

March 9, 1943.

W. H. COBI

2,313,625

COLLAPSIBLE MANDREL OR CORE FOR DRIVING MOLDS FOR CONCRETE PILES

Filed Nov. 10, 1939

3 Sheets-Sheet 1

Fig. 1.

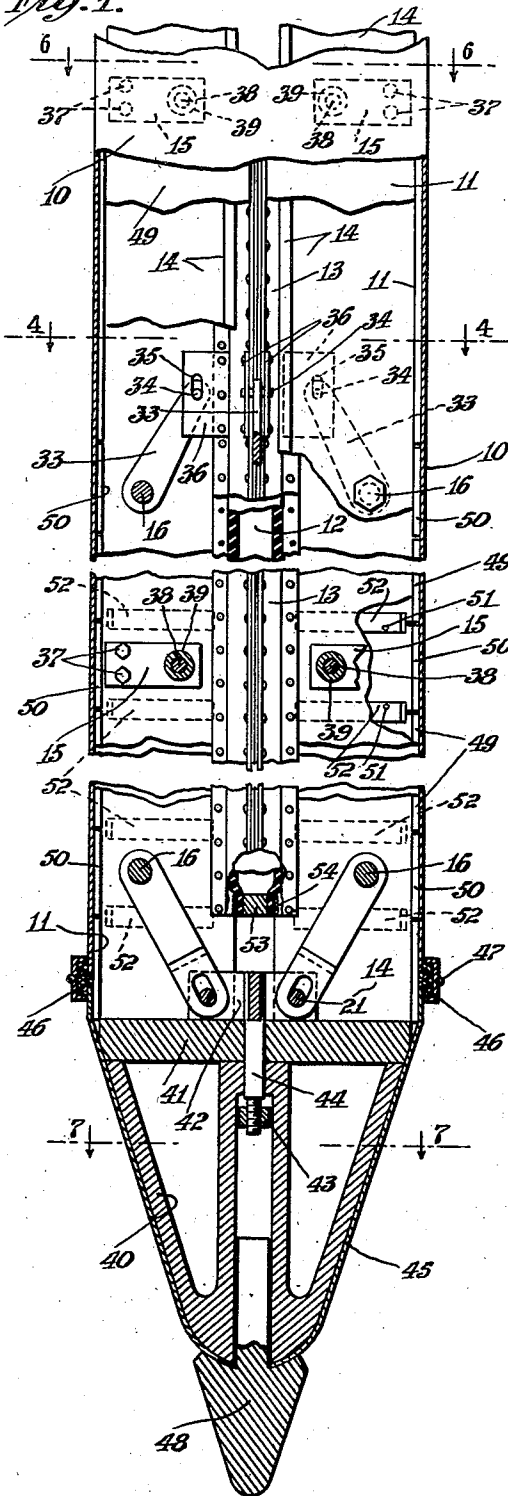
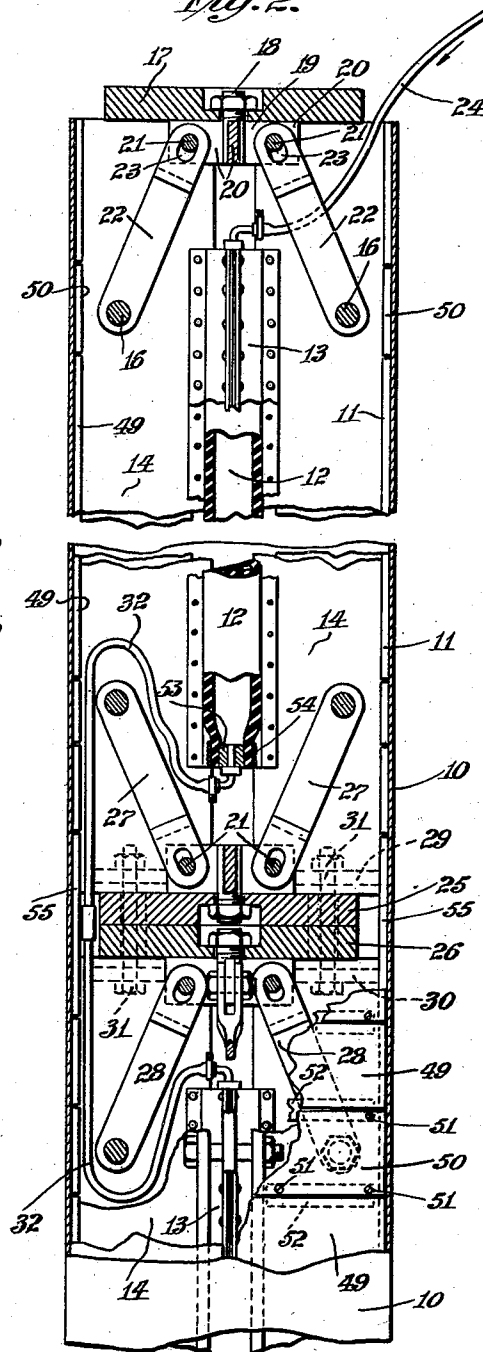


Fig. 2.



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Fig. 3.

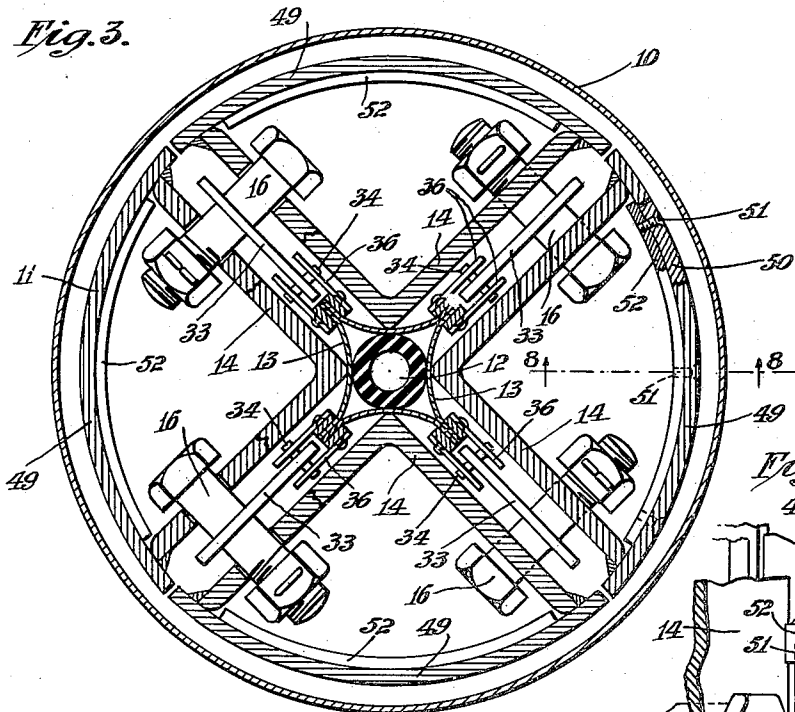


Fig. 8.

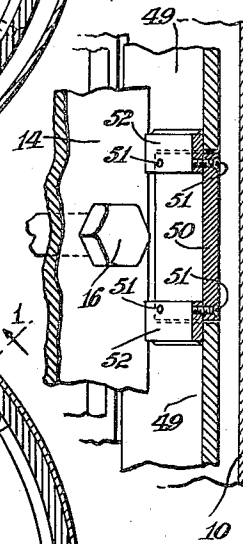
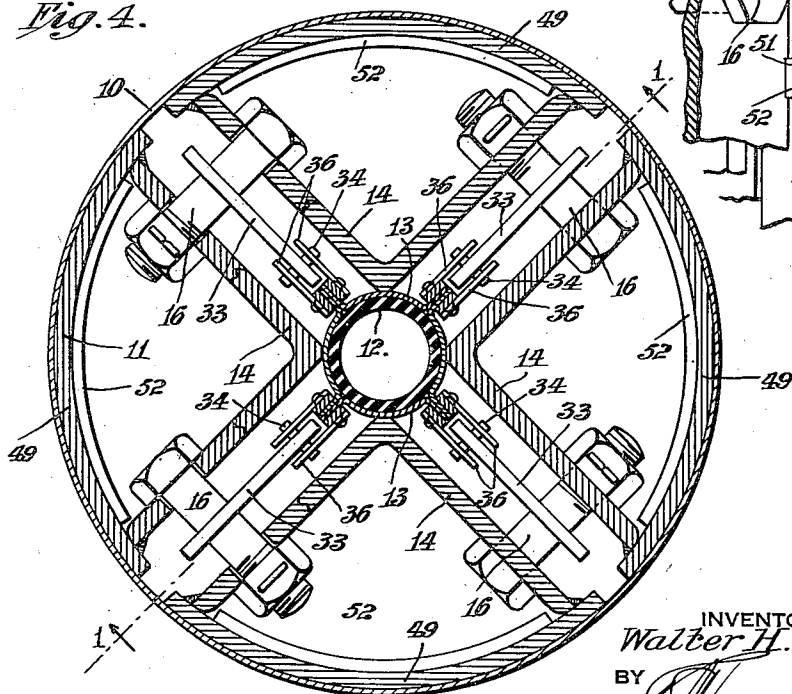


Fig. 4.



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Fig. 5.

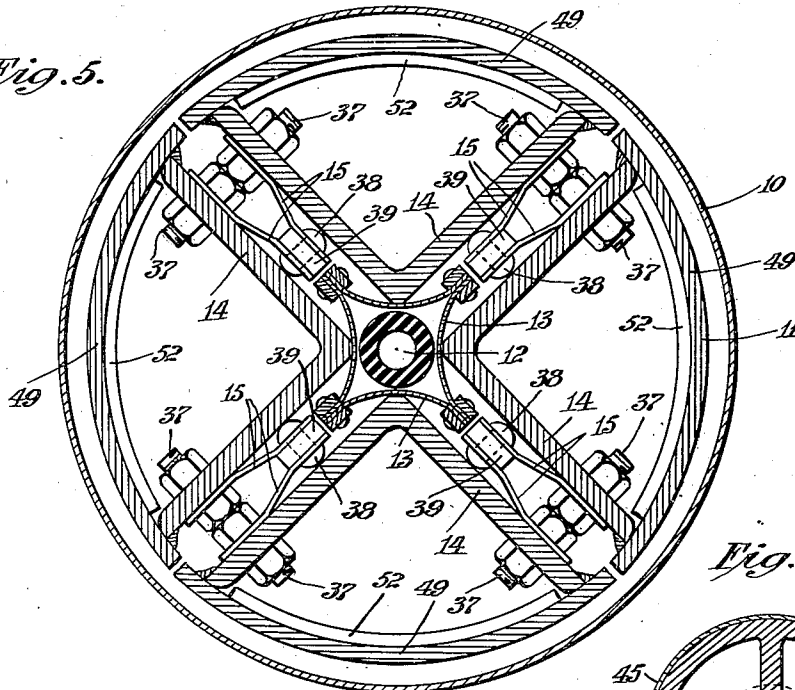


Fig. 7.

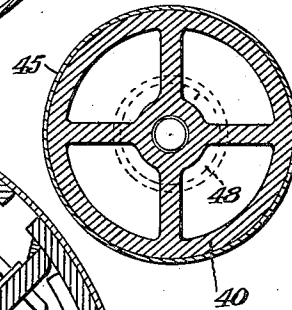
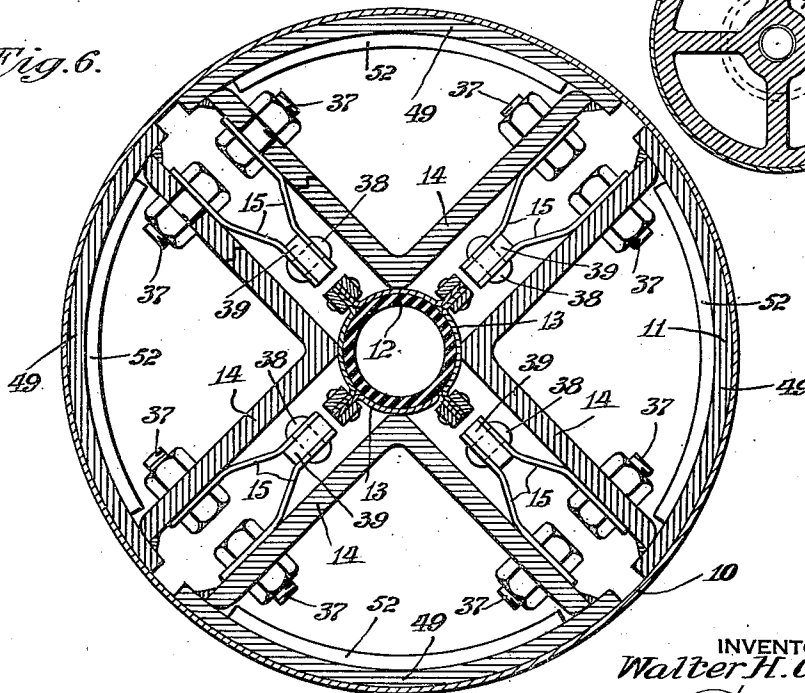


Fig. 6.



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UNITED STATES PATENT OFFICE

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COLLAPSIBLE MANDREL OR CORE FOR
DRIVING MOLDS FOR CONCRETE PILES

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Application November 10, 1939, Serial No. 303,826

18 Claims. (Cl. 61—79)

This invention relates to expansible mandrels or cores capable of being driven into the ground with a shell or mold for a concrete pile, and has for an object to provide a light weight device of this class which is inexpensive to both construct and operate.

Another object is to provide such a mandrel capable of being expanded by fluid pressure instead of by mechanical elements such as screws, wedges or the like.

A further object is to provide an expansible mandrel which is light enough in weight per unit weight to be handled by the use of a portable crawler type rig instead of the usual land rig which requires more expensive labor.

Yet another object is to provide means for accurately adjusting the amount of expansibility given the mandrel whereby the tightness of fit of the mandrel within the driven shell may determine whether the hammer blows for driving the shell are imparted to the shell from the mandrel along its length or principally at the bottom of the shell.

Still a further object is to provide an expansible mandrel for driving the molds intended for concrete piles in which the mandrel is adapted to be made in comparatively short lengths each connected with the others simultaneously expanded or collapsed with ease without the necessity of having rotatable or slidable connections between the sections for expanding or collapsing them.

In most of the molds for concrete piles it has been customary to use an expansible mandrel insertable in the mold or shell and adapted to receive hammer blows for driving it into the earth with the mold or shell. Such cores or mandrels have usually been expanded mechanically by means of screws, cams, wedges or the like. When the mold or shell is polygonal in cross section a minimum number of sides has been necessary in order to simplify the expanding or contracting mechanism. Another objection has been the weight of these cores and the labor expense of handling them. Such mechanically actuated cores are not easily withdrawn if bent and are not adapted to be made in short lengths.

According to this invention these disadvantages are overcome and a fluid pressure type expansible core provided which is light in weight per unit length and adapted to be more readily handled than have previously commercial cores for this purpose.

Fig. 1 is a vertical section of the lower por-

tion of the shell or mold with the expansible core in place, the section being taken substantially on the line 1—1 of Fig. 4, the parts being shown in elevation with certain portions broken away.

Fig. 2 is a vertical section of the upper portion of the device of Fig. 1, showing how it is connected to an upper section.

Fig. 3 is an enlarged section on the line 4—4 of Fig. 1, but having the core collapsed.

Fig. 4 is a view on the line 4—4 of Fig. 1 and similar to Fig. 3 except that the parts of the core are expanded, as shown in Figs. 1 and 2.

Fig. 5 is an enlarged view taken on the line 6—6 of Fig. 1 but with the parts of the core collapsed.

Fig. 6 is also a section on the line 6—6 of Fig. 1 but with the portions of the core expanded.

Fig. 7 is a section on the line 7—7 of Fig. 1. Fig. 8 is a vertical section on the line 8—8 of Fig. 3, showing the construction of the hand holes.

The usual water impervious metal shell or mold 10 in which the concrete pile is to be cast is driven into the earth by means of an expansible mandrel or core which receives the blows from a hammer and transmits them to the shell in driving the same into the earth. In the present case the expansible core or mandrel 11 is expanded by means of fluid pressure within the elastic container 12 of rubber or other suitable material.

Surrounding the elastic container 12 is a flexible metal wrapper 13 made of four pieces of spring brass riveted or bolted together along their edge portions as shown in the cross sectional views in Figs. 3 to 6. Outside the wrapper 13 are frame members 14; in the embodiment illustrated each includes an angle member. Springs or other elastic means 15 are connected between adjacent portions of the frame members for the purpose of collapsing the core or mandrel when fluid pressure within the container 12 has been reduced sufficient to substantially collapse the metal wrapper 13. Bolts 16 passing through adjacent web portions of the angles or frame members constitute a tension connection for limiting the amount of radial outward movement given the frame members.

The mandrel is preferably made in sections of a convenient length and as shown in Fig. 2 a transverse plate 17 is located at the top of a section to receive the blows of a hammer or other device that may be used for driving the core and

shell into the earth. This plate is made to be capable of limited relative movement transversely of the frame members. A nut and bolt 18 connect this plate 17 with a steel casting 19 having wing portions 20 adapted to fit in between the sides of the angles constituting the frame members.

Links 22 connect pins 21 in members 20 with the bolts 16 through the frame members. Each link is preferably provided with an elongated opening 23 to receive the pin 21 so that hammer blows on the plate 17 are transmitted directly to the frame members and not through the links 22. Yet in withdrawing the collapsed core from the shell, an upward force applied to lift the plate 17 will raise the frame members through the links 22. A flexible rubber hose or other appropriate type connection leads from an air pump or other source of fluid pressure to the elastic container 12. At the lower end of the mandrel section shown in Fig. 2 is another plate 25 similar in construction to the plate 17. A contiguous plate on the next lower section is likewise floating. The plates 25 and 26 are connected with their frame members through the links 27 and 28 respectively.

A fixed diaphragm or plate 29 is preferably welded to its peripheral or segmental portion and shaped to extend in between the sides of each angle or frame member. A similar plate 30 is formed for the adjacent lower mandrel section. Bolts 31 connect these plates 29 and 30 for the purpose of transmitting tension from one mandrel section to the other in withdrawing a collapsed mandrel. As shown in the drawing these bolts 31 are provided with substantial clearance space where they pass through the plates 25 and 26 in order that the floating nature of these plates may not be impeded. An air hose 32 connects the upper elastic container of one mandrel section with that of a lower section in order that each section may be simultaneously expanded the same amount.

As shown in Figs. 1, 3 and 4 links 33 connect the bolts 16 with pins 34 resting in elongated holes 35 in the plates 36 which are riveted to the connections for the flexible metal wrapper 13 as shown in Figs. 3 and 4.

In the early development of this invention the elastic container and its flexible metal wrapper were not anchored to the frame members, yet it was found that the application of hammer blows to the frame members tended to cause relative movement between these frame members and the elastic container and wrapper with the result the container 12 with its wrapper 13 tended to ride up through the cores as the cores were driven into the earth. The links 33 were provided to prevent any substantial riding up or relative upward movement of the elastic metal wrapper with respect to the frame members.

The springs 15 are shown in Figs. 1, 5 and 6 as being secured to the frame members 14 by the bolts 37. Each pair of springs is secured together at the inner end by the rivet 38 passing through the springs and through a spacer member 39. These springs have a tendency to pull the adjacent portions of the frame members together or in other words to collapse the mandrel or core from the position shown in Fig. 6 to that shown in Fig. 5. The bolts 37 and rivets 38, as shown in Fig. 5, limit the collapsing of the core or mandrel to the amount shown.

As shown in Figs. 1 and 7 the lower end portion of the mandrel is provided with a conical

steel casting 40 against which fits the end of the shell or mold 10. Contiguous the top of the conical member 40 is a plate 41, which receives the downward thrusts on the mandrel and transmits them to the conical member 40. The winged casting 42 is similar in construction to the casting 19 except that a nut 43 is provided on a stem 44 so that on lifting the member 42 the conical member 40 will also be raised. As shown connection is not tight, that is, the member 42 is not intended to transmit hammer blows from the frame members to the plate 41. The central bore in the member 40 should be large enough to permit the insertion of an appropriate socket wrench for moving the nut 43. The conical lower end 45 of the shell 10 is shown as being connected with the upper part of the shell 10 by means of a joint 46, in this case illustrated as being formed of rolled edges spanned by semi-circular hoops of the cross sectional shape illustrated and these semi-circular hoops are held together by a wire 47 wrapped one or more times around them to keep them in place. Of course any other appropriate type of connection may be used between the lower conical end 45 and the main body 10 of the casing or shell. Any type of shell may be used. The lower end 45 of the shell is perforated for reception of the stem of the conical point 48. On retraction of the mandrel or core the point 48 remains in the earth along with the shell or mold 10 but the frame members and their attached parts including the conical member 40 are withdrawn.

As shown in Figs. 3 to 6 inclusive, each frame member 14 includes the angle illustrated, to the ends of which are welded the segmental longitudinal members 49. These members are provided with hand holes so as to allow access to the bolts 16 and 37 for adjusting them after the mandrel has been assembled but before it is driven into the shell. These hand holes are provided with covers 50 shown in Figs. 3 and 8 for example. Each cover is secured by screws 51 to the metal strips 52 which have been welded to the segmental members 49. Loosening the screws 51 enables the hand hole cover 50 to be removed for access to the bolts 16 and 37.

The mandrel or core is assembled by inserting the expandable rubber container 12 within the flexible steel wrapper 13. The frame members 14 are then assembled in position as shown in Figs. 3 and 5. The links 33 are connected as are also the springs 15 as each frame member is put in place. The segmental members 49 were of course previously welded to the angles before being assembled. The conical end portion of the casing is connected by the joint 46 to the main body of the shell 10. The conical member 40 and the frame members 14 are together inserted into the shell. The point 48 is inserted just prior to the mandrel being driven into the earth. On retraction the point 48 is left in the ground. Prior to insertion of the mandrel into the shell the bolts 16 will have been accurately adjusted to give just the desired amount of expansion to the mandrel or core. Adjustment of the bolt 16 permits such accurate control of expansion of the core that it will be found possible to transmit hammer blows along the length of the thin shell 10 or if the core is not expanded sufficiently to place the shell under any substantial transverse tension the hammer blows may be in major part delivered to the lower end part of the shell so that the shell will be pulled into the ground.

One embodiment of this invention which has been successfully tried out had approximately the following sizes and dimensions for parts. The shell was formed in about 10' sections connected in any appropriate manner. The angles 14 had a bearing surface of about $\frac{3}{8}$ to $\frac{1}{2}$ inch on the spring brass wrapper 13. This spring brass wrapper 13 was made of 26 gage spring brass, which is about .018 inch in thickness. The springs 15 were made about 2" wide and about 3" long of spring steel about $\frac{1}{8}$ of an inch thick. The rivet 38 is about a one inch steel rivet. The hand holes are about 4" longitudinally by about 9" in angular extent. The angles 14 are about 30' in length though shorter sections may easily be formed. The strips which clamp the edges of the spring brass wrapper 13 are made of cold rolled strips about $\frac{3}{8}$ of an inch to about $\frac{3}{4}$ of an inch in about 10' sections fastened together with rivets about 1" apart. The container sections are formed of pure gum rubber and can be obtained in almost any length desired. It has a wall about $\frac{1}{4}$ inch thick when deflated. In each end of the container 12 is a plug 53, the rubber being wire-wound at 54 in order to provide a tight joint at the ends of the rubber and between the rubber and the plug to prevent the escape of air pressure. About 120 lbs. of air pressure has been used. It is desirable to have the bolts 16 under tension so that in event a hammer blow should be distributed more on one angle member than upon another the bolts would assist in distributing the impact among all the angle members. The pressure plates at the top and bottom of each mandrel section can float to a limited extent with respect to the section. Preferably hammer blows are transmitted to and from the plates 17, 25, 26 and 41 and the frame members 14. On withdrawing the core from the shell, the inclination of the links 22, 27, 28 and 33 assist in collapsing the frame members, that is, moving them radially inward due to a component of the lifting force tending to accomplish this result.

This invention is believed to be adapted for use with a tapered shell, that is, one for forming a tapered pile or for a shell which has a polygonal cross section, or for a shell which may be corrugated either longitudinally or transversely. While the major portion of the driving thrust may be applied at or adjacent the point or lower end of the shell, nevertheless by having the shell 10 slightly under a transverse tension due to the tight fit of the core or mandrel therein, the driving thrust may be transmitted longitudinally along the length of the shell. This invention is adapted for a shell having a polygonal cross section and almost any number of sides whereas the heretofore common mechanically expandable cores are not adapted for a shell having more than three sides without running into expense and complication for each additional side. A segmental member 55 preferably spans the space between adjacent frame members where a joint in the core exists.

Instead of the rivets shown in the drawing as holding the wrapper edges clamped together, bolts are easier to remove, there being shake proof washers under each nut to prevent the nut turning or becoming loose. Cotter pins are preferably employed passing through each bolt 16 and its nut.

In practice the plate 17 is often wider than the diameter of the shell to provide means to facilitate lifting the mandrel out of the shell.

I claim:

1. An expansible mandrel or core for insertion in a metal shell to receive hammer blows for driving the shell into the ground, which comprises an expansible container for fluid under pressure, a flexible metal wrapper contiguous said container when expanded and adapted when the container is collapsed to be out of contact with a large portion of the container outer surface, substantially rigid frame members for receiving hammer thrusts and transmitting them to said shell, said frame members being at least in part contiguous said wrapper and adapted to be moved radially outward by said wrapper into contact with said shell, and elastic means cooperating with adjacent frame members for drawing said members radially inward away from said shell on collapse of said container and wrapper, and a tension connection between each pair of adjacent frame members for limiting the full expansion of said wrapper and preventing the application of substantial transverse tension to said shell.

2. An expansible mandrel or core for insertion in a metal shell to receive hammer blows for driving the shell into the ground, which comprises an expansible container for fluid under pressure, a flexible metal wrapper contiguous said container when expanded and adapted when the container is collapsed to be out of contact with a large portion of the container outer surface, substantially rigid frame members for receiving hammer thrusts and transmitting them to said shell, said frame members being at least in part contiguous said wrapper and adapted to be moved radially outward by said wrapper into contact with said shell, and elastic means cooperating with adjacent frame members for drawing said members radially inward away from said shell on collapse of said container and wrapper, and tension means radially between said shell and wrapper and in cooperation with said frame members for limiting expansibility of said container and wrapper and the angular separation of said frame members.

3. An expansible core or mandrel for driving a shell into the ground for molding therein a concrete pile, said mandrel including longitudinal frame members adapted to receive hammer blows, means for radially expanding said frame members, means for moving said expanding means with said frame members under hammer blows while transmitting said blows substantially entirely through said frame members, a transverse block contiguous the ends of said frame members, another mandrel section substantially like the first mentioned and including frame members, expanding means, and a transverse block contiguous the first mentioned block and the ends of the frame members in the second mandrel section, and fluid pressure means connecting the expanding means in each section independently of any longitudinal thrusts on the frame members of the two sections and threaded securing means passing through the contiguous transverse blocks by means of which a lifting thrust may be transmitted from one mandrel section to another for withdrawal.

4. An expansible mandrel including a plurality of longitudinal frame members, means for moving said frame members radially outward, bolts for limiting the outward movement of said frame members and each passing through adjacent portions of said members, arcuate portions secured to said frame members, access to said bolts before the mandrel is in operation being provided

by hand holes in said arcuate portions, a cover for said hand holes, and strips secured to said arcuate portions along opposite sides of a hand hole, and extending laterally across said hole for a short distance, and means passing through said hand hole cover and strips for securing the cover in place.

5. The combination with a metal shell in which a concrete pile is to be cast, of an expansible mandrel for receiving hammer blows and driving said shell into the ground, said mandrel including an expansible fluid pressure container, frame members moved substantially radially outward by said container into contact with said shell, means connecting said frame members and capable of withstanding and transmitting the force of hammer blows between said frame members, connecting means between said container and frame members whereby downward movement of said frame member and shell under the impact of hammer blows moves the container with said frame members, said frame members being capable of relative radial movement with respect to one another when said container is at least partially collapsed whereby withdrawal of said mandrel from said shell is facilitated in event the shell may have been deflected from a straight line while being driven into the ground, and means for moving said frame members radially inward on collapse of said container.

6. A collapsible mandrel capable of receiving hammer blows and comprising an expansible fluid pressure container, frame members radially outside said container and adapted to be pressed radially outward by said container, adjustable tension means for limiting the radial outward movement of said frame members without impeding the collapse of said mandrel and the inward movement of said frame members, said adjustable tension means connecting adjacent frame members, means connecting said container with said frame members whereby the container will move downward with the frame members under hammer blows, and means for collapsing the mandrel and moving the frame members radially inward on collapse of said container, the frame members being radially movable relative to one another when said mandrel is collapsed.

7. A collapsible mandrel capable of receiving hammer blows and comprising an expansible fluid pressure container, frame members radially outside said container and adapted to be pressed radially outward by said container, adjustable tension means for limiting the radial outward movement of said frame members without impeding the collapse of said mandrel and the inward movement of said frame members, said adjustable tension means connecting adjacent frame members and being adapted to transmit the force of hammer blows between said frame members, means connecting said container with said frame members whereby the container will move downward with the frame members under hammer blows, and means for collapsing the mandrel and moving the frame members radially inward on collapse of said container, said adjustable tension means including a number of bolts having their axes in planes generally transverse of the longitudinal axis of the frame members and arranged along said frame members inward of their radially outer surface, the outer surfaces of said frame members having recessed portions providing access to said bolts, and removable covers to support a thin shell from bulging inwardly

under outside pressure in the area of said recessed portions.

8. In an expansible mandrel for a metal shell in which a concrete pile is to be cast, the shell being adapted to be driven into the ground by means of a pile driver imparting blows to the mandrel within the shell, the mandrel comprising radially movable frame members, a device centrally of said frame members for moving them radially outward, the improvement which comprises thrust transmitting tension members having their axes substantially normal to a plane through the axis of said mandrel and passing between adjacent frame members, connecting adjacent frame members for limiting radial outward movement of said frame members, and distributing impact blows from one frame member to another.

9. In an expansible mandrel for receiving impact blows, frame members radially movable, an expansible fluid pressure container centrally of said frame members for moving them radially outward, said container having a flexible metal wrapper between it and said frame members and fitting tightly about the container when it is expanded, the improvement for moving the expanded container with said frame members under impact on the frame members and comprising a tension member secured to one of said frame members and to said flexible metal wrapper.

10. In an expansible mandrel for receiving impact blows, frame members radially movable, an expansible fluid pressure container centrally of said frame members for moving them radially outward, said container having a flexible metal wrapper between it and said frame members and fitting tightly about the container when it is expanded, the improvement for limiting radial outward movement of said frame members and transmitting impact from one frame member to another, which improvement includes tension members arranged substantially normal to a plane through the mandrel axis passing between adjacent frame members and located radially inward of the periphery of said frame members.

11. In an expansible mandrel for receiving impact blows, frame members radially movable, an expansible fluid pressure container centrally of said frame members for moving them radially outward, said container having a flexible metal wrapper between it and said frame members and fitting tightly about the container when it is expanded, the improvement for limiting radial outward movement of said frame members and transmitting impact from one frame member to another, which improvement includes tension members arranged generally normal to a plane through the mandrel axis and passing between adjacent frame members and located radially inward of the periphery of said frame members, said tension members being adjustable and the periphery of said frame members being provided with hand holes and removable covers therefor whereby the tension members may be accessible for adjustment from outside the mandrel.

12. In an expansible mandrel adapted for driving a metal shell into the ground under impact blows, the mandrel including frame members radially movable, an expansible fluid pressure container centrally of said frame members for moving them radially outward, said container having a flexible metal wrapper between it and said frame members and fitting tightly about the container when it is expanded, the improvement for

moving the expandend container with said frame members under impact on the frame members and comprising a tension member having a lost motion connection between said flexible metal wrapper and a frame member, secured to one of said frame members and to said flexible metal wrapper, said tension member and the container and wrapper when collapsed permitting relative radial movement between the frame members in withdrawing the mandrel from the shell.

13. In an expansible mandrel to be driven by blows, radially movable frame members, a device centrally of said frame members for moving them radially outward, the improvement for transmitting impact between frame members and comprising impact stress transmitting rigid members connecting adjacent separately radially movable and closely spaced frame members and arranged therebetween whereby impact may be distributed between said frame members without passing through said device.

14. In an expansible mandrel for receiving impact blows, frame members which are radially movable, an expansible fluid pressure container centrally of said frame members for moving them radially outward, said container having a flexible metal wrapper between it and said frame members and fitting tightly about the container when it is expanded, the improvement for moving the expanded container with said frame members under impact on the frame members and comprising tension members secured to said frame members and to said flexible metal wrapper at angularly spaced positions and holding said container spaced from each end of the frame members.

15. In an expansible mandrel for a metal shell in which the mandrel includes frame members,

a fluid pressure device radially within the frame members for pressing the frame members radially outward against said shell, the improvement which comprises means for limiting radial outward movement of said frame members, and tension means for distributing impact blows in a general axial direction between said frame members.

16. A mandrel comprising an expansible fluid pressure container, frame members radially outside the container and adapted to receive hammer blows longitudinally of the mandrel and be moved radially outward by said container, a lifting connection for said frame members, and inclined tension links between said lifting connection and frame members, said links being adapted on the application of a lifting force to said connection to tend to move said frame members radially inwardly.

17. An expansible mandrel comprising a plurality of frame members, means for moving said frame members radially outwardly, means for distributing longitudinal thrusts between said frame members, and means whereby the frame members may be longitudinally pulled, each of said means being shaped to allow relative radial inward movement of one frame member with respect to another during said pulling.

18. An expansible mandrel comprising a plurality of frame members, a fluid pressure container radially within said frame members for moving them radially outwardly, said frame members being longer than said container, and means for distributing received hammer blows between said frame members whereby said container is independent of such hammer blows.

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