope, which cable extends upwardly along said pile. Side walls 7 are further shaped in such a manner that when the stabilizer 4 is in a closed position, a portion of said side walls contacts the intermediate wall 3 whereby the broad plate extends at an angle upwardly and outwardly from said intermediate wall 3 in such a manner that said stabilizers substantially form a wedge.

In the operation of this principal modification of the present invention, the H-beam pile is driven downwardly into a stratum of earth, for example, which will not ordinarily support the H-beam with a load thereon until a short distance from the point at which it is desired to maintain the same. During this driving motion, blocks 9 have retained the stabilizers 4 in their closed position and due to the wedge shape of said stabilizers, the same has readily moved downwardly with the H-beam pile, causing a passage in the earth substantially equal to the total outside dimensions of said pile. When the pile has reached the aforementioned point, the cables attached to eyebolts 10 are pulled upwardly by operators together with the blocks 9 through the passage in the earth formed by said closed stabilizers 4. With the removal of the blocks 9, the pile is driven a few feet further and the lip 25 of the stabilizers will bite into the earth at the start of said drive and function in a manner similar to a rudder by following the path of least resistance through the earth which will be away from the vertical or downward path of the pile 1 due to the diverging position of lip 25 relative to wall 3 of said pile 1. Further, earth will be compressed between lip 25 and wall 3 and will act as a wedge for forcing the two members apart with the result that the stabilizers 4 will be caused to pivot immediately upon the downward movement of pile 1 after the removal of blocks 9. Said lips 25 will naturally follow an arc which is favorable to the pivotal movement of the stabilizers and their angle of divergence relative to the wall 3 and also relative to the stabilizer 4 is a matter of design for obtaining the best results. Therefore, due to the force transmitted to the stabilizers by the pile at their points of connection, said stabilizers will be forced outwardly gradually as the pile is driven downwardly, until the upper end of each of said stabilizers contacts the intermediate wall 3, at which point the downward movement of the pile should be discontinued. The stabilizers have now compressed and are supported by a large additional area of the surrounding stratum and as a result thereof, the sliding resistance of the earth to the pile has been greatly increased, whereby, the pile will remain in its stabilized position even upon the addition of a load thereto considerably heavier than loads previously applied to H-beam piles situated in like strata. The plate and side walls of the stabilizers form substantially a scoop shape and as a result thereof, retain the earth thereunder and prohibit the sliding of the earth therefrom. In this manner, any downward movement of the pile and stabilizer only increases the amount of earth compacted thereunder and the more the downward movement thereof, the greater the increase of the resistance of the earth to said pile.

Figs. 5 to 8 inclusive, of the drawings, disclose a second modification of the present invention wherein stabilizers are applied to a round or tubular pile. In this modification, casing 13 represents a tubular pile but, of course, may equally as well be solid without deviating from the present construction. Mounted through said pile 13 upon a diameter thereof is a bolt 5 and pivotally mounted upon each outer end portion of said bolt 5 are a pair of stabilizers 11 and 14. Each of said stabilizers 11 and 14 have a pair of diametrically opposed openings formed through the upper portion along the outer edges thereof for permitting said bolt 5 to pass therethrough comprising a pivotal mounting of the stabilizers upon said bolt 5. Nuts 6 in threaded engagement with said bolt 5 retain the stabilizers

on said bolt and at the same time, retain the bolt in position relative to the pile. As will be noted especially in Fig. 5, stabilizers 11 and 14 are formed having a pair of straight walls connected by a semi-circular wall, thereby creating a deep scoop-like form therefor. These three walls of the stabilizers have their top edge 15 thereof shaped concave to permit the said walls to arrive at a position approximately at right angles to the pile when the stabilizers are in an open position. Stabilizers 11 and 14 each have extending from their bottom end 22 a flared portion or lip 26 which, as shown, extends away at an angle from the entire lower end 22 but may be sized and positioned upon a portion of said end 22 whenever such a sized lip 26 will function as is desired. As in the previous modification, a pair of blocks 12 are each interposed between one of the stabilizers and the pile 13 for retaining the stabilizers in a closed position around said pile. When in a closed position, said stabilizers 11 and 14 are substantially wedge-shaped, having a cross section approximately equal to the cross section of the pile at their lower end and extending upwardly and outwardly with a cross section larger than the pile at their upper end.

The operation of this second modification is quite similar to the first mentioned modification in that the pile 13 is driven downwardly while the stabilizers 11 and 14 are retained in their closed wedge-shaped position by means of the blocks 12. The pile is driven downwardly into the earth 8 until a short distance above the point at which the pile is to be maintained and then the blocks 12 are drawn upwardly through the passage formed in the earth by the closed stabilizers 11 and 14 by means of the cables attached to eyebolts 10. The pile is then driven downwardly and the lower lips 26 of the stabilizers 11 and 14 from the beginning of the drive, bite into the surrounding stratum and are caused to move at an angle from the direction of movement of pile 13 due to the natural tendency of the lip 26 to move through the surrounding earth with its lower edge foremost. The diverging position of lips 26, relative to pile 13, causes earth to be compressed in the space therebetween and this compressed earth will function in the manner of a wedge for forcing the lips and their connected stabilizer away from pile 13 but due to the pivotal connection therebetween, lips 26 will move through an arc and said stabilizers 11 and 14 are caused to move outwardly from the pile 13 until the upper edge 15 of said stabilizers contacts the pile 13 and arrests the motion of the stabilizers. In this manner, pile 13 compacts a greater area of earth than with the stabilizers closed and any further downward movement thereof is braked due to the large increase in resistance of the earth compacted under the scoop-shaped stabilizers 11 and 14. By the scoop shape of said stabilizers, the earth is prevented from escaping therefrom and any downward movement of the pile due, for instance, to an increase of load thereon, will be met by an increased resistance as more of the surrounding stratum is packed under the stabilizers.

Another example or modification for carrying out the principle of the present invention is disclosed in Figs. 9 to 11 inclusive, wherein stabilizers are applied to a solid, rectangular pile. Reference numeral 17 indicates a square pile having a bolt mounted therethrough and which bolt has pivotally mounted on the outer portions thereof a pair of stabilizers 18. The outer portions of said bolt pass through diametrically opposed openings formed in the upper portion of said stabilizers near the outer and top edges thereof and nuts 6 in threaded connection with said bolt retain the said stabilizers thereon as well as maintain the bolt in its position relative to said pile 17. Said stabilizers 18 are formed having a plate and a pair of side walls 29 connected to and projecting substantially at right angles from the plate. The upper edge 29 of said side walls 29 are shaped to permit the stabilizers 18 to project laterally from said pile 17 when in their open position. The plate of each of said stabilizers 18 has a lip or flared portion 28 formed contiguous with and extending from the lower end 27 thereof. Lips 28 are formed at an angle with said plate of the stabilizers 18 in order that upon end 27 being in its closed position against pile 17, the lip 28 will diverge from the said pile. Interposed between the plate of said stabilizers 18 and the pile 17 are a pair of blocks 19 which are shaped to snugly fit therebetween and retain the stabilizers in a closed position relative to said pile 17. Said blocks have eyebolts 10 connected thereto and extending vertically therefrom, which eyebolts are in turn connected to cables which extend upwardly along the sides of said pile 17.

By driving the square pile 17 downwardly into a section of earth with the stabilizers retained in their closed position by the blocks 19, said stabilizers, which as shown expressly in Fig. 10 having substantially a wedge shape when in their closed position, will create a sufficient enlargement of the passage through the earth over the passage normally made by the square pile alone to permit the blocks 19 to be drawn upwardly along the sides of said pile and outwardly above the surface of the earth with a minimum amount of effort. This slightly increased passage around the pile may be filled in with a concrete or the like, if so desired, or with additional earth. The removal of the blocks 19 trips the stabilizers 18 and permits the same to be rotatable about their pivot point. Said blocks 19 are only removed from their position between the pile and said stabilizers 18 when the combination has reached a point directly above that at which it is desired to sustain the pile. Upon the removal of the blocks 19, the pile 17, similar to the aforementioned operations as applied to the previous modifications, is caused to move downwardly. The lips 28 of said stabilizers 18 meet with sufficient resistance from the surrounding stratum as the upper end of the stabilizers is caused to move downward with the pile due to the pivotal connection therebetween, to retain them at the level at which they were upon the removal of the blocks 19. This resistance of the lips 28 together with the downward force applied at the pivotal point of said stabilizers 18 by the bolt 5 causes the stabilizers to move outwardly from the pile 17 until the upper edge 29 of said stabilizers contacts the side of pile 17, whereby any further movement thereof is arrested. The stabilizers, in their arrested position as shown in Fig. 11, extend laterally from the pile 17 while the pile 17 is now at the position relative to the earth in which it is desired to maintain the same. Further, as in the other modifications, the stabilizers 18, due to their plate and side wall, are substantially scoop-shaped and will therefore retain and compact therebeneath a considerable area of the surrounding stratum, whereby, the

resistance of the soil to any downward movement of the pile is greatly increased to an extent which makes it possible for the pile to maintain a load from approximately ten to twenty times as great as the same pile without stabilizers would maintain in similar strata.

The foregoing described modifications clearly disclose a definite principle for stabilizing piles regardless of the shape of a cross section thereof. This definite principle, briefly stated, is to provide scoop-shaped or like members for the pile, which members, when retained by locking means in a closed position upon the pile, are substantially wedge-shaped to offer the minimum amount of resistance in the downward movement thereof with the pile and yet, which members create a passage for the removal of said locking means along the sides of said pile. Further, the members are so shaped as to permit them to extend laterally from said piles when pivoted through an arc limited only by contact of a portion of the member with said pile for increasing the resistance of the earth to any downward movement of said pile and which members are maintained in a locked lateral position by contact with said piles.

The lips or flared portions formed contiguous with but extending at an angle from the ends of each of the stabilizers can be readily incorporated upon all stabilizers or piling which either do or do not have means for causing them to move from the closed or non-stabilizing position to the open or stabilizing position. By connecting directly or indirectly to the free ends of the stabilizers a plate having a leading edge relatively thin as compared to its upper and lower faces and positioning said plate in a diverging manner relative to the stabilizer, said stabilizer will be caused to open or rotate upon the contact with the surrounding earth by said plate whenever the stabilizer is in its free rotatable condition. Therefore, it can be readily seen that the principle disclosed and operatively described herein is of equal importance to and can be formed or connected with other types and arrangements of stabilizers.

The present apparatus which contains a minimum number of members will not noticeably increase the force required to drive the pile downwardly and yet the stabilizing members thereof are simply and efficiently operated by the mere tripping thereof and continued downward movement of the pile.

The principle of the modifications shown herein can be readily applied to various shaped piles without departing from the spirit and scope of the present invention and therefore, any further modifications or changes of the examples shown herein which come within the scope of the claims are deemed to be part of the present invention.

I claim:

1. An improvement in piles comprising a structural support, a pair of stabilizing members pivotally joined to said support upon a common axis for limited pivotal movement thereon, and means for retaining said members in a given position relative to said support.

2. An improvement in piles comprising a structural support, a shaft mounted through said support upon a diameter thereof, and a pair of stabilizing members rotatably supported by said shaft for limited pivotal movement about said support.

3. An improvement in piles comprising a structural support, a shaft mounted through said support upon a diameter thereof, a series of stabilizing members and each of said members having diametrically opposed points rotatably supported by said shaft for limited pivotal movement about said support.

4. An improvement in piles comprising a structural support, a series of stabilizing members, each of said members having diametrically opposed points near their outer edges rotatably supported by said support upon a common axis thereof and each of said members having its top edge shaped to permit a rotation thereof through a given arc which is limited by contact of either upper or lower edge of said member with said support.

5. An improvement in piles comprising a supporting body, a series of stabilizing members, said members being capable of forming substantially a wedge with said body, and a series of blocks each detachably interposed between one of said members and said body in such a manner as to retain said wedge formation when desired.

6. An improvement in piles comprising a cylindrically shaped supporting body, a series of concave members pivotally carried at their upper portions by said body, said members each having the upper edge thereof shaped to permit said members to move through an arc limited by the contact of said upper edge with said body in one direction and the contact of the lower edge of each member with said body in the opposite direction, and means for retaining each of said members with said lower edge against said body.

7. An improvement in piles comprising a cylindrically shaped supporting body, a series of concave members, said members each having the lower edge shaped to fit closely around the periphery of said body, said members each tapering from said lower edge to an upper edge shaped larger than said periphery of the body, said concave members each being pivotally carried at outer edge portions by said body in such a manner as to permit said upper edge thereof to be a desired distance from said body and said lower edge to be against said body periphery in one position, said concave members each being further pivotally carried at their outer edge portion by said body in such a manner as to permit said upper edge to contact said body and retain their respective member substantially lateral to said body in another position, and a series of blocks each capable of being interposed between a concave member and said body to retain said lower edge of the member about said periphery of the body when desired.

8. An improvement in piles comprising a cylindrically shaped supporting body, a shaft mounted through said body, a pair of concave members rotatably mounted on said shaft with each member on a side of said body opposite the other member, said members being shaped to form a wedge with said body when in a closed position, said members being further shaped to permit them to pivot to a lateral position relative to said body and to be retained in said lateral position by contact with said body by a portion of said member and a pair of wedges each capable of being detachably mounted between a member and said body to retain said member in said closed position when desired.

9. An improvement in piles comprising a cylindrically shaped supporting body, a series of concave members pivotally carried at their upper portions by said body upon the periphery there-

of, said members each having the upper edge thereof shaped to permit said members to move through an arc limited by the contact of said upper edge with said body in one direction and the contact of the lower portion of each member with said body in the opposite direction, each member having said lower portion at the end thereof bent to extend at an angle from the remaining portion thereof and means for retaining each of said members with said lower portion against said body.

10. An improvement in piles comprising a structural support, means carried thereby capable of forming a wedge therewith in one position and lateral projections therefrom in a second position, a plate connected to said means for assisting said means to move from one position to the second upon said pile being driven into the earth and means for retaining said first means in said first mentioned position when desirable.

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