United States Patent [19]

Wandell

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[54] **PERCUSSION HAMMER**

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[52] **U.S. Cl.** **173/15,** 173/133

[51] **Int. Cl.** **E02d 7/10**

[58] **Field of Search** 173/15–17

[56] **References Cited**

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[57] **ABSTRACT**

There is provided a percussion hammer of the type used for driving piles and the like, and including a differential diameter piston defining a ram reciprocally positioned within a differential diameter cylinder. An anvil is mounted for limited movement in one end of the cylinder positioned in the path of the ram to receive percussion blows therefrom. Main valve means are provided for controlling the working fluid so as to cycle the ram through power and return strokes. Safety means are provided for shutting off the supply of working fluid rendering the ram inoperative when the percussion hammer is out of engagement with a pile.

3 Claims, 6 Drawing Figures

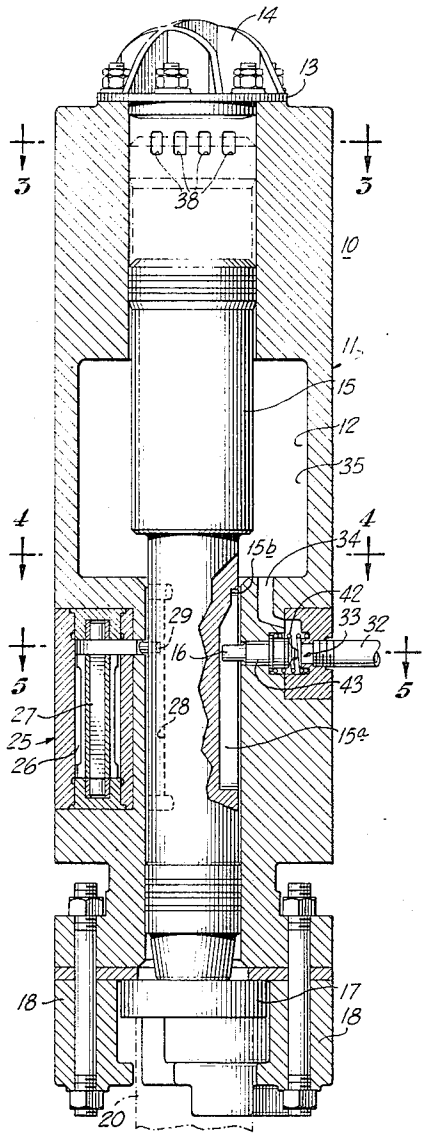


Fig. 2

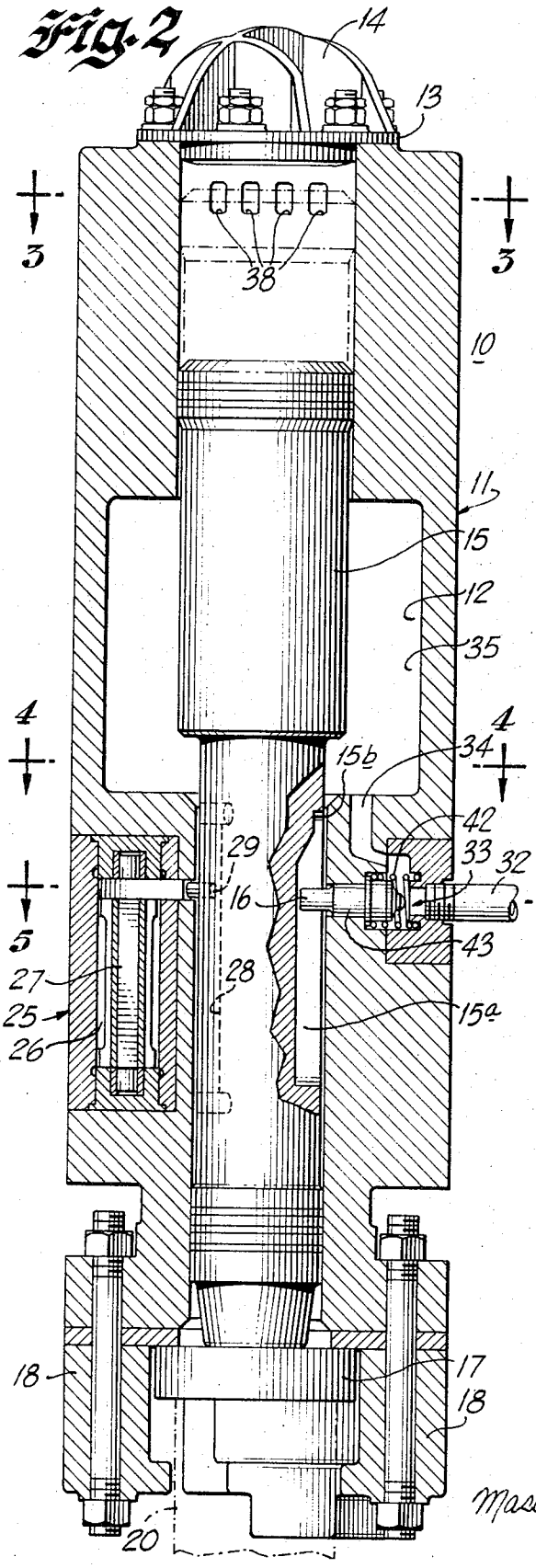
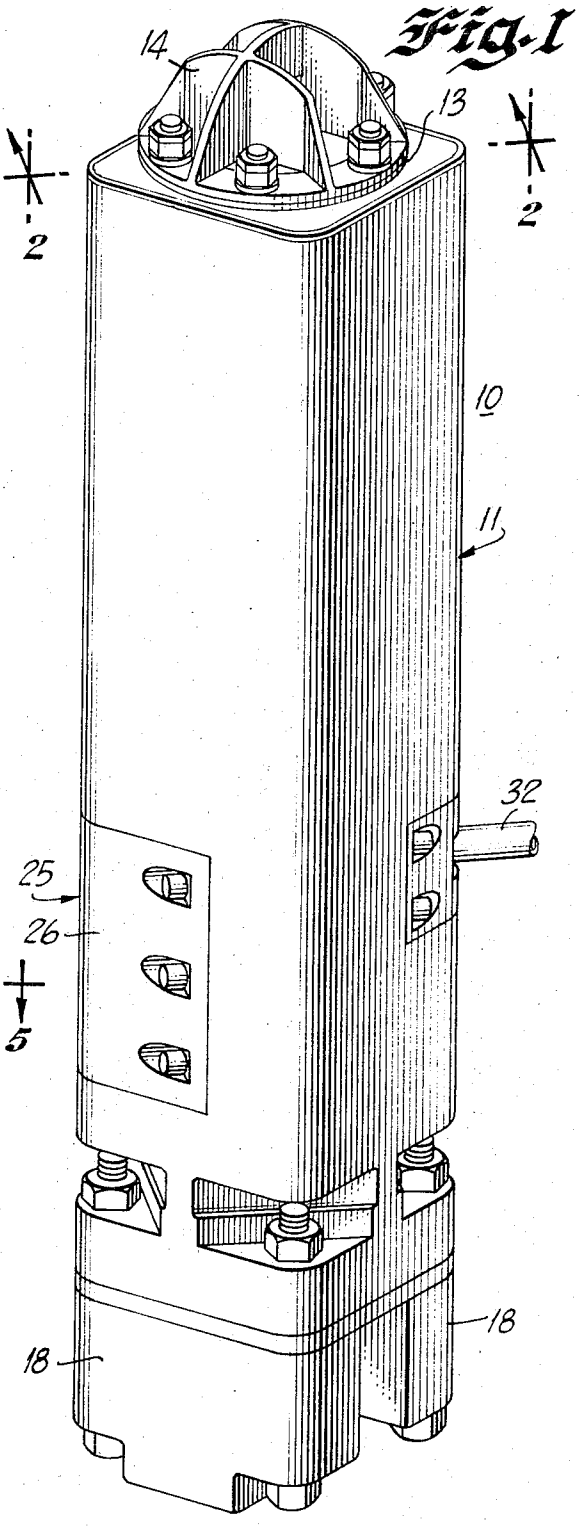


Fig. 1



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Fig. 3

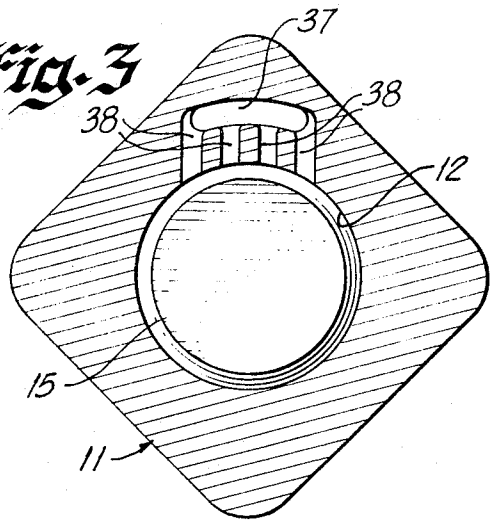


Fig. 4

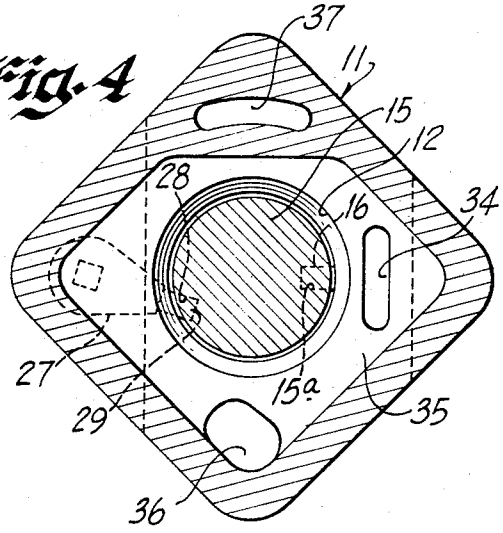


Fig. 5

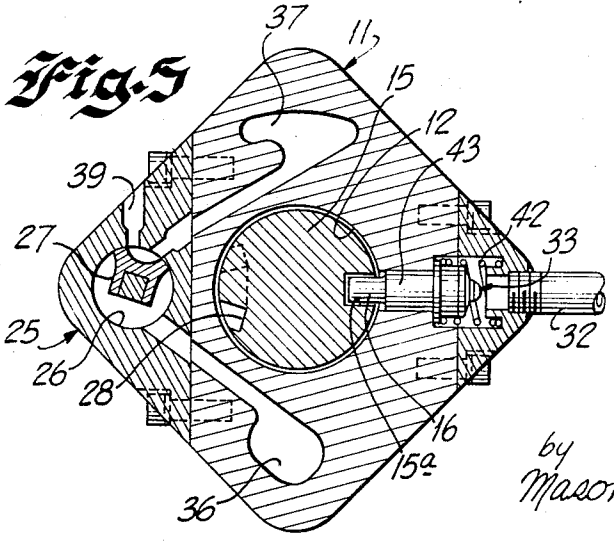
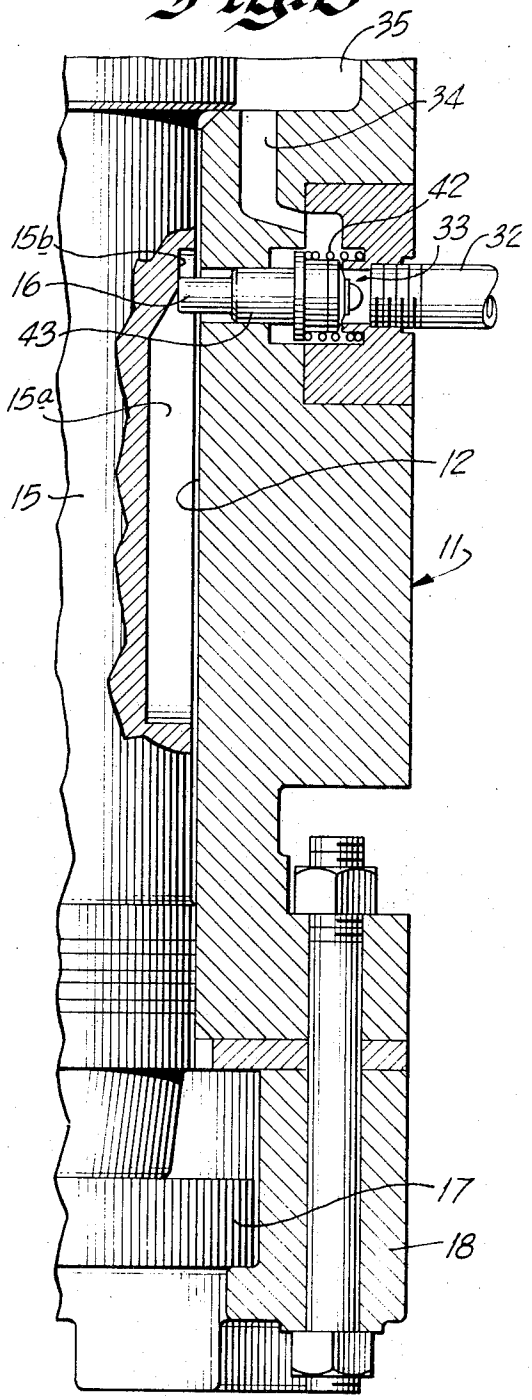


Fig. 6



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PERCUSSION HAMMER

The present invention relates to a percussion hammer and, more particularly, to a percussion hammer for driving piles and the like.

Power driving percussion hammers are conventionally supported from a crane or the like, and set on the top of a pile to be driven. The pile driving hammer will include an impact anvil engaging the top of the pile, and a ram within the hammer will be reciprocated so as to strike impact blows on the impact anvil, thus driving the pile. Commercial pile driving hammers may be of a variety of types, and may be classified as single acting or double acting. In single acting pile driving hammers, the ram is lifted by the working medium, which may be steam, air or other medium, and dropped against the anvil by gravity. With a double acting hammer, the ram after lifting is driven against the anvil by the force of the working medium, in addition to the force of gravity. Such hammers are moved from one pile to the next by the crane or other supporting structure, and during this movement the cycling of the ram should be stopped to prevent damage to the hammer. However, in the event that the working fluid is not turned off during such movement, or in the event that the pile driving hammer slips off the top of the pile, difficulty is encountered with continued cycling of the ram. One such safety control for stopping the cycling of the ram is disclosed and claimed in my copending application Ser. No. 42,338 filed June 1, 1970. The present invention is an improvement over the construction therein disclosed.

One object of the present invention, therefore, is the provision of a new and improved percussion hammer.

Another object of the present invention is the provision of a new and improved percussion hammer having an improved safety means which prevents cycling of the ram when the hammer is out of engagement with a pile.

Still another object of the present invention is the provision of a new and improved percussion hammer having a safety means for automatically shutting off the working fluid when the hammer is out of engagement with the pile.

Further objects and advantages of the present invention will become apparent as the following description preceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In accordance with these and other objects of the present invention, there is provided an improved percussion hammer of the type for driving pile and the like. The percussion hammer is provided with a differential diameter piston defining a ram and reciprocally positioned within a differential diameter cylinder. An impact anvil is mounted in one end of the cylinder positioned in the path of the ram to receive percussion blows therefrom. Suitable control means are provided for controlling the working fluid to cycle the ram through power and return strokes. Advantageously in accordance with the present invention suitable means are provided for shutting off the working fluid and thereby preventing further cycling of the ram if the percussion hammer is out of engagement with a pile.

In accordance with a preferred embodiment of the invention, the impact anvil is positioned at the lower

end of the cylinder for limited movement between an upper and lower position; the impact anvil is held in the upper position when the percussion hammer rests on a pile, and drops to its lower position if the percussion hammer is out of engagement with a pile. The piston defining the ram has a working stroke between an upper position in which the ram is raised above the impact anvil, and in intermediate position wherein the impact ram strikes the anvil when the hammer rests on a pile so that the anvil is in its upper position; and the ram will move to a lower position when the impact anvil is in its lower position with the hammer out of engagement with a pile. When the impact anvil is in it's lower position a valve is actuated responsive to the position of the piston and effective to shut off the supply of working fluid, thus arresting further cycling of the ram.

For a better understanding of the present invention, reference may be had to the accompanying drawings wherein:

FIG. 1 is a perspective view of the improved percussion hammer according to the present invention;

FIG. 2 is an elevational cross sectional view of the percussion hammer of FIG. 1, taken along line 2—2 of FIG. 1;

FIG. 3 is a cross sectional plan view of the percussion hammer of FIG. 1, taken along line 3—3 of FIG. 2;

FIG. 4 is a cross sectional view of the improved percussion hammer of FIG. 1, taken along line 4—4 of FIG. 2;

FIG. 5 is a cross sectional view of the percussion hammer of FIG. 1, taken along line 5—5 of FIG. 2; and

FIG. 6 is a fragmentary cross sectional view of the percussion hammer of FIG. 2, illustrating the safety valve in its closed position.

Referring now to the drawings, there is illustrated an improved percussion hammer 10 in accordance with the present invention, and including a housing 11 defining a differential diameter cylinder 12, being closed at the top by a cylinder head 13 forming a lifting bail 14. The lifting bail 14 is adapted to swing from the cable of a crane or other mechanism so as to position the percussion hammer onto the top of a pile represented in phantom in FIG. 2 at 20.

Within the cylinder 12 is differential piston 15 defining a ram. Conveniently the ram 15 may be a one piece forging, completely contained within the cylinder 12. In the illustrated hammer, the cycle of the hammer is double acting, so that the ram 15 is lifted up through the return stroke, and is powered down through the power stroke by both the force of the fluid and gravity. The ram 15 is prevented from radial rotation by a suitable guide, such as the guide pin 16, FIGS. 2 and 5, extending through the housing 11 and aligned within a groove 15*a* in the piston wall. The ram 15 is positioned to impinge upon an impact anvil 17 in the lower end of the cylinder 12. The anvil 17 is mounted for limited vertical movement between suitable guide 18 between an upper position, illustrated in FIG. 2, and a lower position, illustrated in FIG. 6.

Control of the piston 15 is by a valve gear mechanism 25, best shown in FIGS. 2 and 5, within a fluid chamber or steam chest 26. It is understood that the valve gear mechanism 25 may be of any known type to control the reciprocation of th piston 15, and in the illustrated embodiment the valve gear mechanism includes a rotary valve element 27 controlled by a surface cam 28 defined as a groove in the longitudinal side surface of the

piston **15**, and having a valve actuator portion or cam follower **29** on the end of a valve arm extending out of the fluid chamber **26**. The cam surface **28**, upon vertical reciprocation of the piston **15**, will reciprocate the valve arm and rotary element **27** controlling the cycling of the piston **15**.

To control the reciprocation of the piston **15** defining the ram, there is provided a plurality of fluid passageways and chambers in the housing **11**. More specifically the working fluid enters through a fluid inlet **32**, through a safety valve **33**, and through a passageway **34** into a chamber **35** opening between the differential diameter portions of the piston **15**. A fluid passageway **36** leads from the chamber **35** to a steam chest **26**. An additional fluid passageway **37** leads from the steam chest **26** to a plurality of ports **38** opening in the upper closed end of the cylinder **12**. Additionally an exhaust passageway **39** leads from the steam chest **26** to the atmosphere.

In operation it will be understood that working fluid such as steam enters through the fluid inlet into the chamber **35** wherein the fluid pressure continually exerts upward bias on the piston **15** as a result of its action on the differential diameters of the piston **15**. Fluid from the chamber **35** passes through passageway **36** into the steam chest **26**. The valve element **27** rocks about its central axis wherein the cylinder top through ports **38** are selectively connected to the atmosphere through the exhaust passageway **39**, or upon rocking of the rotary valve element **27** in a counterclockwise direction as viewed in FIG. **5**, the top of the cylinder **12** will be connected through the ports **38** to the steam in the steam chest **26**. Thus in the position of piston illustrated in FIGS. **2** and **5**, with the piston **15** at its intermediate position, the upper end of the cylinder **12** is exhausted to atmosphere so that the fluid acting on the differential area of the piston in the chamber **35** will move the piston **15** upwardly through a return stroke. As the piston **15** approaches its uppermost position, the rotary valve **27** will be shifted by the action of the cam follower **29** and surface cam **28** counterclockwise as viewed in FIG. **5**, admitting the high pressure working fluid into the top of the cylinder **12**. Since the area on top of the piston **15** is substantially greater than the differential area acted on by the fluid in the chamber **35**, the piston **15** will be driven downwardly through a working stroke by the combined force of the fluid and gravity. Downward movement of the piston **15** will be effective to return the rotary valve element **27** to the position of FIG. **5**, thus recycling the tool.

It will be understood that the piston **15** and associated ram have a working stroke between the upper position, illustrated in phantom in FIG. **2**, wherein the ram is raised above the impact anvil **17**, and the intermediate position, illustrated in solid in FIG. **3**, wherein the ram strikes upon the impact anvil **17** when the hammer **10** rests on a pile so that the anvil **17** is in its upper position, and the piston **15** and associated ram are movable to the lower position illustrated in FIG. **6**, wherein the ram rests on the impact anvil **17** when the hammer **10** is out of engagement with a pile so that the anvil **17** is in its lowest position.

In accordance with the present invention there is provided a safety means arresting the cycling of the ram when the hammer **10** is out of engagement with a pile. More specifically when the anvil **17** drops to its lowermost position, as illustrated in FIG. **6**, the piston and associated ram will drop to their lowermost position, below its working stroke, as illustrated in FIG. **6**. The safety valve **33** is normally spring loaded by a compression spring **42** to an open position. The guide pin **16** constitutes an extension of the valve stem **43**. Throughout thp normal working stroke of the piston **15**, the guide pin **16** rides freely within the groove **15***a*. However the bottom surface of the groove **15***a* defines a cam surface, having a lobe **15***b* adjacent its upper end, so that when the piston **15** moves to its lowermost position, the guide pin **16** is engaged by the lobe **15***b* thereby shifting the valve stem **43** to close the valve **33**, as illustrated in FIG. **6**, and cutting off the supply of working fluid.

From the above detailed description, it will be seen that there is provided a means for automatically arresting the cycling of the ram in a percussion hammer when the hammer is out of engagement with a pile. Advantageously damage to the hammer is avoided.

Although the present invention has been described by reference only to a single embodiment thereof, it will be apparent that numerous other modifications and embodiments will be devised by those skilled in the art which will fall within the true spirit and scope of the principles of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A percussion hammer adapted to rest on a pile and comprising a housing having defined therein a cylinder; a piston mounted in said cylinder and defining a ram; an impact anvil mounted for limited movement in one end of said cylinder positioned in the path of said ram, said anvil being supported in an upper position when the hammer rests on a pile and dropping to a lower position when the hammer is out of engagement with a pile; main valve means for controlling the working fluid to cycle said ram through power and return strokes; and safety means including safety valve means for closing off the supply of working fluid and directly actuated by said piston when said piston drops to said lower position.

2. A percussion hammer adapted to rest on a pile and comprising a housing having defined therein a cylinder; a piston mounted in said cylinder and defining a ram; an impact anvil mounted for limited movement in one end of said cylinder positioned in the path of said ram, said anvil being supported in an upper position when the hammer rests on a pile and dropping to a lower position when the hammer is out of engagement with a pile; said piston having a working stroke between an upper position in which said ram is raised above said impact anvil, and an intermediate position wherein said ram strikes said impact anvil when said hammer rests on a pile so that said anvil is in its upper position, and a lower position wherein said ram rests on said impact anvil when said hammer is out of engagement with a pile so that said anvil is in its lower position; main valve means for controlling the working fluid to cycle said ram through power and return strokes; said piston having a safety cam operatively associated therewith and safety means including safety valve means closing off the supply of working fluid to said main valve when said impact anvil is out of engagement with a pile; said safety valve including a cam follower element engageable with said safety cam when said ram is in said lower position to close off the supply of fluid.

3. A double acting percussion hammer adapted to rest on a pile and comprising a housing having defined therein a differential diameter cylinder closed at its larger end; a piston of corresponding different diameters mounted in said cylinder and defining a ram; said piston including a safety cam defined in its surface; an impact anvil mounted for limited movement in one end of said cylinder positioned in the path of said ram, said anvil being supported in an upper position when the hammer rests on a pile and dropping to a lower position when the hammer is out of engagement with a pile; safety valve means for controlling the inlet of working fluid into the space in said cylinder between the differential diameters of said cylinder; passage means interconnecting said space and the closed end of said cylinder; main valve means in said passage means sequentially connecting said closed end with said space and with exhaust to cycle said ram through power and return strokes between an upper piston position in which said ram is raised above said impact anvil and an intermediate piston position wherein said ram strikes said impact anvil when said hammer rests on a pile so that said anvil is in its upper position, said ram moving to a lower piston position when said hammer is out of engagement with a pile so that said anvil is in its lower position; said safety valve including a cam follower element engageable with said safety cam when said ram is in said lower piston position to close off the supply of fluid into said space.

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