Oct. 11, 1960 W. ALSTON 2,955,430

ANCHOR

Filed March 24, 1958 3 Sheets-Sheet 1

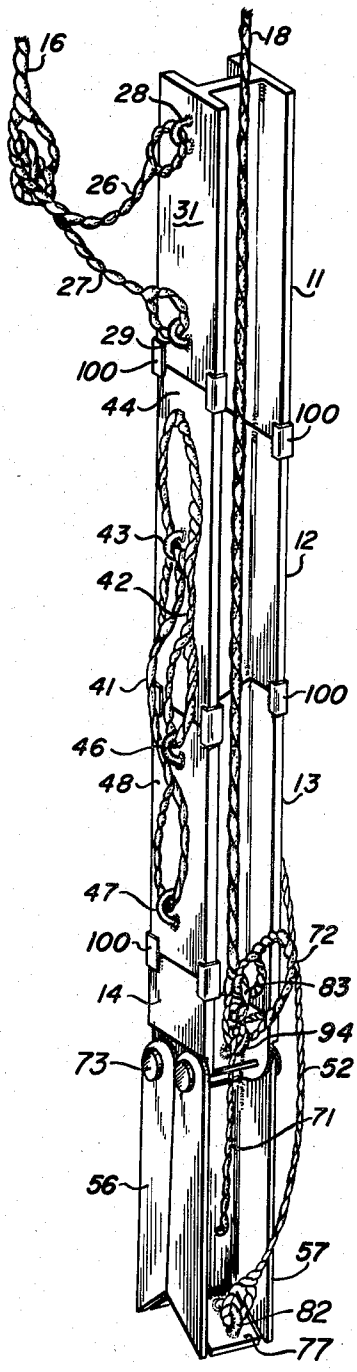


FIG. 1

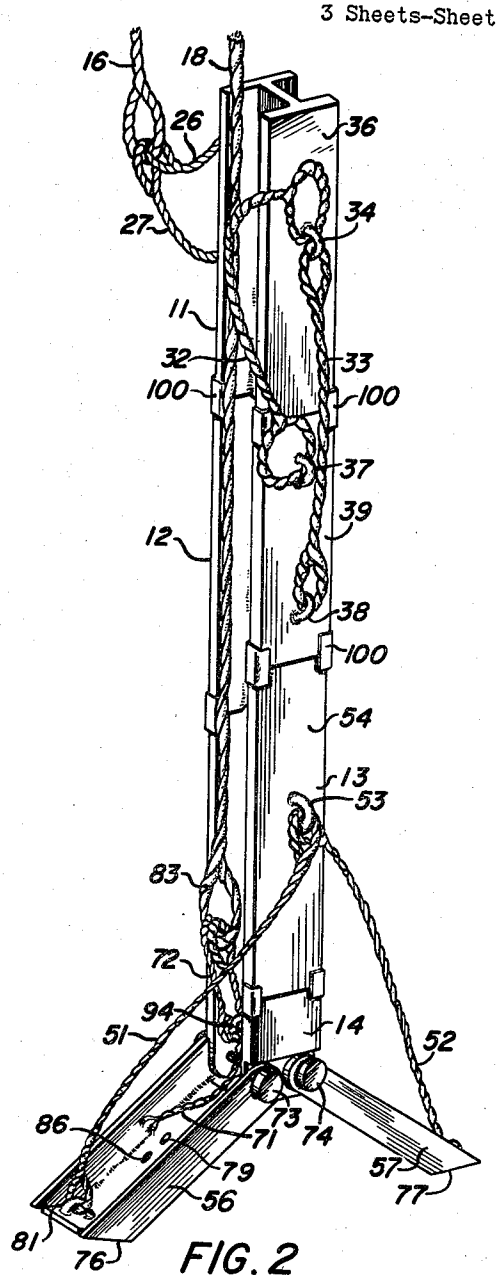


FIG. 2

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Oct. 11, 1960 W. ALSTON 2,955,430

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Filed March 24, 1958

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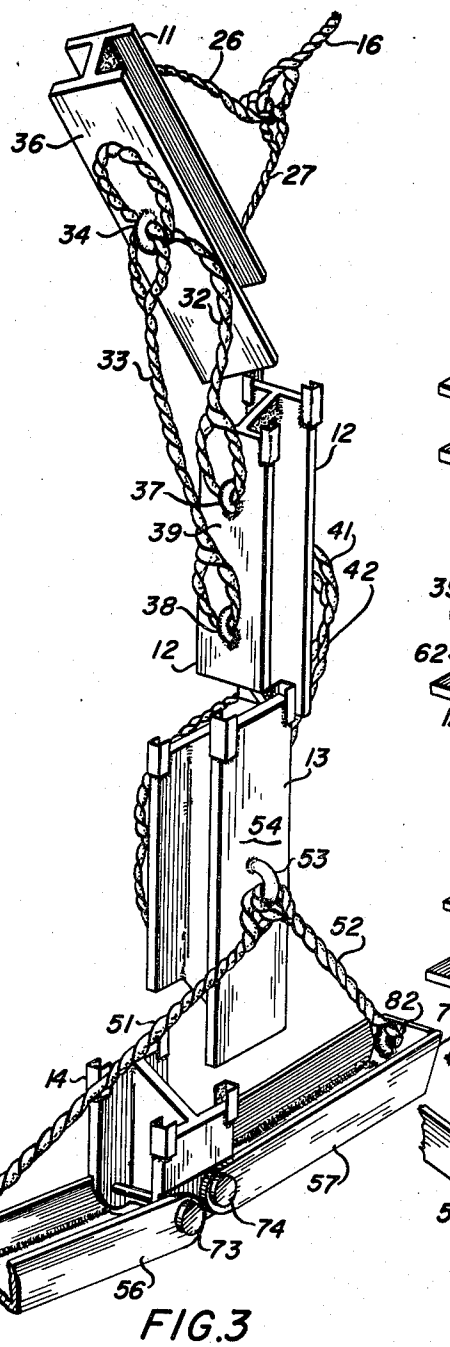


FIG.3

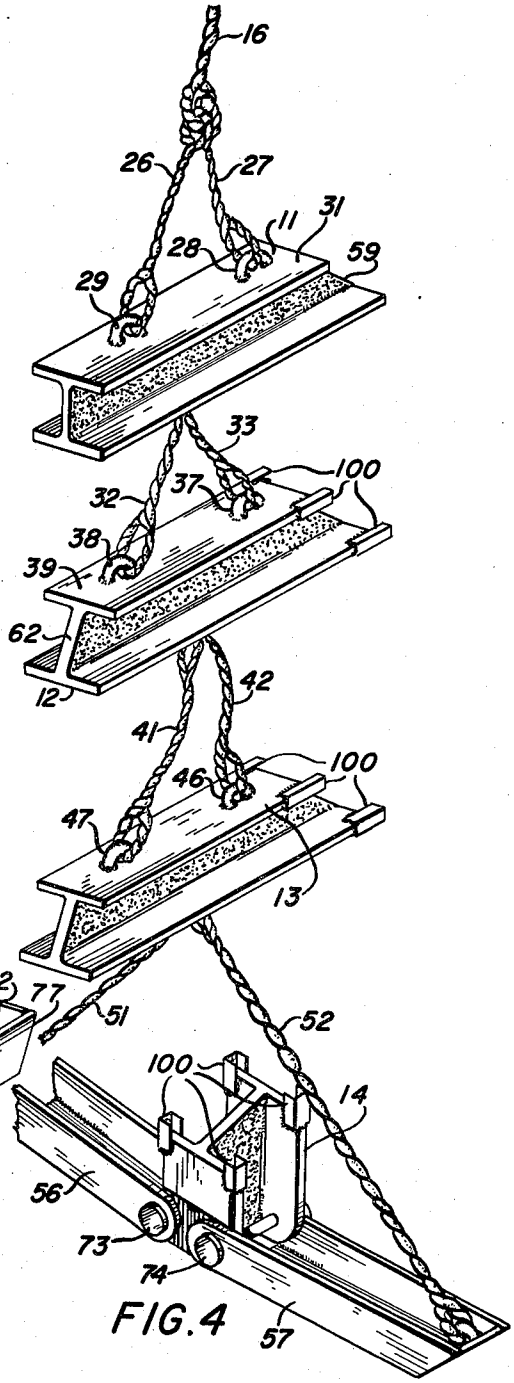


FIG.4

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Oct. 11, 1960 W. ALSTON 2,955,430

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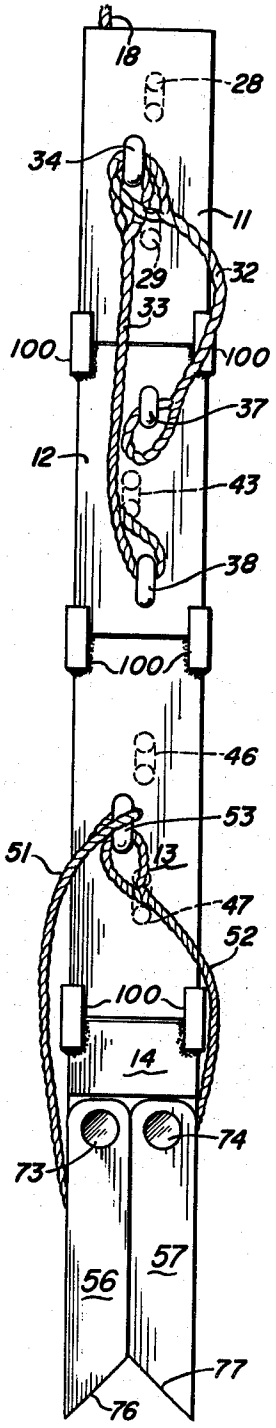


FIG. 5

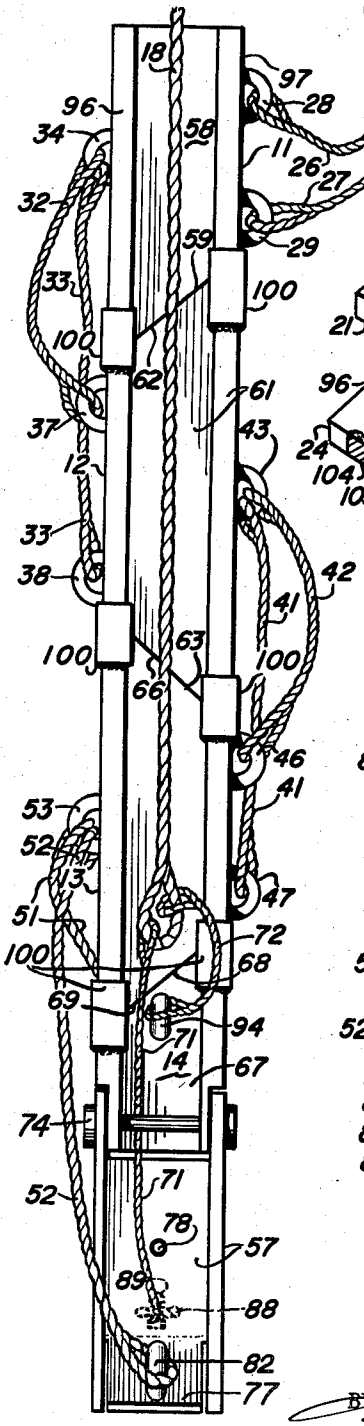


FIG. 6

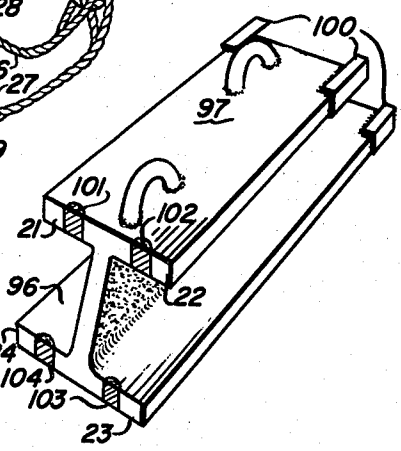


FIG. 7

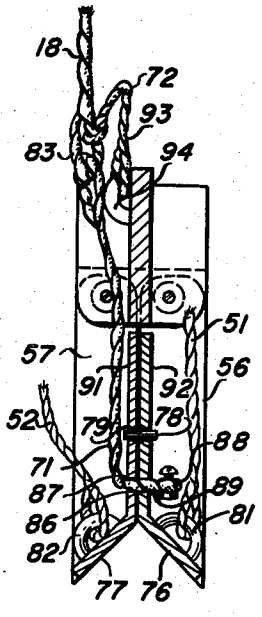


FIG. 8

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2,955,430

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11 Claims. (Cl. 61—53)

The invention relates to anchors designed for heavy duty permanent installations in bodies of water such as rivers, lakes, bays, oceans and the like.

An object of the present invention is to provide an anchor which will have great holding strength in a permanent installation as described and as needed in the construction and erection of bridge pillars, anchorages, and other underwater construction, submarine nets, salvage operations, and generally wherever a very heavy duty type of permanent anchor is required.

Another object of the present invention is to provide an anchor of the character above which may be made up on the job from a length of steel piling thereby minimizing the problems of remote manufacturing, transportation, and handling and delays occasioned thereby, and may be easily and rapidly embedded in the earth floor of the water body using conventional pile driving equipment.

Referring to the drawings:

Figure 1 is a perspective view of the anchor constructed in accordance with the present invention.

Figure 2 is a perspective view of the anchor taken from an opposite side and shows the flukes of the anchor in partially open position.

Figure 3 is a perspective view of the anchor in holding position.

Figure 4 is a perspective view of the anchor in full holding position.

Figure 5 is a side elevation of the anchor.

Figure 6 is another side elevation of the anchor.

Figure 7 is a fragmentary perspective view of one end of the anchor sections with connecting portions of the end shown in cross-section.

Figure 8 is a fragmentary cross-section of the lower end of the anchor.

The anchor of the present invention consists briefly of a plurality of pile sections 11, 12, 13 and 14 fitting end to end to provide a continuous length of piling for driving into the ground, an anchor line 16 connected to one of the sections, and a plurality of cables connecting the sections at predetermined points to cause their separation and transverse orientation as seen in Figures 3 and 4 upon upward pulling of the anchor line 16. As a feature of the present invention, a holding line 18 is secured to the lowermost section 14 and extends upwardly therefrom centrally of the sections and functions when taut as seen in Figure 1 to secure the sections together against endwise separation during the driving of the sections into the ground, the connection of the holding line to the lowermost section being formed for breaking after driving of the sections into the ground for extraction of the holding line. The action of the holding line 18 is here facilitated by the forming of the sections of H-beam cross section so that the sections provide at their corners 21, 22, 23 and 24, see Figure 7, a four point engagement for support and for driving of the sections as a length of piling. The holding line 18 extends longitudinally

through one of the channels of the H-beam section and is thus located radially within the four corners of the sections so as to secure the sections together in rigid alignment.

In order to effect the aforementioned crosswise orientation of the sections in response to an upward pull of the anchor line 16, the lower end of the anchor line is connected by a pair of cables 26 and 27 to longitudinally spaced points 28 and 29 (ears) on one side 31 of the uppermost section 11 so as to cause the rotation of the uppermost section to a crosswise position upon upward pulling of the anchor line. In a similar fashion a pair of cables 32 and 33 are used to connect a mid point 34 (ear) on the opposite side 36 of the uppermost section 11, see Figure 3, to longitudinally spaced points 37 and 38 (ears) on one side 39 of the adjacent lower section 12; a pair of cables 41 and 42 connect a mid point 43 (ear) on the opposite side 44 of section 12 to longitudinally spaced points 46 and 47 (ears) on one side 48 of the adjacent lower section 13; and a pair of cables 51 and 52 connecting the mid point 53 (ear) on the opposite side 54 of section 13 to a pair of flukes 56 and 57 more fully described below.

As will be observed from the foregoing and from Figures 1, 2 and 3 the cable connections are made alternately at opposite sides of the sections 11—14 so as to cause rotation of adjacent sections in opposite directions of rotation as depicted in Figure 3 to positions crosswise of the direction of pull of the anchor line. This alternate reverse direction of rotation is facilitated by the forming of the ends of the sections in alternately diagonal planes of opposite slope, see Figure 6. With reference to Figure 6 it will be noted that the web 58 of section 11 is cut on a downwardly sloping diagonal to the left as seen in the figure, to define a biased lower end 59 for the section. The web 61 of the adjacent lower section 12 is cut on the same diagonal so as to define a biased upper end 62 for section 12. In the opening up of the sections in the ground, section 11 will rotate in a counterclockwise direction as seen in Figure 6 whereas section 12 will be rotated in a clockwise direction. Accordingly the bias end 59 of section 11 and the bias end 62 of section 12 will be arranged to widen towards the bottom of the sections in a crosswise position of the sections as seen in Figure 4. Similarly the web 61 at the opposite end 63 of section 12 is cut on a diagonal sloping downwardly to the right as seen in Figure 6; the web 64 of the adjacent lower section 13 is cut on a diagonal to provide a mating upper biased end 66 for the section; and the web 64 and the web 67 of the adjacent lower section 14 are cut on a diagonal downwardly sloping to the left as seen in Figure 6 to provide biased ends 68 and 69 for sections 13 and 14. The several cables are connected as aforementioned so that in the opening up operation of the sections, section 13 will rotate in a counterclockwise direction as seen in Figure 6 so that its biased ends 63 and 69 will widen to the bottom of the section in the crosswise position of the section so as to provide in common with the other sections maximum holding power.

As another feature of the invention, the rigging of the cables are such as to produce an off-center twisting rotary action of the sections in moving to their crosswise position so as to present an optimum area of the sections in the direction of pull of the anchor line. This is accomplished as will be best seen in Figure 5 by arranging the connections of the cables to the series of ears, as above-described, in offset relation to the center plane of the sections.

As a further feature of the present invention the anchor is provided with a plurality of flukes 56 and 57 which

are pivotally secured to the lowermost section **14**, and the holding line **18** is provided with a first connection **71** to the flukes for holding them in closed position during the driving of the sections into the ground; the holding line having a second connection **72** to the lowermost section **14** for securing the sections **11—14** in rigid alignment during ensuing driving action of the pile to open the flukes. This second connection **72** is formed for breaking after the opening of the flukes for extraction of the holding line preparatory to opening up of the sections. As will be observed from the drawings, the flukes are here arranged as a horizontally opposed pair pivotally secured as by pins **73** and **74** at their upper ends to section **14** for swinging apart movement of their lower ends **76** and **77**. To facilitate the opening of the flukes these lower ends **76** and **77** are divergently tapered as best seen in Figures 5 and 8 to effect the opening of the flukes when released for opening by the breaking of the first holding line connection **71** and upon subsequent driving into the ground. Preferably a transverse pin **78** is secured to one of the flukes **56** and projects through a transverse opening **79** in the other fluke in the closed position of the flukes as seen in Figure 8 so as to maintain the flukes in transversely aligned position during the driving of the flukes into the ground. As will be understood, if one of the flukes were to hit a hard object or the like during such driving action it would tend to hold up while the other fluke drifted down. The aligning pin **78** keeps the two flukes in horizontal juxtaposition during the driving operation but does not interfere with the horizontal separation of the flukes upon breaking of the holding cable connection **71**. The cables **51** and **52** above-described are connected at their lower ends to eyes **81** and **82** at the ends **76** and **77** of the flukes so as to hold open the flukes upon separation of the sections as above described and as seen in Figure 4 of the drawings. Normally the pull of the anchor line is at an angle to vertical so that each of the cross member sections will pull into completely undisturbed earth as the anchor line pulls to its full holding position.

As will be best seen from Figures 1, 2 and 8, the holding line **18** terminates in a lower loop **83** which is connected by the holding line extension **71** to the flukes **56** and **57**, the line extension **71** extending through aligned openings **86** and **87** in the flukes near their lower ends where the end **88** of the line **71** is secured by means of a crosspin or bolt **89**. The flukes are here preferably formed of opposed back to back channel-shaped cross-sections with the back sides **91** and **92** of the flukes at the center plane of the assembly in the closed position of the flukes and with the open sides of the channel sections facing outwardly. This construction accomplishes two important results. First, by drawing the holding line **18** taut, line extension **71** will draw tightly against the center plane of the assembly so as to rigidly secure the flukes in closed position. Secondly, when the flukes move to open position, the open sides of the channel-shaped flukes will be disposed uppermost for providing a cup-like maximum resisting action to the upward pull of the anchor line.

The holding cable extension **71** is made somewhat lighter than holding line **18** so that after the anchor has been driven as a length of vertical pile into the ground, subsequent pulling of the holding line, or holding the holding line while driving the pile further into the ground, breaks the holding line extension **71** so as to free the flukes **56** and **57** for pivotal opening or separation of their lower ends **76** and **77**. In order to hold the sections **11—14** in rigid alignment during this opening of the flukes, a second holding line extension **93**, here providing the aforementioned second connection **72** is used and which is connected from loop **83** at the lower end of the holding line to an eye **94** provided on section **11**. After full opening of the flukes, extension **93** is broken and holding line **18** may be extracted. To accomplish the foregoing it will be observed that holding line **18** must be heavier than either line extension **71** or line extension **93**. For example the main holding cable **18** may be one inch diameter steel cable and the line extensions **71** and **93** may be five-eighths of an inch diameter steel cable.

The anchor is now set and ready to perform its holding action. Pulling up of the anchor line **16** causes the sections to successively separate, twist and rotate towards a horizontal position as above described. The orientation of the parts may end up anywhere between their positions as shown in Figures 3 and 4, depending upon the amount of pulling force applied to the anchor line, it being observed that the anchor parts constantly orient themselves to improve the holding power of the anchor as greater pull is applied to the anchor line. At the same time the connections of the cables **51** and **52** to the eyelet **53** are such as to cause a relative rotation of the open flukes to a position crosswise of section **13** for maximum holding power.

With reference to Figures 6 and 7, it will be noted that the H-beams are cut square across their flanges **96** and **97** so as to provide square seating and straight ahead driving force when the associated sections function as a single vertical pile. The webs **58**, etc. are cut at a bias, here shown at approximately 35°, as illustrated in Figure 6, so as to provide the bias section ends as above described. If desired, and as here shown, a series of U-shaped clips **100** may be provided at the corners of the abutting sections so as to retain the sections in alignment during the driving operation and during the breaking of the holding lines. These clips may be secured as by welding to the lower end of each adjoining pair of sections so as to slidably receive the flanges of the adjacent upper section.

It is quite feasible to make up the present anchor on the job site. A single length of H-beam may be cut as above described but preferably not completely through the full cross-section of the beam thus desirably leaving small connecting areas **101**, **102**, **103**, and **104**, see Figure 7, on the flanges so as to leave the H-beam intact as a single length of piling for handling, picking up, etc. prior to driving into the underwater floor. Connecting areas **101—104** are preferably spaced inside the outside edges of the flange so that their final cutting, as by burning, will not impair the good solid four-corner seated position of the several sections on each other for straight ahead driving power. The connecting areas **101—104** should be sufficient to permit complete handling and elevation of the beam. After all of the cables are properly attached, as above described, the H-beam may be lifted into vertical position for driving. Then, with the holding line **18** taut, the connecting points **101—104** of each of the sections may be cut loose and the length of piling driven into the underwater bed, as above described. As will be understood, the lateral pressure of the earth on the sides of the unit also tends to hold the sections together during the ensuing driving action.

I claim:

1. An anchor comprising, a plurality of H-beam pile sections fitting end to end to provide a continuous length of piling and providing at their corners at least a four-point engagement for support and for driving into the ground, a holding line secured to the lowermost of said sections and extending longitudinally of said length of piling and in the channel of said H-beam within the periphery defined by said corners and functioning when taut to secure said sections together in rigid alignment during the driving of said sections into the ground, the connection of said holding line to said lowermost section being formed for breaking after driving of said sections into the ground for extraction of said holding line, an anchor line secured to the uppermost of said sections at longitudinally spaced points and extending upwardly from said uppermost section for extension to an object

to be anchored so as to cause said uppermost section to rotate to a position crosswise of the direction of pull of said anchor line, and a pair of cables connecting a mid point of each of said sections to points spaced longitudinally of the adjacent lower section with the connections being made alternately at opposite sides of said sections so as to cause rotation of adjacent sections in opposite directions of rotation to positions crosswise of the direction of pull of said anchor line upon vertical separation of said sections as occasioned by the upward pulling of said anchor line.

2. An anchor as characterized in claim 1 wherein the connections of said anchor line and said cables to said sections are offset from the center plane of said sections to produce a twisting rotary action of said sections in moving to their crosswise position to present an increased area in the direction of pull of said anchor line.

3. An anchor as characterized in claim 1 and having a pair of horizontally opposed channel-shaped flukes pivotally secured at their upper ends to the lowermost of said sections for swinging apart movement of their lower ends from closed to open positions of said flukes, said holding line having a first connection to said flukes to hold said flukes in closed position during the driving of the aligned sections into the ground, said first connection being formed for breaking after initial driving of said sections whereby continued driving will effect an opening of said flukes, said lower ends of said flukes being divergently tapered from each other to assist in said opening of said flukes, said holding line having a second connection to said lowermost section for securing said sections in rigid alignment during the driving action to open said flukes, said second connection being formed for breaking after opening of said flukes for extraction of said holding line, and a pair of cables connecting said lower ends of said flukes to the adjacent upper section so as to effect the holding open of said flukes upon separation of said sections as aforesaid, the open side of the channel-shaped flukes being disposed uppermost in the open position of said flukes for resisting the upward pull of said anchor line.

4. An anchor comprising, a length of piling formed of a plurality of elongated sections having ends and sides and fitted together end to end for driving as a continuous length into the ground, slack lines connected to adjacent sections, each of said slack lines having one end connected to one longitudinally extending side of one of said sections and its other end connected to the next adjacent section, the slack lines of adjacent sections being on an opposite side of the next adjacent section, and an anchor line connected to one side of the uppermost section opposite to the connection of the slack line to the uppermost section, whereby upon pulling of said anchor line after the driving of said piling the sections are sequentially separated, reoriented and embedded with their lengths transverse to the direction of pull on said anchor line, the various sections being increasingly embedded according to the amount of said pull.

5. An anchor as characterized in claim 4, wherein said length of piling has a longitudinal channel therein, the combination also including, a holding line secured to the lowermost of said sections and extending longitudinally of said length of piling within said channel and functioning when taut to secure said sections together and against endwise separation during the driving of said sections into the ground, the connection of said holding line to said lowermost section being formed for breaking after driving of said sections into the ground for extraction of said holding line.

6. An anchor as characterized in claim 5, wherein said anchor line is bifurcated and connected to said uppermost section at longitudinally spaced points thereon, so as to cause the rotation of said uppermost section to a cross-wise position upon upward pulling of said anchor line, and wherein the slack lines connecting said sections

comprise a pair of lines connecting the mid-point of the upper of said sections to points spaced longitudinally on the adjacent lower section so as to cause the rotation of the adjacent lower section to a cross-wise position upon vertical separation of said sections as occasioned by the upward pulling of said anchor line.

7. An anchor as characterized in claim 4, wherein said piling is formed of a plurality of H-beam pile sections with the channels thereof aligned to form continuous channels extending the length of said piling and providing engagement at each of the corners of said H-beam sections for driving into the ground, and a holding line secured to the lowermost of said sections and extending longitudinally of said piling within one of the channels thereof and functioning when taut to secure said sections together in rigid alignment during the driving of said sections into the ground, the connection of said holding line to said lowermost section being formed weaker than said holding line for breaking after driving of said sections into the ground for extraction of said holding line.

8. An anchor comprising, a plurality of elongated pile sections having ends and sides and fitted together end to end for driving as a continuous length into the ground, said sections having an aligned longitudinal channel formed therein, flukes pivotally secured to the lowermost of said sections, a holding line having a first connection to said flukes and extending longitudinally within said channel and functioning when taut to secure said sections and flukes in rigid alignment during the driving of said sections into the ground, the said first connection being formed for breaking after driving of said sections into the ground whereby continued driving of said sections will effect an opening of said flukes, said holding line having a second connection to said lowermost section for securing said sections in rigid alignment during the driving action to open said flukes, said second connection being formed for breaking after opening of said flukes for extraction of said holding line, slack lines connected to adjacent sections, each of said slack lines having one end connected to one longitudinally extending side of one of said sections and its other end connected to the next adjacent section, the slack lines of the adjacent sections being on an opposite side of the next adjacent section, and an anchor line connected to one side of the uppermost section opposite to the connection of the slack line to the uppermost section, whereby upon pulling of said anchor line after the driving of said piling the sections are sequentially separated, reoriented and embedded with their lengths transverse to the direction of the pull on said anchor line.

9. An anchor as characterized in claim 8 wherein said flukes are arranged as an horizontally opposed pair pivoted at their upper ends for swinging apart movement of their lower ends, said lower ends being divergently tapered to effect opening of said flukes when released for opening by the breaking of said first connection and upon subsequent driving into the ground, a transverse pin secured to one of said flukes, the other of said flukes being formed with a transverse opening receiving said pin in the closed position of said flukes so as to maintain said flukes intransversely aligned position during driving into the ground in the closed position of said flukes.

10. An anchor as characterized in claim 9 wherein a pair of slack lines connects the lower ends of said flukes to the adjacent upper section so as to effect the holding open of said flukes upon separation of said sections as aforesaid.

11. An anchor as characterized in claim 1 wherein the ends of each section are formed on converging planes inclined from the axis of said section to provide relatively lengthened and foreshortened flat sides of said H-beam section, the slack line connection of each section to the adjacent upper section and the anchor line connection to the uppermost section being made on the foreshortened

side of the section, and the slack line connection of each section to the adjacent lower section being made on the lengthened side of the section, whereby upon upward pulling of said anchor line the rotating lower end of each section during the reorientation thereof bears against the upper end of the next lower section and begins the rotating reorientation of said next lower section before the slack line connection between the sections has been tautened.

References Cited in the file of this patent

UNITED STATES PATENTS

756,805	Shuman	Apr. 5, 1904
809,374	Holden	Jan. 9, 1906

FOREIGN PATENTS

242,834	Great Britain	Nov. 19, 1925
263,698	Italy	July 29, 1927