

Nov. 20, 1962

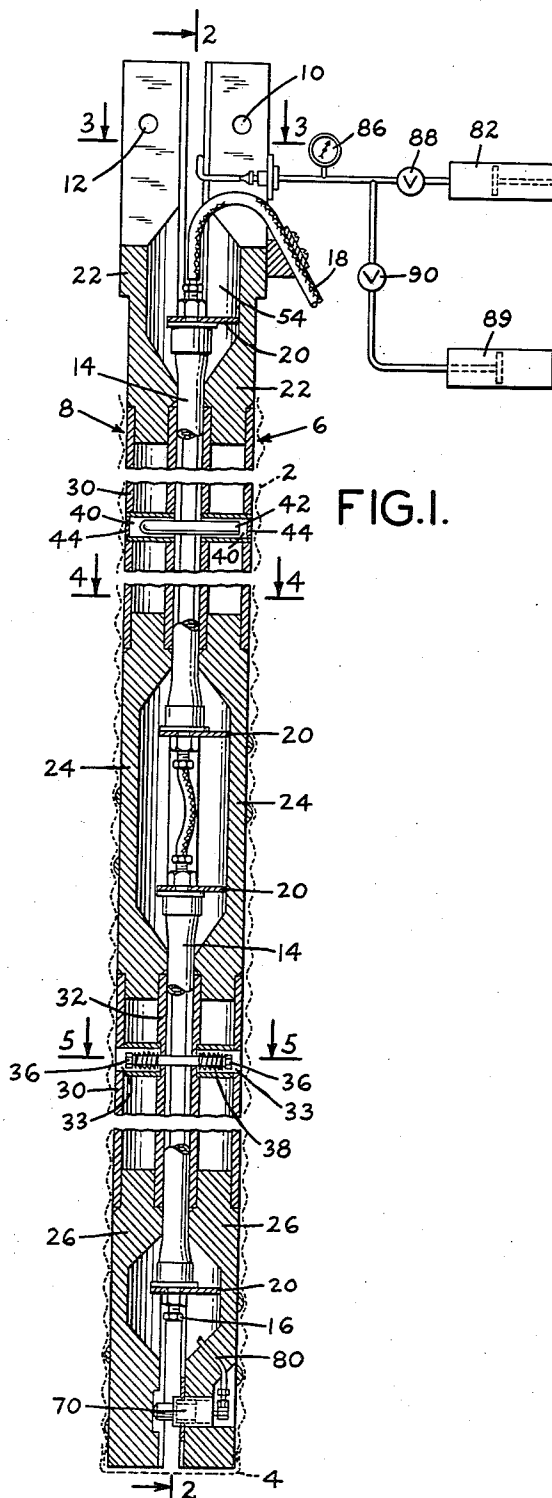
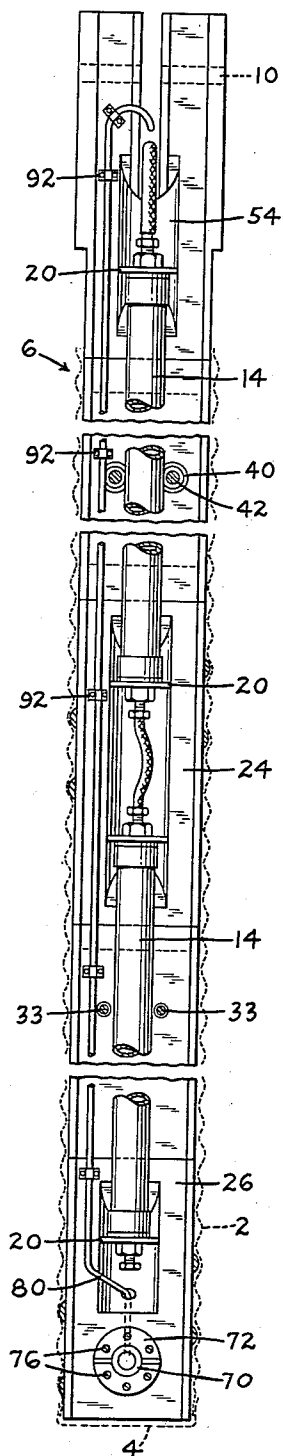
W. H. COBI
PILE DRIVING MANDREL

3,064,439

Filed March 23, 1960

2 Sheets-Sheet 1

FIG. 2.



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FIG. 3.

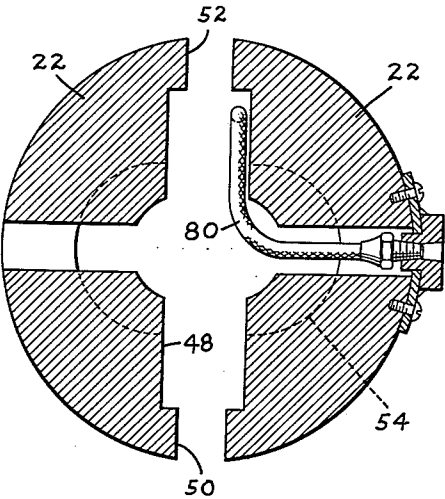


FIG. 4.

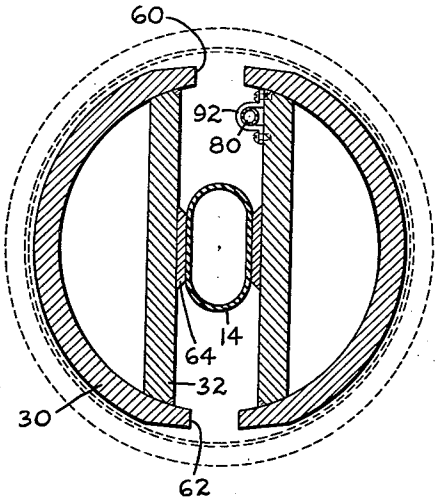


FIG. 6.

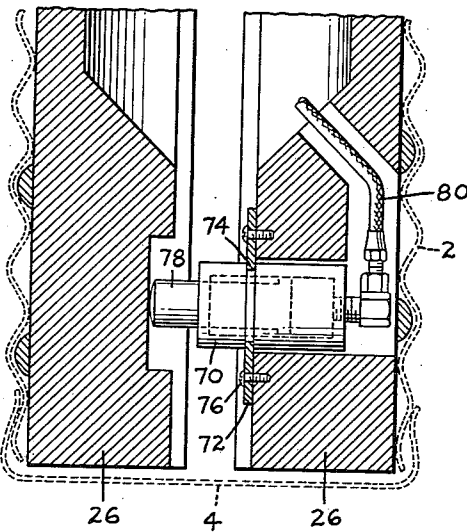
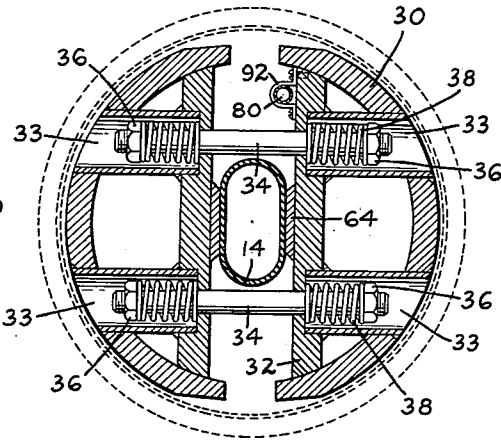


FIG. 5.



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3,064,439

PILE DRIVING MANDREL

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8 Claims. (Cl. 61—53.72)

This invention relates to mandrels for driving thin walled pile shells and, more particularly, to pneumatic expansible mandrels for driving such shells.

Pile shells of the type herein involved are tubular, cylindrical containers formed from a relatively light gauge metal and are usually provided with corrugations which extend spirally along the length of the shell. Such shells are driven into the ground to a strata having sufficient load bearing capacity and, thereafter, are filled with concrete to form, what is generally known as, a cast-in-place pile. Before the shell is driven, one end is closed by a cap or boot and the shell is driven from its open end with a hammer, the shell, as it is driven into the ground, displacing the ground in sufficient volume to accommodate the shell. For example, a twelve inch diameter shell used extensively, displaces almost eight-tenths of a cubic foot of material for each linear foot of shell driven.

Due to the gauge of the metal, the walls of pile shells are of insufficient strength to withstand driving forces and, hence, a mandrel is used for driving. The mandrel is inserted into the shell before driving and extends from the lower, or closed end of the shell, upward beyond the upper or open end. Intermediate its top and bottom and extending axially along the mandrel, at least for substantially the full length of the shell, the mandrel is usually provided with a plurality of arcuate members or segments adapted to engage opposite inner walls of the shell. On their outer arcuate surfaces, these segments may be provided with ribs or bars, positioned to fit into the shell corrugations. During driving, the blows or impacts of the driving hammer are imparted to the mandrel at its top above the open end of the shell, driving the mandrel and shell into the ground, the segments supporting and reinforcing the shell wall.

As mentioned above, as the mandrel and shell are driven for each unit of penetration a certain volume of material must be displaced. This displacement takes place at the driven or closed end of the shell where, through the driving forces, material is forced out of the way of the advancing shell. The pressures created in displacing this material form a ball or bulb of pressure around the closed end of the shell. These pressures surrounding the lower end of the shell will, for purposes of convenience, be referred to herein as displacement pressures.

The characteristics and magnitude of the displacement pressure depend on the material into which the shell is driven. Thus, when driving through loose fill or sandy granular material and the like, the material is readily compacted and results in only nominal displacement pressures against the lower end of the shell which are readily sustained by the closed end of the shell reinforced by the mandrel. However, in cohesive soils, such as hard clays and the like, the material is much more difficult to displace and displacement pressures can be substantial, even exceeding the strength of the mandrel reinforced shell and result in collapse of the shell at its lower end and the squeezing together of the mandrel. Once the shell is collapsed, the shell seizes or sticks the mandrel, making removal of the mandrel difficult. In many instances where the mandrel is stuck, the mandrel cannot be removed in the normal manner and it is necessary to hammer or bump the mandrel out of the shell or bump out the mandrel and shell together. In addition to being costly in

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both time and labor, this operation can, and often does, result in damage to the shell and mandrel.

Since the displacement pressure emanates from the advancing pile shell, the magnitude of the pressure and its duration, to a large extent, depends on the compressibility of the material into which the shell is driven and the compressibility of the adjacent material. Thus, where driving is in loose fill or sandy granular material, displacement pressures are readily absorbed and equalized in the material surrounding the pile tip and only small increments of displacement pressures are sustained for any length of time by the lower end of the shell. In other materials, such as cohesive soils, the surrounding materials are relatively slow in absorbing and equalizing displacement pressures and some time may lapse before the displacement pressures are equalized. Thus, in this latter material, at the time of driving, a relatively high displacement pressure may occur which is slowly absorbed and equalized in the surrounding material. Thus, relatively high displacement pressure against the lower end of the shell may continue after driving is completed and slowly decrease after driving as the pressure equalizes with the surrounding material. While the shell, reinforced by the expanded mandrel, may be of sufficient strength to withstand this high displacement pressure without collapsing, the strength of the shell standing alone may be marginal and, if the mandrel is removed too soon after driving, the tip or lower end of the empty shell may subsequently collapse. Such a shell, of course, cannot be used and, hence is a complete loss.

It is an object of the present invention to provide an improved pile driving mandrel.

It is a further object of the invention to provide a pile driving mandrel in which a supplemental actuator is provided at the lower or tip end of the mandrel to reinforce the lower end, during driving, against forces tending to collapse the mandrel.

A still further object is to provide an improved pneumatically expansible mandrel in which the lower or tip end of the mandrel is held at the expanded position during driving against forces tending to collapse the mandrel by a mechanism independent of the operator.

Still a further object is to provide an improved pneumatically expansible mandrel wherein the axial alignment of the mandrel in the shell may be maintained throughout driving irrespective of increases in pressure at the tip or lower end of the shell.

A still further object is to provide a mechanism for maintaining the lower end of a mandrel in its expanded position against displacement pressures of driving.

These and other objects of the invention will be apparent from the description and accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of the device of the invention and showing part of the actuating mechanism diagrammatically in inflated position;

FIG. 2 is a longitudinal view taken along the line 2—2 of FIG. 1 showing the pressure container and face of one of the mandrel segments in inflated position;

FIG. 3 is a transverse sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a transverse sectional view taken along the line 5—5 of FIG. 1; and

FIG. 6 is an enlarged sectional view of the lower end of the device of FIG. 1.

In U.S. patent application Serial No. 522,909, now Patent No. 2,990,688, there is shown and described a pneumatically expansible mandrel having oppositely disposed leaves or segments extending axially of the mandrel.

Each of the segments include an outer arcuate plate for engaging the inner wall of a pile shell and an inner flat plate joined at its opposite ends to the ends of the arcuate outer plate to form a chord therebetween. The leaves or segments are positioned with their flat plates facing each other along the longitudinal axis of the mandrel and a pneumatically inflatable pressure container is positioned between the oppositely facing flat plates.

In its collapsed or retracted position, the leaves or segments of the mandrel are held inwardly toward the axis of the mandrel by springs. When the pressure container is inflated, the inflated pressure container forces the leaves or segments outwardly compressing the springs. On deflation of the pressure container the compressed springs return the segments inwardly toward the axis of the mandrel. Thus, the mandrel is inserted in a shell with the segments contracted and, when in position in the shell, pneumatic pressure is introduced into the pressure container forcing the segments outward into engagement with the inner wall of the shell, engaging the mandrel and shell for driving. After the shell has been driven the pneumatic pressure in the container is released, the springs return the segments inwardly out of engagement with the inner wall of the shell, thereby allowing withdrawal of the mandrel from the shell.

The oppositely disposed flat plates and the pneumatic pressure container extend substantially the full length of the mandrel. Thus, when the mandrel is expanded, a uniform outward force is distributed along the axial length of the shell by the expanded mandrel segments. Since the shell is cylindrical, when the mandrel is expanded the segments are substantially parallel. Hence, as the mandrel is driven, the driving forces are distributed by the mandrel leaves substantially uniformly along the shell.

While a uniform outward force on the shell is desirable and aids driving of thin-walled pile shells, the inward pressures against the shell and mandrel during driving are not uniform. Due to displacement pressure at its lower end, a substantial differential in inward pressures of the shell against the mandrel may develop during driving. Thus, the inward pressure of the shell at its lower end may be substantially greater than the inward pressure at the top of the shell. This differential in inward pressure may become so great that the bottom or lower end of the shell may be forced inwardly, forcing the lower end of the segments inward, and result in an outward deflection or spreading of the segments at the upper end of the shell. Thus, instead of being parallel, the segments assume a V position, forming a wedge which, as the shell is driven, results in further collapse of the shell and mandrel at the lower end of the mandrel. As driving continues with the mandrel collapsed at its lower end, the shell and mandrel become further interlocked, seizing the mandrel. Once the shell collapses, the mandrel cannot be removed in the normal manner and must be bumped or driven upward together with the shell. This, of course, delays the driving operations and results in damage to the shell and often to the mandrel.

In the improved mandrel of the instant invention, means are provided at the lower end of the mandrel to maintain the initial parallel alignment of the mandrel segments throughout the driving operation and prevent the inward pressures against the shell from collapsing the lower end of the shell. In addition to the pneumatic actuator which is operative to engage the segments with the inner walls of the shell, an auxiliary expansible means, operated independent of the pneumatic expansible actuator, is positioned adjacent the lower end of the mandrel. The mandrel is inserted in the shell in the customary manner and is expanded by the pneumatic expansible actuator and, after the mandrel is expanded, the auxiliary actuator is operated to hold the lower end of the segments in their expanded position. Thus, as displacement pressures build up at the lower end of the shell, the lower end of the mandrel is supported by the

auxiliary actuator to maintain the parallel alignment of the mandrel segments and prevent the shell from collapsing inward.

Referring now to the attached drawings illustrating an embodiment of the invention, in FIG. 1 there is shown a corrugated shell 2 closed at its bottom end by cap 4 which may be welded or otherwise suitably attached to the shell. A mandrel having leaves or segments, generally indicated 6, 8, is positioned in shell 2 with its bottom or lower end in engagement with cap 4. At their upper ends, segments 6, 8 extend outwardly beyond the upper end of shell 2 and are provided with suitable apertures 10, 12 for attachment to the driving hammer mechanism (not shown).

A pressure container 14, closed at its lower end by a plug 16 and connected at its upper end by hose 18 to a source of compressed air (not shown) is disposed intermediate segments 6, 8 and is supported on one of the segments by a plurality of supports 20 welded or otherwise suitably attached to one of the segments.

Segments 6, 8 are each semicylindrical, having an outer arcuate surface engageable with the inner wall of shell 2 and an inner flat surface engageable with pressure container 14. The segments may be formed as a solid unit or, as shown in the attached drawings, may be formed from a plurality of castings 22, 24, 26 interconnected by plates 30, 32 welded or otherwise attached to the respective casting.

In the attached drawings three such castings are shown which, for purposes of convenience, are identified as upper casting 22, intermediate casting 24, and lower casting 26. Since it is customary to fabricate mandrels in various lengths, depending upon the length of pile shell to be driven, it is to be understood that, in shorter mandrels, the intermediate casting 24 may be omitted and, in longer mandrels, a plurality of intermediate castings 24 may be employed. For ease and convenience in manufacture, it is preferred to fabricate the mandrel in increments of 20 foot length. Thus, mandrels are fabricated to drive shells up to 20 feet, 40 feet, 60 feet, etc. A mandrel for driving a 20 foot pile shell would include only the upper casting 22 and lower casting 26, the castings being joined by plates 30, 32. In a mandrel for driving shells 40 feet long, the three castings, as shown in the attached drawings, would be employed, while in a mandrel for driving 60 foot shells the upper casting 22, lower casting 26 and two intermediate castings 24 would be employed. In longer mandrels, additional intermediate castings would be used.

Segments 6, 8 are provided with aligned apertures 33 spaced in pairs along the length of the mandrel, the apertures 33 being positioned at opposite sides of pressure container 14. A pin 34, provided at its opposite ends with heads 36, is positioned in each of the apertures 33. Springs 38 are carried at the opposite ends of pin 34 and are seated at one end on head 36 and, at the opposite end, on a seat provided on plate 32 in aperture 33. Pins 34 maintain segments 6, 8 in transverse alignment, springs 38 returning the segments to their collapsed position when pressure container 14 is deflated. A second series of aligned apertures 40 passing transversely through the mandrel may also be provided at spaced points along the mandrel, each of the apertures containing a pin 42. Pins 42 are held positioned in apertures 40 by a plug 44 fitted in the opposite ends of the apertures. While only one set of pins 34 and one set of pins 42 are shown in the attached drawings, it is to be understood that, in actual practice, a plurality of such pins are employed, the pins being spaced in pairs axially along the mandrel.

Referring now to FIG. 3, the upper casting 22 is formed with an outer arcuate surface 46 and an inner flat surface 48, the flat surface 48 joining the ends of arcuate surface 46 forming a chord therebetween. At its opposite ends, flat surface 48 is provided with abutments 50, 52 for purposes more clearly pointed out hereinafter. Each of

the upper castings 22 is formed with a cavity 54 to accommodate support 20 and the connection of pressure container 14 to hose 18.

Castings 24 and 26 are formed similar to casting 22 and are each provided with outer arcuate surfaces, inner flat surfaces, cavities to accommodate the pressure container supports and, at their opposite ends, the flat surfaces are provided with stops similar to those on casting 22 in FIG. 3. As best shown in FIGS. 4 and 5, arcuate plate 30 is joined adjacent its opposite ends by a plate 32, the opposite ends of plate 30 extending beyond plate 32 to form stops 60, 62. Intermediate its ends, plate 32 is provided with a seat 64 engageable by pressure container 14.

Referring now to FIGS. 1 and 6, cylinder 70 is fixed in casting 26 of segment 6 and is held by a split ring 72 seated in a groove 74 formed in cylinder 70, ring 72 being connected to casting 26 by screws 76. Piston and piston rod 78 is operatively disposed in cylinder 70, piston and piston rod 78 being operable to engage a seat formed in the oppositely disposed casting 26. Cylinder 70 is connected by hydraulic conduit 80 to pumps 82, 84, and gauge 86. Valves 88, 90 are positioned in conduit 80 intermediate cylinder 70 and pumps 82, 84. Conduit 80 extends upwardly along the inner face of segment 86 and is fixed thereto by clips 92.

As illustrated in the attached drawings, the mandrel is expanded, pressure container 14 being inflated and segments 6, 8 being in contact with the inner wall of shell 2. Thus, the mandrel is in position to drive the shell. Piston and piston rod 78 is extended in cylinder 70 and is in contact with casting 26 of the oppositely disposed segment 8. After the shell has been driven, pressure container 14 is deflated, piston and piston rod 78 is withdrawn, and segments 6, 8 are retracted by springs 34. The mandrel may then be withdrawn from the shell.

In operation, the collapsed mandrel is inserted in a shell with the lower end of the mandrel in contact with boot 4. With the mandrel in position in the shell, pressure container 14 is inflated moving segments 6, 8 outward into engagement with the inner wall of the shell. The pressure container is fully inflated, that is, the inflating pressure intended for driving is introduced into pressure container 14. In practice, this pressure may be 100 to 125 p.s.i. or higher. With pressure container 14 fully inflated, the outer arcuate surfaces of segments 6, 8 are in firm contact with the opposite inner walls of the shell, segments 6, 8 being in spaced substantially parallel alignment in the shell.

After pressure container 14 has been fully inflated and segments 6, 8 are in firm contact with the inner walls of the shell, valve 88 is opened and valve 90 remains closed. With valve 88 open, pump 82 is actuated, forcing hydraulic fluid through conduit 80 into cylinder 70 moving piston and piston rod 78 outward until piston rod 78 contacts segment 8. Once piston rod 78 is in firm contact with segment 8, as indicated by a pressure reading on gauge 86, valve 88 is closed.

Once segments 6, 8 are expanded and brought into contact with the inner wall of the shell by the inflation of pressure container 14, the alignment of the segments axially along the shell walls for driving has been established and it is not desirable to disturb this alignment. Hence, in actuating piston rod 78, only sufficient pressure is supplied to cylinder 70 to move piston and piston rod 78 into firm contact with the opposing segment. A pressure reading of about 10 p.s.i. on gauge 86 is sufficient to indicate firm contact. When this pressure is reached valve 88 is closed.

With the mandrel expanded in the shell and piston rod 78 in contact with the opposing segment, the shell and mandrel are driven. As displacement pressures occur at the lower end of the shell during driving, piston rod 78 maintains the spacing of the segments, preventing the shell from collapsing and seizing the mandrel. Thus,

throughout driving, parallel alignment of the mandrel segments is maintained.

In addition to maintaining the alignment of the segments during driving, piston 70 and piston rod 78 also serve as an indicator of conditions during driving at the lower end of the mandrel. As displacement pressures increase or decrease during driving corresponding increases and decreases can be observed on gauge 86. Thus, during normal driving, as the displacement pressure increases at the lower end of the mandrel, the increase in pressure on the mandrel at the bottom of the shell will be transmitted through the hydraulic fluid in conduit 80 to gauge 86 and will result in an increase in the reading on the gauge. If, during driving, the lower end of the mandrel is driven into the vicinity of a boulder, displacement pressures increase rapidly due to the inability of the boulder to absorb displacement pressures. Hence, by observing gauge 86, a rapid increase in displacement pressure will be noted. Once the mandrel tip has been driven past the boulder, displacement pressures will be more rapidly absorbed in the surrounding material and a decrease in the reading on gauge 86 will be noted. Thus, by observing the rapid increase and sudden decrease in gauge readings during driving, it is possible to detect the presence of boulders and other incompressible materials.

As aforesaid, in moist clays relatively high displacement pressures may be encountered which pressures are slowly absorbed and equalized in the surrounding clay. While the mandrel reinforced shell is of sufficient strength to withstand these pressures and stand open, if the mandrel is removed from the shell before a sufficient portion of these pressures has been absorbed, the shell may collapse. This is particularly true in the instant invention where the lower end of the segments are locked in the expanded position. By maintaining the mandrel in its expanded position in the shell until the displacement pressure against the shell has been lowered to a safe pressure by equalization of the displacement pressures in the surrounding material, collapse of the shell can be avoided. Thus, by observing the pressure reading on gauge 86 before deflating and removing the mandrel, it is possible to avoid collapse of the shell. If the reading on pressure gauge 86 is above a predetermined value when driving is completed, the mandrel is allowed to stand expanded in the shell until the reading on gauge 86 falls below the predetermined safe limit. The mandrel is then deflated and removed from the shell.

To provide rapid release of piston and piston rod 78 after driving for removal of the mandrel, it is preferred to employ pump 84 and valve 90. When driving is completed, with valve 88 closed valve 90 is opened. Pump 84 is actuated exhausting hydraulic fluid from conduit 80 and cylinder 70, thereby releasing piston rod 78. Thus, after driving, the pneumatic pressure is exhausted from pressure container 14 and piston 78 is released by releasing the hydraulic pressure from cylinder 70. With the pneumatic pressure exhausted and the hydraulic pressure released, springs 38 return the segments inward engaging the stops at the ends of the arcuate surfaces and the mandrel may then be withdrawn from the shell. Obviously, if desired, a single pump and valve may be employed for actuating and retracting piston rod 78. Other means, such as a spring or the like, may also be employed to effect rapid release of piston rod 78 after driving.

While the invention has been described in connection with a mandrel having two oppositely disposed segments, it is to be understood the invention may also be employed with mandrels having more than two segments arranged in oppositely disposed pairs. Thus, an auxiliary actuator, such as has been described, would be positioned between each pair of oppositely disposed segments, the individual actuators being either independently actuated or linked to a common hydraulic supply conduit.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having outer surfaces for engaging the inner wall of a pile shell, each of said segments having an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full length of said segments for exerting pressures thereon simultaneously in opposite directions to drive said segments outwardly into engagement with said inner wall of the shell, and means independent of said pressure container means disposed between said oppositely disposed segments adjacent the lower end thereof for maintaining said oppositely disposed segments in engagement with the inner wall of the shell, said last mentioned means being operated independent of said pressure container means.

2. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having outer surfaces for engaging the inner wall of a pile shell, each of said segments having an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full length of said segments for exerting pressures thereon simultaneously in opposite directions to drive said segments outwardly into engagement with said inner wall of the shell, and means independent of said pressure container means disposed between said oppositely disposed segments and adjacent the lower end thereof for maintaining said end of said segments in engagement with the inner wall of the shell, said last mentioned means being operated independent of said pressure container means.

3. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having a lower end adapted to be inserted into a pile shell and an upper end adapted to extend upwardly out of said shell, each of said segments having an outer surface for engaging the inner wall of a pile shell and an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means extending for substantially the full length of said segments and interposed between said inner surfaces of said segments for exerting pressure thereon substantially in opposite directions to drive said segments outward into engagement with said inner wall of the shell, and hydraulic means disposed between said oppositely disposed segments adjacent said lower end for maintaining said oppositely disposed segments at said lower end in engagement with the inner wall of the shell, said hydraulic means being operated independent of said pressure container means.

4. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having a lower end adapted to be inserted into a pile shell and an upper end adapted to extend upwardly out of said shell, each of said segments having an outer surface for engaging the inner wall of a pile shell and an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full

length of said inner surfaces for exerting pressure on said inner surfaces substantially in opposite directions to drive said segments outward into engagement with said inner wall of the shell, hydraulic means independent of said pressure container means disposed between said segments adjacent said lower end for maintaining the lower end of said segments in engagement with the inner wall of the shell, and means independent of said pressure container means for operating said hydraulic means.

5. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having a lower end adapted to be inserted into a pile shell and an upper end adapted to extend upwardly out of said shell, each of said segments having an outer surface for engaging the inner wall of a pile shell and an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full length of said segments for exerting pressure thereon substantially in opposite directions to drive said segments outward into engagement with said inner wall of the shell, means on one of said oppositely disposed segments adjacent the lower end thereof for engagement with the other of said oppositely disposed segments for maintaining said segments in engagement with the inner wall of the shell, and means independent of said pressure container means for operating said means on one of said oppositely disposed segments.

6. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having a lower end adapted to be inserted into a pile shell and an upper end adapted to extend upwardly out of said shell, each of said segments having an outer surface for engaging the inner wall of a pile shell and an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full length of said inner surfaces for exerting pressure thereon substantially in opposite directions to drive said segments outward into engagement with said inner wall of the shell, a cylinder on one of said oppositely disposed segments adjacent the lower end thereof, a piston and piston rod in said cylinder, and hydraulic means for moving said piston and piston rod in said cylinder into engagement with the other of said oppositely disposed segment and for holding said piston and piston rod in engagement with said oppositely disposed segment, said hydraulic means being independent of said pressure container means.

7. An expansible mandrel for driving pile shells, said mandrel comprising a plurality of oppositely disposed segments having a lower end adapted to be inserted into a pile shell and an upper end adapted to extend upwardly out of said shell, each of said segments having an outer surface for engaging the inner wall of a pile shell and an inner surface forming an integral portion of said segment and extending longitudinally along substantially the length of said segment, flexible pneumatic pressure container means interposed between said inner surfaces of said segments and extending for substantially the full length of said inner surfaces for exerting pressure thereon substantially in opposite directions to drive said segments outward into engagement with said inner wall of the shell, a cylinder on one of said oppositely disposed segments adjacent the lower end thereof, a piston and piston rod in said cylinder engageable with the other of said oppositely disposed segments, a hydraulic pump independent of said pressure container means, a fluid pressure conduit interconnecting said cylinder and said pump, a valve in said fluid pressure conduit, whereby, as fluid pressure is delivered through said conduit to said cylinder, said pis-

ton and piston rod are actuated into engagement with said oppositely disposed segment.

8. In an expansible mandrel as recited in claim 7, a gauge in said fluid pressure conduit intermediate said valve and said cylinder.

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