July 27, 1954 E. A. SMITH 2,684,577

EXPANSIBLE PILE-DRIVING CORE

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Fig. 1.

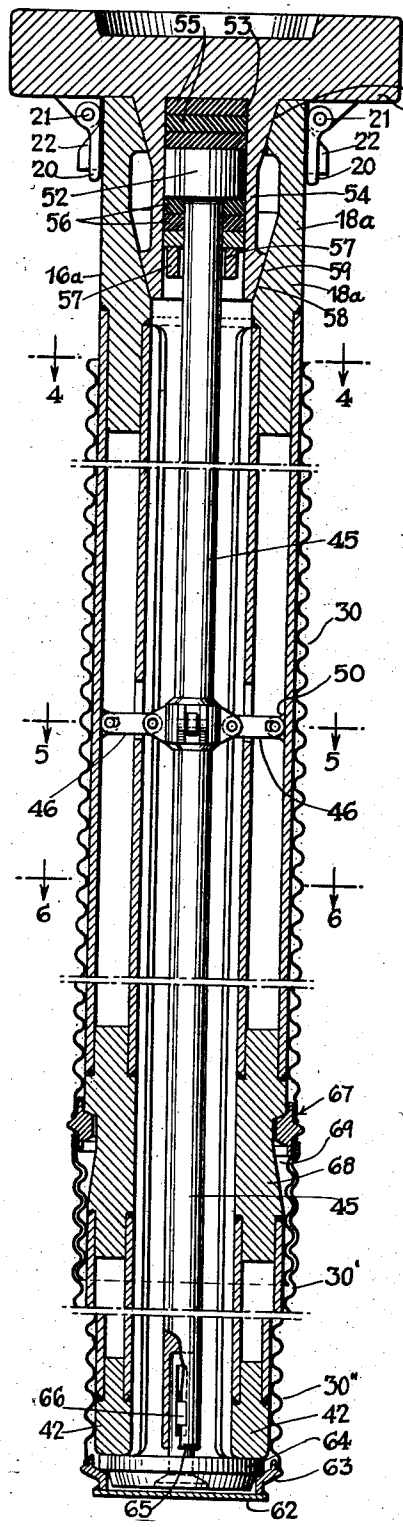


Fig. 2.

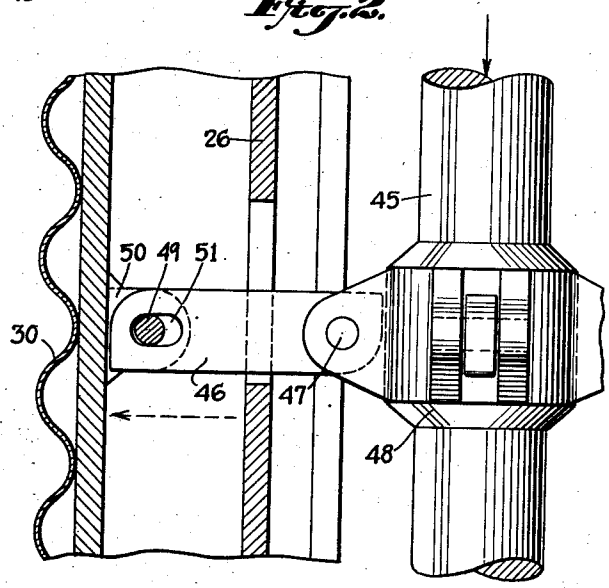
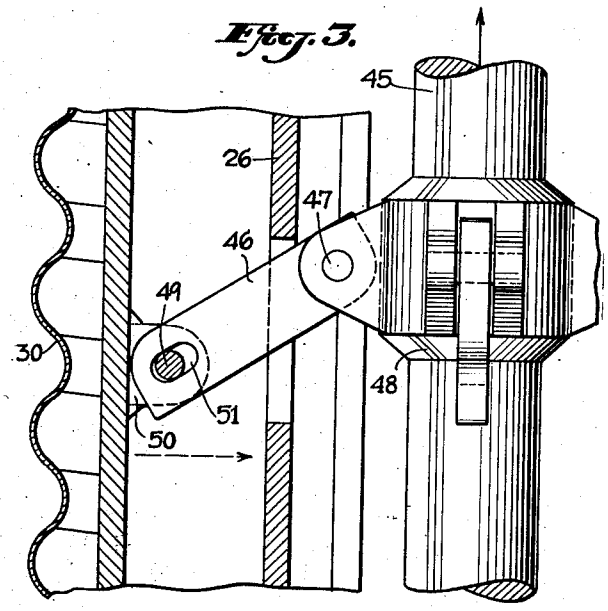


Fig. 3.



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Fig. 4.

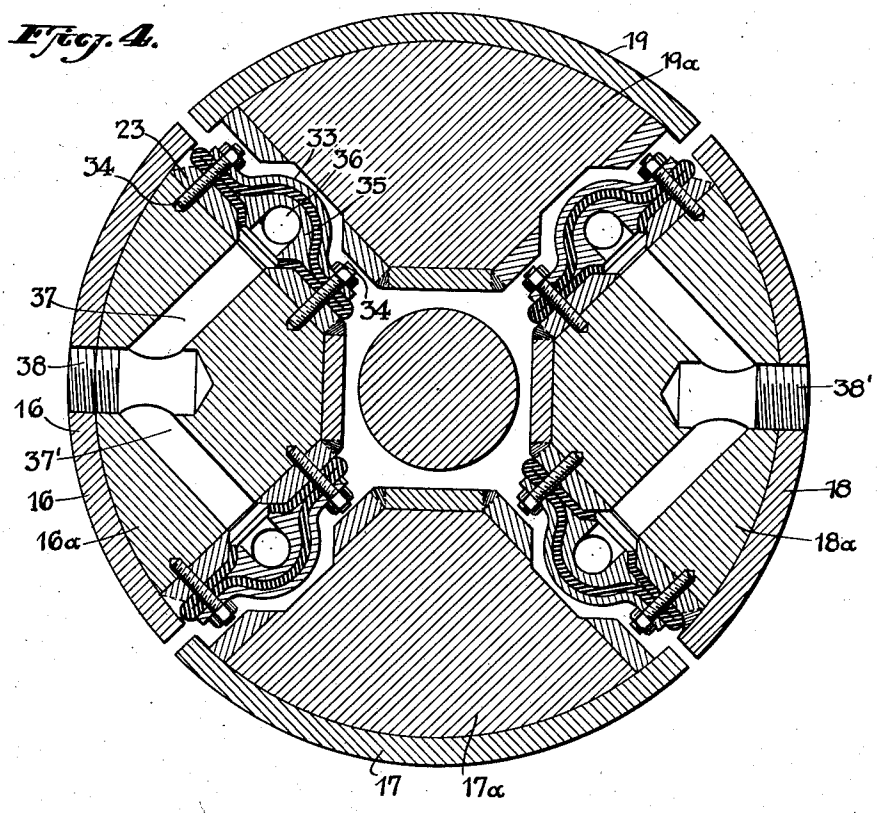


Fig. 5.

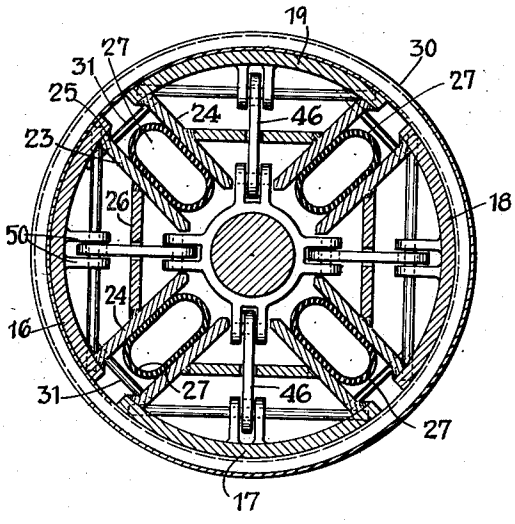
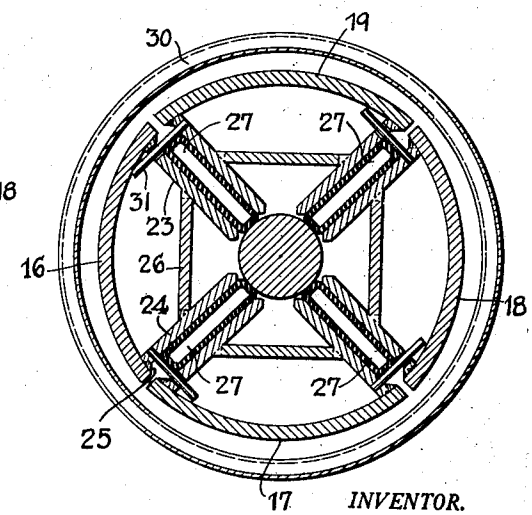


Fig. 6.



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Fig. 7

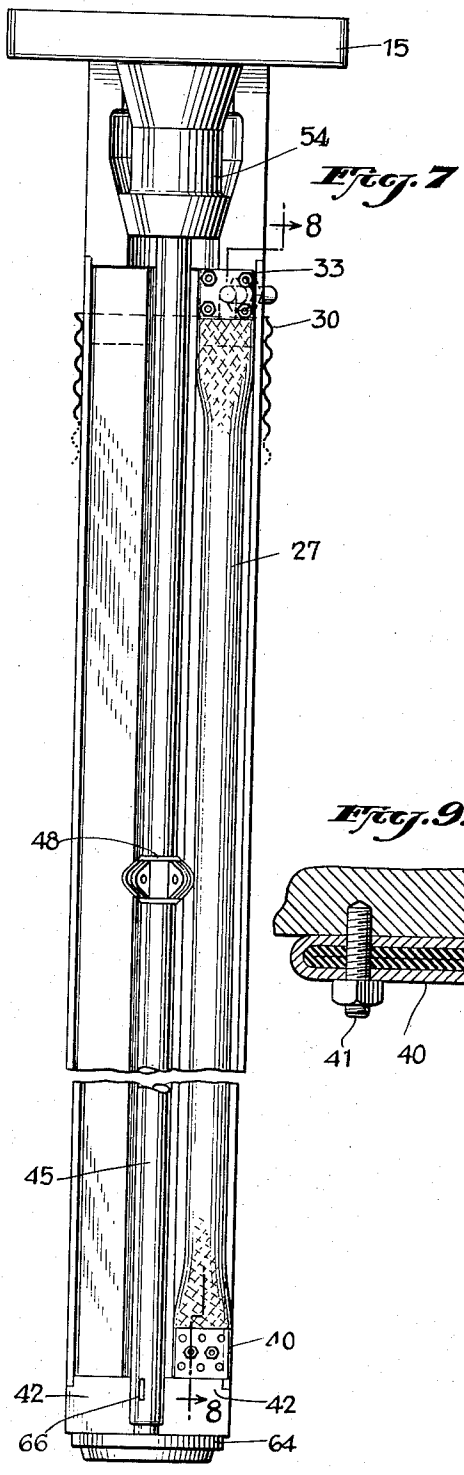


Fig. 8.

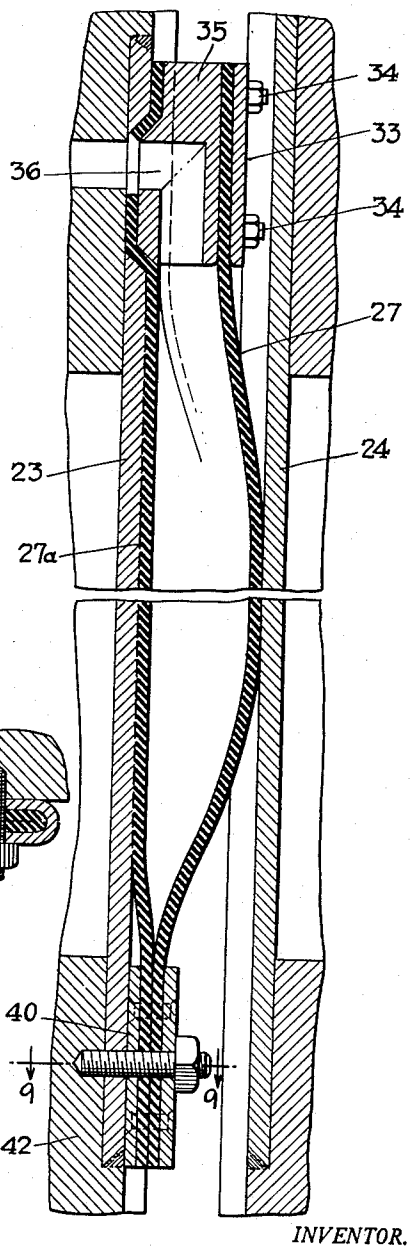


Fig. 9.

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Fig. 10.

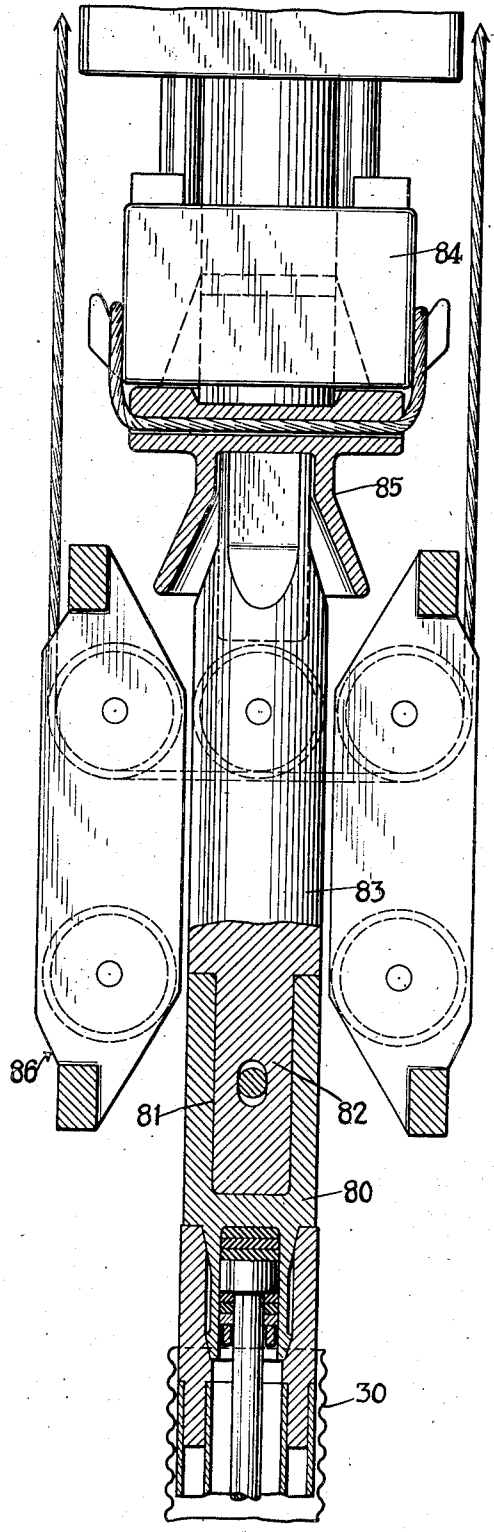


Fig. 11. Fig. 12. Fig. 13.

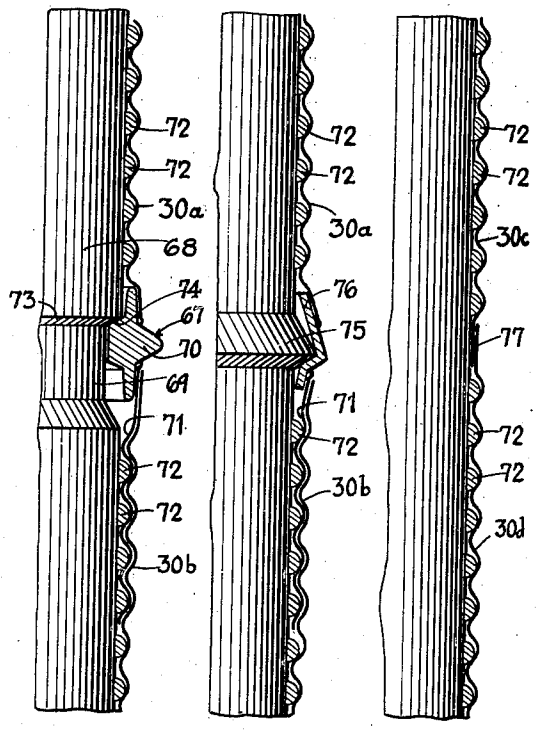


Fig. 15.

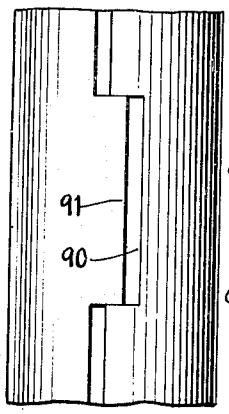
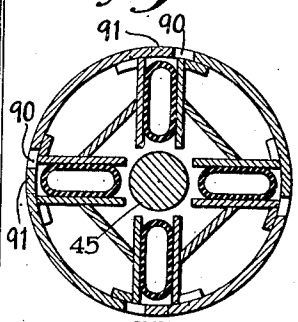


Fig. 14.



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UNITED STATES PATENT OFFICE

2,684,577

EXPANSIBLE PILE-DRIVING CORE

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Application June 25, 1952, Serial No. 295,445

9 Claims. (Cl. 61—79)

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This invention relates to expansible mandrel or driving core constructions adapted for use within pile shells for imparting impacts from a pile driving hammer to the interior portions of the shells.

Heretofore collapsible mandrel or driving core means of various types have been used for this purpose comprising a number of elongated leaves interconnected by mechanical linkages and other parts, the leaves being adapted to be forced radially outwardly into engagement with the interior walls or other parts of the pile shell. But such linkages and mechanisms become relatively complicated and heavy if so constructed as to be relied on to apply adequate expansion pressure to the leaves throughout and all along a lengthy core. Also, if the leaves are positively retained in their expanded positions by mechanical means, unless such retaining means are closely spaced, the leaves may become bent if the pile shells during driving meet obstructions causing inward crushing forces.

In efforts to avoid these difficulties, expansible driving cores have been proposed in forms having on the exterior thereof flexible means expansible by internal fluid pressure to frictionally engage the pile shells. But since such flexible means would be directly in contact with the interior surface of the pile shell, if the latter should become crushed or torn during the driving, then the fluid-containing flexible means would be injured or destroyed. Also the flexible fluid-containing means will be exposed to possibilities of excessive wear or cutting when the core is being handled during installation or removal. Another expedient has been to arrange the leaves each as a rigid structure of a segment-shaped cross-section, around a central flexible member expansible by fluid pressure, the leaves being retractable by springs upon deflation of the expansible member, but such an arrangement, aside from involving various complications, does not insure that the leaves will be held in their correct relative positions for proper frictional engagement all around the interior walls of the pile shell to make possible the imparting of the forces of the hammer blows uniformly to various parts of the shell. Also with the central part of the core thus occupied by the expansible member, the latter prevents use of any dependable rugged centrally located means for positively retracting the leaves and for pulling the assembly out of the shell after the latter has been driven.

With the present invention, the above-noted difficulties are eliminated by providing a core

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having a plurality of the leaves arranged about a central space containing a pull-rod connected by linkage means to the several leaves and, in between each two adjacent leaves, an expansible member is located, which may be in the form for example of a length of readily available hose such as used for fire hose purposes. With this arrangement, the pull-rod and the linkage means may be used to initially expand the core, leaving the final expansion to be accomplished by means of fluid pressure in the hose lengths and when it is desired to collapse the core, upon releasing the fluid pressure in the hoses, the pull-rod may be used forcibly and positively to collapse the core and to pull the assembly from the shell, even though the shell in driving may have become distorted so as to bind against the core. The pull-rod and linkage arrangement, in conjunction with the separate hose lengths between each pair of leaves, assures that the latter will be correctly positioned at all times.

Other and more specific objects, features and advantages of the invention will appear from the detailed description given below, taken in connection with the accompanying drawings which form a part of this specification and illustrate by way of example the presently preferred embodiments of the invention.

In the drawings:

Fig. 1 is a vertical sectional view of a preferred form of core constructed in accordance with the invention and showing such core (with some sections broken away) positioned within a step-tapered form of corrugated sheet metal pile shell;

Figs. 2 and 3 are enlarged views showing parts of the pull-rod and linkage means connected thereto in two different positions of operation respectively;

Fig. 4 is a sectional view taken substantially along line 4—4 of Fig. 1;

Fig. 5 is a sectional view taken substantially along line 5—5 of Fig. 1 and showing the core parts in expanded relation;

Fig. 6 is a sectional view taken substantially along lines 6—6 of Fig. 1 and showing the core parts in collapsed relation;

Fig. 7 is a vertical sectional view similar to Fig. 1, but with certain parts removed so as to particularly show the arrangement of one of the expansible hose lengths;

Fig. 8 is an enlarged vertical sectional view, partly broken away, showing a preferred manner of securing the ends of the lengths of hose;

Fig. 9 is a sectional view taken substantially along line 9—9 of Fig. 8;

Fig. 10 is a vertical sectional view of the upper portion of a core embodying the invention, but having a modified form of headpiece, this view also showing the manner in which this modification may be used with so-called "shelling up" equipment as disclosed in my co-pending application Serial No. 273,920, filed February 28, 1952;

Figs. 11, 12 and 13 are detail sectional views showing different modifications of that part of the core construction which engages pile shell portions at and adjacent joints in the shell; and

Figs. 14 and 15 respectively are cross-sectional and vertical elevational views showing a modification of certain portions of the core assembly.

Referring to Fig. 1 in further detail, the core head portion in the construction here shown is indicated at 15, such portion being adapted to receive through suitable follower pieces or the like, the impacts from the pile driving hammer. In the particular construction here shown, the core has four "leaves" 16, 17, 18 and 19 (Figs. 4–6) each of which, at its upper end, is detachably connected as by links 20 with the headpiece, such links being pivoted as at 21 and comprising loops arranged to releasably embrace lugs as at 22 formed on the upper ends of the leaves.

As best shown in Figs. 4–6, each of the leaves may comprise an outer portion of arcuate cross-section. A pair of plates as at 23, 24 are each welded along one of these arcuate members along adjacent each vertical edge of the latter, as indicated for example at 25. The plates as at 23, 24 may be rigidly held in the relative positions shown, by welding in position therebetween another member such as a plate 26 having suitable gaps or openings therethrough at various points to permit the links hereinafter described to pass therethrough.

Thus each of the leaves comprises a rigid structure of generally sector like cross-section. Between each adjacent pair of such leaves, one of the above-mentioned lengths of hose 27 is located and extends in the usual case substantially from end to end of the core structure. For this purpose, hose of rubber laminated and covered with fabric may be used, preferably a good grade of hose of the type readily available as fire hose. Thus expansible members of this form do not have to be specially designed and constructed for the purpose.

As shown in Fig. 6, the hoses 27 are in substantially collapsed condition with the leaves retracted from the pile shell indicated at 30. In Fig. 5, the hoses are shown expanded after being inflated with compressed air or other fluid, and as the result of the engagement of opposed side walls of each hose with plates such as at 23, 24 on two adjacent leaf structures, the latter, by the conjoint action of the hoses, have been moved apart and outwardly so that the arcuate portions thereof engage under pressure against the interior surfaces of the pile shell. It will be noted that the plates, such as 23, 24 are so located as to provide therebetween a radially extending space of substantially rectangular cross-section and the plate surfaces present extended areas against which the walls of the hoses may bear under pressure without any danger of abrupt bending, cutting or cracking of the hose walls. Furthermore, the position of each leaf when in its expanded location is under the control of two of the hose lengths and the spacing between each adjacent pair of leaves is controlled by a separate hose, and accordingly the action of the hoses in expanding is such as to press each leaf outwardly in proper position so that it exerts uniform pressure against the pile shell throughout the length of the shell, and entirely around the inside surface of the shell, except for the relatively narrow gaps between each pair of leaves.

To prevent the hoses from moving out of place at the above-mentioned gaps, any suitable means may be provided at various points along the length of the core, for example as shown in Figs. 5 and 6, pins as at 31 may be used for this purpose. One end of each such pin may be fixed in place in any suitable way, for example in one of the plates 24, whereas the other end of each such pin 31 may extend into and through an opening in an opposite plate such as at 23, such opening preferably having sufficient clearance about the pin so as to insure that the pin will not interfere with the desired relative movement of the leaf structures.

The upper end portion of each leaf may include a solid metal extension portion of segmental cross-section, as indicated at 16*a*, 17*a*, 18*a* and 19*a* in Fig. 4. The upper ends of these solid portions, as shown in Fig. 1, extend up into contact with the underside of the core head, the links 20 serving to retain the core head in contact therewith when impacts are being imparted by the head to the remainder of the core.

As shown in Figs. 4 and 7–9, the upper end of each hose may be clamped as by a member 33, secured as by screws 34 to an extension of one of the leaf plates 23, the interior of the end of the hose being cemented to a suitable fitting as at 35 containing a cavity 36 communicating with a fluid-pressure connection 37 for the admission and exhaust of gas, air or other fluid, into the hose. As indicated in Fig. 4, the hoses may be connected in pairs as by passages 37, 37′, connected to one inlet as at 38, so that for the four hoses, fluid may be admitted through a total of two inlets 38, 38′. But since each hose is individually secured, it may be readily removed and replaced individually upon becoming worn or injured without disturbing the other hoses.

As shown in Figs. 8 and 9, the lower end of each hose may be secured in flattened closed condition within a flattened tubular clamping member as at 40, secured in place as by screws 41 on a solid bottom portion as at 42 on each leaf (see Figs. 7 and 8).

The interior surfaces of the upper end of each hose may be cemented in gas-tight relation to the fittings 35 and the interior surfaces within the lower end of each hose may be cemented together to effectively seal the lower ends. If desired, portions along one side of each hose, as indicated at 27*a* in Fig. 8, may be cemented to one of the plates as at 23 for the purpose of retaining the hose in place, and in that event, pins 31, such as above described for that purpose, may be omitted. As will be apparent from Fig. 4, two of the leaves 16 and 18 may each have two of the hoses mounted along the sides thereof, in which case the other two leaves 17 and 19 would not be equipped with hoses. This avoids the necessity of providing fluid pressure inlets on more than two of the leaves.

Referring particularly to Fig. 1, a pull-rod or center bar 45 extends axially through the core. (A heavy wire cable could be substituted for this rod.) At several spaced points down along its length, this rod is connected by links 46 to each leaf. As best shown in Figs. 2 and 3, the inner

end of each of these links is pivotally connected as at 47 to a collar member 48, fixed upon the rod. The outer end of each link is pivotally connected as at 49 to pairs of lugs as at 50 welded to the interior of the arcuate portion of each leaf. Each link is slotted as at 51 to receive the pivot pins 49, the slot formation being such that when the rod 45 is in its downward position, as indicated in Fig. 2, each leaf will be pushed out toward the pile shell, but not necessarily in contact therewith, and when the rod 45 is pulled upwardly as shown in Fig. 3, each leaf will be forcibly pulled inwardly out of contact with the pile shell 30 with sufficient clearance to insure that there will be no difficulty in withdrawing the core from the shell, even though the shell may have become somewhat distorted in driving. The slots 51 also, as shown in Fig. 2, extend inwardly far enough so that when the rod 45 is in its downward position, the pivoting pin 49 will still have enough clearance in the slot to permit the leaf to be forced further out into engagement with the pile shell under the pressure of the expanding hoses. Yet, in case there is no shell embracing the core or part of the core, the slots are such that the ends thereof will engage with the pins 49 and prevent each leaf from being moved too far out in extended position. Thus in case it is desired to use a particular core construction both for pile shells of corresponding length and for pile shells which are shorter, this may readily be done without causing the upper portions of the core to be expanded too far, or out of proper relation to receive the impacts from the core head.

While links 46 are shown in Fig. 1 only at one position, it will be understood that similar links are provided at several vertically spaced locations as conditions may warrant along the length of the core.

The upper end of the rod 45 may be formed with an enlargement 52 located within a recess 53 in a neck portion 54 on the underside of the core head. A plurality of cushioning discs as at 55 may be inserted in this cavity above the enlargement 52, and a plurality of annular cushioning members 56 encircle the rod 45 just below the enlargement 52. These rings may be retained in place as by transversely removable key members 57. All these cushioning members may be formed of any suitable hard elastic material such as laminated plastic material of a nature which will withstand such force of the impacts as may tend to be imparted by the core head to the upper end of the rod 45, the purpose of the cushioning means being to prevent any such force from being applied to the rod 45 as might tend to damage the rod or its connected parts.

As shown in Fig. 1, the outer surface of the lower end of the neck portion 54 may be formed with an upwardly and outwardly tapered portion 58 for engaging complementary tapered surfaces as at 59 on each leaf. Similarly, tapered surface-engaging portions may be provided as at 60 at the very upper ends of each leaf at the areas of engagement with the upper end of the neck 54. These tapered surfaces insure that the neck 54 will act to retain each leaf properly spaced from the others when in expanded position.

As also shown in Fig. 1, the lower end of the pile shell may be closed by a boot plate 62 welded to a boot ring or the like 63, which in turn is welded at its periphery to the lower edge of the pile shell. A drive plate 64 is preferably interposed between the lower end of the core and the pile shell closure means. This drive plate may be provided with a retrieving pin 65 extending up from its center portion into a cavity within the lower end of rod 45 and detachably secured therein as by a key 66.

As further shown in Fig. 1, at each region where a core leaf passes a joint as at 67 in the pile shell, the leaf may be formed with a solid metal insert as at 68. In the outer surface of the member 68, an annular cavity as at 69 may be provided for receiving the connecting member at the shell joint 67. Three different possible modifications of the structure at this region are shown in Figs. 11, 12 and 13.

As shown in Fig. 11, a pile shell section 30*a* is welded at the joint 67 to a plow ring 70. The next shell section 30*b* has its end portion in threaded engagement with a corrugated sheet metal collar portion 71, which is welded to the plow ring 70. The core leaf portion 68 as well as the other leaf portions of the core, may be provided on their exterior surfaces with a series of half-round bar or rod portions as at 72, welded in place and in positions such as to have thread-like engagement with the corrugations of the shell sections. The upper side of the cavity 69 may be formed with a shoulder 73 for engagement with a shoulder 74 on the plow ring 70. Thus through the medium of the bars or rods 72 and the shoulders at 73, 74, impacts applied to the core leaf are imparted to the shell at closely spaced points all around and along the shell structure. Hence if the pile shell or the shell sections are quite long, even though same have to be subjected to very heavy driving forces, they will be pulled down into the earth by engagement at each of the corrugations and hence straightening out of the corrugations due to excessive tension in the metal is avoided. Some of the gripping bars or rods as shown at 72 may be omitted, particularly at locations nearer the upper end of the shell. In cases where the shoulders 73, 74 will suffice for imparting of the impacts to the shell, the rods or bars 72 may all be omitted, although even in that event the core leaves will generally be held against the interior surfaces of the shell with sufficient pressure by the action of the expanded hoses so that there will be frictional engagement all along between the core and shell. In case shell sections such as 30*b* are welded directly to the plow ring, then screw collars such as at 71 may, of course, be omitted.

The form shown in Fig. 12 is similar except that the core is formed with a protruding driving shoulder portion 75 for engaging with a form of connection member 76 which has internally an annular recess with which portions such as at 75 on the core leaves have driving engagement. With this form of construction, the amount by which the core has to be collapsed for removal can be made somewhat less than with the form of Fig. 11.

In the form shown in Fig. 13, pile shell sections as at 30*c* and 30*d* are telescoped somewhat at their ends, one within the other, and welded or threaded together at 77 without the use of any driving shoulder means. In this form the rods or bars as at 72 are relied on for imparting the driving impacts to the shell.

When the core is to be inserted in a pile shell, it is suspended by connecting the core head to a hoisting cable on the pile driving rig, and while the links 20 are disconnected. At that time, the

neck portion 54 of the core head will be partially located above the upper ends of the core leaves and the pull rod 45, with the links in the position shown at 46 in Fig. 3, will serve to suspend the core leaves while same are being lowered into the shell. When the core leaves are down in place in the shell, the core head is thrust downwardly to the position shown in Fig. 1, whereupon the rod 45 spreads the leaves by the action of the links 46 as shown in Figs. 1 and 2. Then the links 20 are hooked onto the lugs 22. At this time the hoses are ready to be connected to the source of gas pressure, and inflated.

After the shell has been driven by the core, then in order to remove the core, the links 20 beneath the core head are disconnected and the gas pressure in the hoses is released, then the core head is raised along with the rod 45 which pulls the links 46 to the position shown in Fig. 3, thus collapsing the core. As will be apparent at the upper portion of Fig. 1, the neck portion 54 of the core head is so shaped that when it is raised, the upper ends of the leaves are free to move inwardly. The core as now collapsed is free to be raised out of the shell while being suspended by the core head.

With the form of the invention shown in Fig. 10, the core parts are the same as of Fig. 1, except that here the upper part of the core head at 80 is made of substantially the same diameter as the core itself when the leaves are expanded. The core head here has a recess 81 at its upper end for receiving an extension 82 formed on a "messenger plug" 83, such as described in my above-mentioned co-pending application. Impacts from the pile driving hammer, the lower portion of which is here indicated at 84, are imparted through a suitable follower 85 to such messenger plug. The latter is so constructed and adapted to be raised and lowered by the use of a sheave frame 86, that in "shelling up" the core in the pile shell, the messenger plug may be lowered down through the pile shell to pick up a core located in a previously driven hole or shell and pull such core up into proper position within the shell, whereupon the boot pieces are applied to the lower end of the shell and the assembly is ready for driving, all as more fully explained in my said application Serial No. 273,920.

In some cases it may be found desirable to provide means in addition to the links at 20 at the upper end of the core for holding the leaves in their correct relative positions vertically. For this purpose, as shown in Fig. 15 at the gaps between leaves, one of the leaves may be provided with a recess as at 90 and the adjacent leaf with a tongue-like portion 91 within the recess 90 in a manner more fully apparent from the cross-sectional view of Fig. 14. Tongue and recess formations of this kind may be located at various vertically spaced points along the core as may be found desirable.

While, as is apparent from Fig. 1, the invention is here shown in a form adapted for driving a step-tapered type of pile shell having shell sections as at 30, 30' and 30'', the core may, of course, be made of uniform diameter throughout its entire length, or if preferred with a slight uniform taper, depending upon the particular type of pile shell being driven. If the lower part of the pile shell is substantially smaller than the upper part, then it may be desirable to provide hose lengths in the lower part of smaller size than in the upper part, or specially tapered hoses may in some cases be preferred.

The hoses may be inflated by connecting to the inlets as at 38, 38' containers or other sources of compressed air, nitrogen or other gas which may be readily available at the location where the pile driving work is being done. In the usual case, a pressure of about 150 lbs. per square inch within the hoses will be ample. Also, if desired, the hoses may be partly filled with water or other liquid, thus making it unnecessary to fill them completely with compressed gas each time the core is installed in a pile shell. A volume of liquid may be used such that same is just sufficient to fill the hoses when in their so-called collapsed positions. On collapse of the core by the pull rod and linkages, the compressed gas in the hoses will be expelled, while the liquid therein will remain, thus reducing to a substantial extent the expense required for compressed gas supplies and also reducing to some extent the time required to introduce and to exhaust the fluid pressure.

It will thus be seen that a collapsible core assembly is provided in which fluid pressure may be effectively used to uniformly apply expanding pressure to the core leaves while by the use of the four symmetrically located hose lengths, the central portion of the core is left available for installation of the center bar or the equivalent 45 for mechanically operating the links 46. The center bar, in conjunction with the links and hoses, operates to maintain the leaves in their correct relative positions at all times. The center bar and links make it possible initially to expand the core while leaving the final powerful expansion to be accomplished by the fluid pressure. The center bar and links further provide a convenient and effective means for forcibly and positively collapsing the core when the bar is pulled up in the normal manner for withdrawing the core from the pile shell. The upper portion of the center bar also functions to hold the head of the core in proper alignment so that the hammer impacts are delivered equally to all of the core leaves.

Occasionally sand or other material may enter the core through holes in the pile shell. Such holes may be due either to faulty manufacture, or to compression or puncturing by rocks or other obstructions in the ground. When such material enters a collapsible core, it tends to make its collapse quite difficult, but the positive mechanical action of the center bar and links as above described is such as to ordinarily satisfactorily overcome this difficulty so that there is little chance, upon removing the core, of pulling the complete shell up along with the core due to any failure of the core to collapse properly.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various further modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains. Reference should accordingly be had to the appended claims in determining the scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about the core axis with generally radial spaces therebetween, and hoses extending longitudinally of the core and along between adjacent

leaf structures within said spaces respectively, whereby upon filling such hoses with fluid under pressure the leaf structures may be forced outwardly of the core and into contact under pressure with the interior surfaces of a pile shell.

2. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about a central space, a member extending longitudinally of the core in said space, linkage means at spaced points connecting said member with each of said leaf structures whereby upon longitudinal movement of said member in one direction said structures are thrust outwardly of said central space by a limited amount and upon movement of said member in the opposite direction the structures are retracted, and hoses extending longitudinally of the core along between adjacent leaf structures, whereby upon filling such hoses with fluid under pressure the leaf structures may be thrust further outwardly into contact under pressure with the interior of a pile shell.

3. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about a central space, a core head for applying impacts to the upper ends of said leaf structures, mechanism including a rod connected to said core head and extending down into said central space and connected by linkage means to said leaf structures for thrusting the leaf structures outwardly when the core head is lowered into normal position onto the leaf structures, said mechanism acting to retract the leaf structures inwardly when the core head is raised, and hoses extending longitudinally of the core along between adjacent leaf structures, whereby upon filling said hoses with fluid under pressure the leaf structures may be thrust further outwardly for contact under pressure with the interior surfaces of a pile shell.

4. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about the core axis with generally radial spaces therebetween, and fluid pressure expansible means extending longitudinally of the core along between adjacent leaf structures within said spaces respectively, the leaf structures each comprising a portion of arcuate cross-section for engagement with the interior surface of the pile shell and two plate portions extending inwardly from the longitudinal edges of said arcuate portion respectively, the expansible means each being positioned to engage one of such plate means on one leaf structure and one of such plate means of another of said leaf structures.

5. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about a central space, each of said leaf structures having a generally sector shaped cross-section, fluid pressure expansible means extending longitudinally of the core along between adjacent leaf structures whereby upon filling such expansible means with fluid under pressure the leaf structures may be forced outwardly into contact under pressure with the interior surfaces of a pile shell, a core head for applying impacts to the upper ends of said structures, and mechanical means connected to said core head and extending down in said central space with connections to said leaf structures for retracting the latter when the core head is raised.

6. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core, and fluid pressure expansible means also extending longitudinally of the core along between two adjacent leaf structures, a substantial portion of the interior of said means being filled with liquid whereby upon filling the remainder thereof with gas under pressure said two leaf structures may be forced apart and into contact under pressure with the interior surfaces of the pile shell, by the use of a substantially lesser quantity of gas under pressure than would be required to fill said means under adequate pressure by the use of gas alone.

7. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about a central space, a center bar extending along within said space, a core head for imparting impacts to the upper ends of said structures, means for retaining the upper end of said center bar against substantial vertical movement with respect to the said core head and including cushioning means to cushion the bar against impacts applied to the core head, and linkage means interconnecting said center bar at spaced points along its length to said leaf structures for forcing the latter in directions inwardly and outwardly of the core respectively when the core head is raised and lowered with respect to said structures.

8. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about the core axis, a radially extending space being provided between at least two of said leaf structures, each of said leaf structures having a cross-sectional outline of generally sector shape, and a hose extending along between two adjacent leaf structures and normally contained within said space whereby when such hose is filled with fluid under pressure the leaf structures may be forced outwardly of the core axis.

9. An expansible core for driving pile shells comprising a plurality of leaf structures extending longitudinally of the core and arranged around about the core axis, each of said leaf structures having a cross-sectional outline of generally sector shape, and hoses extending along between the sides of adjacent leaf structures for forcing the latter outwardly of the core axis when the hoses are filled with fluid under pressure, two of said hoses being mounted on opposite sides respectively of alternate leaf structures for pressing against the intervening adjacent leaf structures respectively.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,865,653	Upson	July 5, 1932
2,170,188	Cobi	Aug. 22, 1939
2,313,625	Cobi	Mar. 9, 1943
2,625,015	Cobi	Jan. 13, 1953