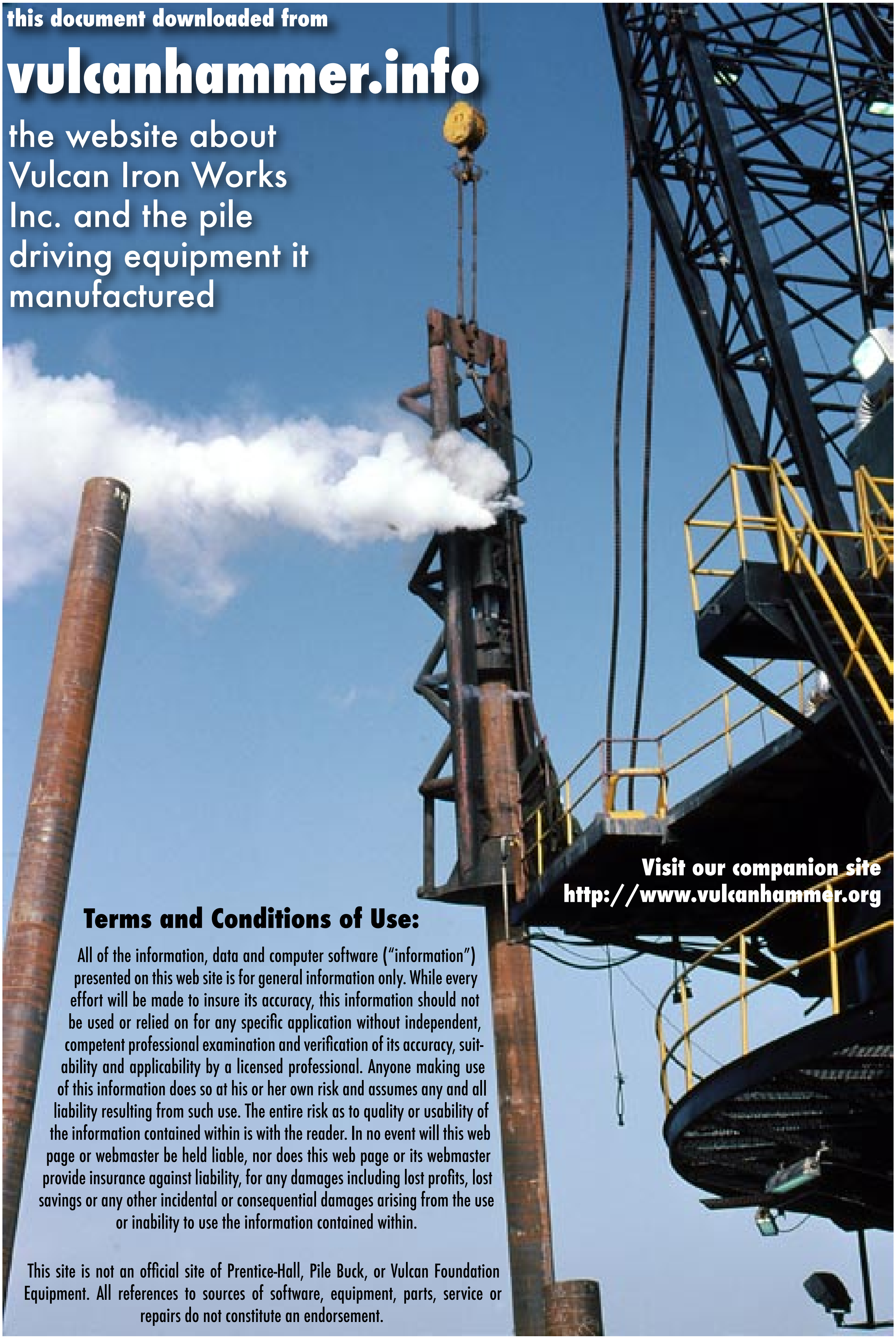

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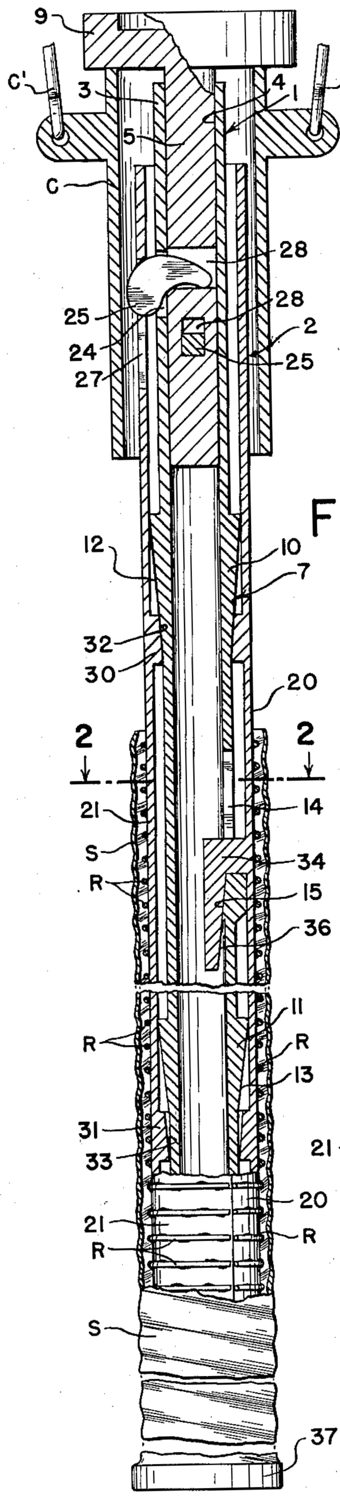
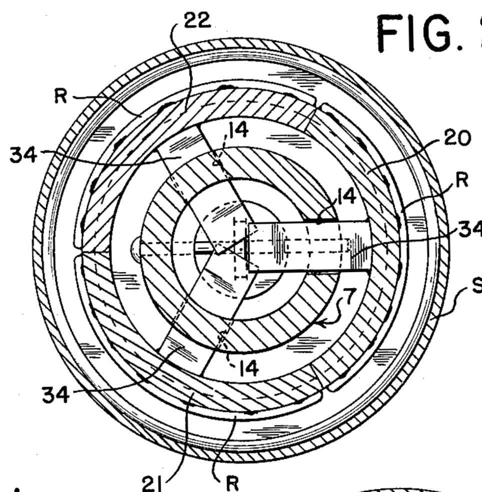


FIG. 1

FIG. 2



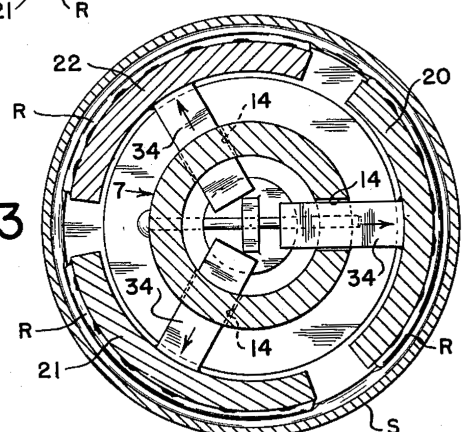


FIG. 3

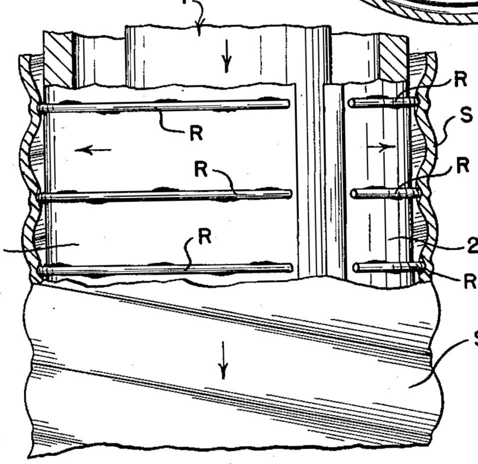


FIG. 4

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FIG. 5.

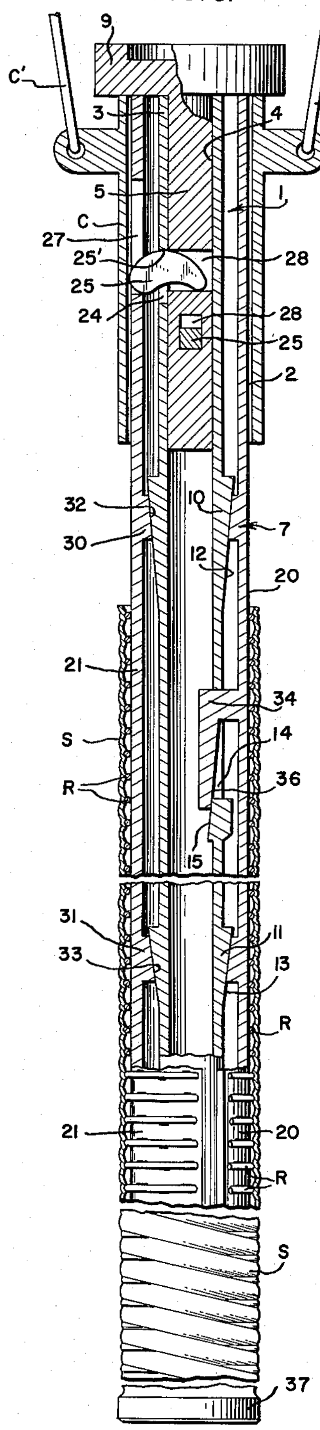
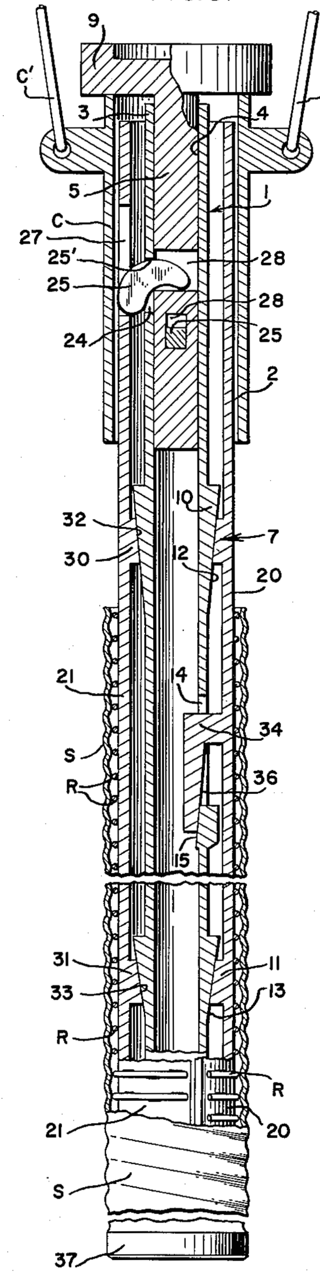


FIG. 6.



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MANDREL FOR DRIVING PILE SHELLS

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6 Claims. (Cl. 61—53.72)

This invention relates to apparatus for driving metal casings, usually called shells, into the earth for forming concrete piles, and has for its object the provision of an improved expansible and collapsible mandrel for driving corrugated shells. My invention is concerned with mandrels of the type having an outer mandrel part comprising a plurality of longitudinally segmented exterior members (usually called leaves) which can be expanded and contracted by an inner mandrel member. My invention provides a plurality of rod segments secured to the outsides of the leaves and disposed in spaced-apart relation with respect to the longitudinal axis of the mandrel. These rod segments have utility when used in driving shells having corrugations, the rods being arranged to span the corrugations at small acute angles, whereby the rods become embedded into the corrugations of the shell when the leaves are expanded in the driving of the shell.

The improved mandrel of my invention may be advantageously used in driving shells having helical corrugations in which case the rods are attached to the leaves at right angles to the longitudinal axis to prevent the rods and corrugations from coinciding with each other, whereby the rods span the corrugations and bite into portions of the corrugations and secure the mandrel to the shell. This engagement of the rods with the shell forms a firm, positive anchor of the shell to the mandrel when it is expanded into the shell. The invention not only has overcome the tendency of the shells to move (creep), unhook or tear in the seams causing expensive delays, but also facilitates driving shells in severe and abnormal conditions. The improved mandrel compensates for variations in the shell and mandrel.

The invention is applicable generally to mandrels having expansible and collapsible segments or leaves, and for the purpose of illustration will be described in connection with a mandrel embodying features of the mandrel of my co-pending patent application Serial No. 550,528, filed December 2, 1955, and now abandoned, of which this application is a continuation-in-part.

In the accompanying drawings:

Fig. 1 is a vertical, fragmentary view, partly in section, of a mandrel embodying the invention shown in its fully contracted or collapsed position;

Fig. 2 is an enlarged sectional view at 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 showing the mandrel in its expanded position,

Fig. 4 is an enlarged fragmentary view of a part of Fig. 1 illustrating the position of the rods and corrugations when driving the shell, and

Figs. 5 and 6 are views similar to Fig. 1 but showing the parts in different relative positions.

The improved mandrel of the invention illustrated in the drawings comprises an inner mandrel member 1 and an outer mandrel member 2. The inner mandrel member is in the form of a continuous tube, the upper portion 3 of which has a cylindrical opening 4 in which the stem 5 is slidable. The stem 5 has an integral driving head 9 which receives the driving blows of the hammer. The tubular member 1 has upper and lower bosses 10 and 11 which have downwardly and inwardly sloping wedge surfaces 12 and 13 respectively. Any suitable number of such bosses may be provided at spaced intervals. The tubular member 1 has a plurality of elongated slots 14 spaced apart circumferentially and in the longitudinal direction of the member. Beneath each slot the tube is enlarged and provided with an upwardly and outwardly projecting wedge surface 15. While only one of such slots and surfaces are shown in Fig. 1 it is to be understood that any suitable number of these may be provided at longitudinally spaced intervals, each being opposite one of the leaves as shown in Figs. 2 and 3.

The outer mandrel member 2 comprises three leaves 20, 21 and 22 which are each segments of about 120° of arc and, when in their contracted position as shown in Figs. 1 and 2, the assembly is circular in cross-section. The assembled and contracted leaves form a continuous tube that fits inside the pile shell or casing S. When the leaves are collapsed as shown in Figs. 1 and 2, the exteriors of the bosses 10 and 11 make close contact with the inner face of the leaves. The upper portion 3 has three longitudinally staggered openings 24 (one opposite each leaf) in each of which a floating cam lever 25 is inserted. One part of each lever projects into an elongated slot 27 in its opposite leaf and the other part projects into an opening 28 in the stem 5. The levers and their respective slots in the leaves and openings in the stem are spaced apart or staggered in the longitudinal direction of the mandrel. The cam levers are referred to as being "floating" since they are not mounted on pintles and are free to move, to a limited extent, relative to the stem 5, the inner mandrel, and the segment leaves.

The upper portion of the mandrel is provided with a loose fitting collar C which is suspended from the hammer crane by a cable C′. This collar is the means by which the mandrel is pulled out of the shell, and since it hangs loose during driving, the mandrel is free to rotate with the shell which has the effect of being threaded into the earth due to the helical corrugations. Another very important function of the loose collar is in its securing of the cam levers in their slots, thus eliminating attaching pins.

The leaves of the outer mandrel member are each provided with upper and lower wedge segments 30 and 31 having upwardly and downwardly sloping surfaces 32 and 33 respectively which operatively engage the wedge surfaces 12 and 13 of the inner mandrel member in expanding the leaves. Each leaf has one or more cam brackets 34 attached thereto and located in staggered relation in the longitudinal direction of the mandrel which are arranged to project through the slots 14 in the inner mandrel member. Each cam bracket has a downwardly and inwardly sloping surface 36 which makes bearing contact with one of the sloping surfaces 15 to draw the leaves inwardly to their collapsed position when the inner mandrel is pulled upwardly.

The cam brackets extend downwardly inside the hollow mandrel a distance such that when the mandrel is removed from the pile shell and the inner mandrel and the segmental leaves are moved relatively to the maximum distance in a direction to extend the leaves, the free or distal ends of the cam levers still lie below the lower ends of the slots and opposite a portion of the wall of the inner mandrel, so that the leaves are held to the inner mandrel and cannot fall away.

It is to be understood that the mandrel can be of any suitable length and may have a lower foot portion of any desired construction, for example as shown in my said patent application, for engaging the lower closed portion 37 of the casing.

At intervals spaced in the longitudinal direction of the mandrel axis a plurality of small rods R are attached as by welding to the exterior surfaces of the leaves 20, 21 and 22. These rods may be of any suitable cross-sectional shape, such as round or half-round, and are advantageously spaced apart a distance corresponding to the distance between adjacent corrugations of the shell. When shells having helical corrugations are to be driven, such as illustrated in the drawings, the rods R are arranged to embrace planes at right angles to the longitudinal axis of the mandrel. As thus arranged the rods are disposed at small acute angles with respect to the corrugations, and when the rods are in engagement with the corrugations they are in at least partial spanning position. It is to be understood, of course, that when the corrugations of the shell are not helical, being in planes at right angles to the longitudinal axis, the rods are so angularly attached to the leaves that they form small acute angles with respect to the corrugations.

Fig. 1 shows the improved mandrel of the invention inserted inside a cylindrical corrugated metal shell S of a type widely used for driving into the earth to form concrete piles. The head 9 is shown in its elevated position prior to driving the mandrel. In this position one end of each of the cam levers 25 is in the upper part of its slot 27 and the other end is in bearing contact with the stem 5 where it enters the slot 28. The surfaces 12 and 13 are above and out of contact with the surfaces 32 and 33. However, the surfaces 36 of the cam brackets 34 are in bearing contact with the surfaces 15 and the leaves are accordingly held in their inner collapsed positions.

In driving the shell S into the earth from the position shown in Fig. 1, an initial gentle pushing on the head 9 is sufficient to force the entire inner mandrel member 1 and the leaves 20, 21 and 22 downward until the leaves engage a foot (not shown) at the lower end of the mandrel which in turn engages the end 37 of the casing. The respective parts then are in the position shown in Fig. 5. This downward movement of the inner mandrel member removes the cam brackets 34 from engagement with the surfaces 15 permitting the leaves to move downwardly and as the inner member continues to move downwardly the surfaces 12 and 13 engage the surfaces 32 and 33 respectively and force the leaves to the fully expanded positions shown in Figs. 3, 4 and 5 and into close contact with the shell S. In this position the driving head 9 bears on both the leaves and the inner mandrel member and the rod segments R engage the corrugations of the shell as shown in Figs. 3 and 4. The rods span portions of the corrugations by reason of their angular relation and bite into or become partially embedded in those portions of the corrugations with which they make direct contact.

When the shell has been completely driven the mandrel is removed as follows: An upward pull is applied by the driving machine to the cables C′ on the collar C and in the initial upward movement of the head, shown in Fig. 6, the cam levers 25 come into action in collapsing the outer mandrel member. In this initial action the cam levers perform three important functions, namely, their outer ends hold the leaves down, they break the contact of the leaves with the inner mandrel member which are bound by the force of the pile hammer, and they lock the stem 5 of the head to the upper portion 3 of the inner mandrel member. As the inner mandrel member is pulled upwardly, one end of each cam lever engages the bottom of slot 28 while the upper mid-point 25′ of the lever contacts the upper portion of the slot 24 in upper portion 3 of the inner mandrel. As the stem 5 is further withdrawn the opposite end of the lever bears down on the leaf slot 27, the mid-point bearing on the upper portion of the slot 24 lifts the inner mandrel member sufficiently to break the contact between the inclined surfaces of the leaves and the inner mandrel member. As a result, the first two functions of the cam levers are performed. As stem 5 is further withdrawn the cam levers lock against the inner member 1 and stop the sliding action of the stem therein. As the inner mandrel continues to move upward the surfaces 12 and 13 move out of contact with the surfaces 32 and 33, as shown in Fig. 1, and then the surfaces 15 move into contact with the surfaces 36 of the brackets 34 and the leaves are pulled inwardly to the position shown in Figs. 1 and 2 thereby freeing the mandrel from engagement with the shell.

I claim:

1. The improved mandrel for driving metal shells for forming concrete piles which comprise an inner mandrel having a hollow portion, an outer mandrel member comprising a plurality of leaves, wedge means on the inner mandrel member for expanding and collapsing the leaves, a driving head having a stem slidably mounted in the inner mandrel member, the leaves, the inner mandrel member and the stem having circumferentially-spaced aligned, longitudinally-extending slots, a cam lever floatingly mounted in each of the aligned slots, the shape of each cam lever and its size relative to the size of the aligned slots in which it is mounted being such that when the head and stem each initially are lifted in collapsing the leaves, the outer end portion of each cam lever bears on its associated leaf at the lower end of the slot therein, holding it down, an intermediate upper surface portion bears on the inner mandrel member at the upper end of the associated slot therein and the inner end portion is engaged by the portion of the stem at the lower end of its associated slot and a force is exerted by the stem on the cam lever in a direction to lift the inner mandrel member relative to the leaves to break the contact between the wedge means on the inner mandrel member and the leaves, and on continued upward movement of the head and stem, the cam levers lock the stem and inner mandrel member together for upward movement.

2. The improved mandrel set forth in claim 1 in which a collar surrounds the outer mandrel member subjacent the driving head and is rotatable relative thereto, the collar has a skirt portion extending downwardly to a position at least opposite the cam levers when the collar is raised, the inside diameter of the collar is larger than the outside diameter of the leaves when the leaves are expanded in the casing so that the leaves do not bind on the collar and prevent relative movement between the collar and the leaves, but is sufficiently small to hold the cam levers in their operative positions in the slots.

3. The improved mandrel as set forth in claim 1 in which the aligned slots in the leaves, the inner mandrel member and the stem are located at different vertical levels.

4. The improved mandrel as set forth in claim 1 in which each of said leaves has cam brackets extending inwardly therefrom, said cam brackets each have a portion extending through a slot in the inner mandrel member and which includes cooperating vertically inclined surfaces carried, respectively, by the portions of the cam brackets which extend through said slots and the inner mandrel member, which cooperating inclined surfaces are operative upon upward movement of the inner mandrel member relative to said leaves to collapse said leaves.

5. The improved mandrel of claim 4 in which a collar surrounds the outer mandrel member subjacent the driving head and is rotatable relative thereto, the collar has a skirt portion extending downwardly to a position at least opposite the cam levers, the inside diameter of the collar is larger than the outside diameter of the leaves when the leaves are expanded in the casing so that the leaves do not bind on the collar and prevent relative movement between the collar and the leaves, but is suf-

ficiently small to hold the cam levers in their operative positions in the slots.

6. The improved mandrel for driving metal shells which comprises a mandrel including an inner mandrel member, an outer mandrel member comprising a plurality of leaves, means on the inner mandrel member for expanding and collapsing the leaves, a driving head non-rotatably connected to the inner mandrel member, a separate collar surrounding the outer mandrel member and directly under the driving head and rotatable relative thereto, the inside diameter of the collar being larger than the outside diameter of the leaves when the leaves are expanded in the casing so that the leaves do not bind on the collar and prevent relative movement between the collar and the leaves, and means for connecting said collar to suspending means.

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