July 8, 1969 H. G. WARRINGTON 3,454,112

PILE DRIVING HAMMER

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FIG. 1

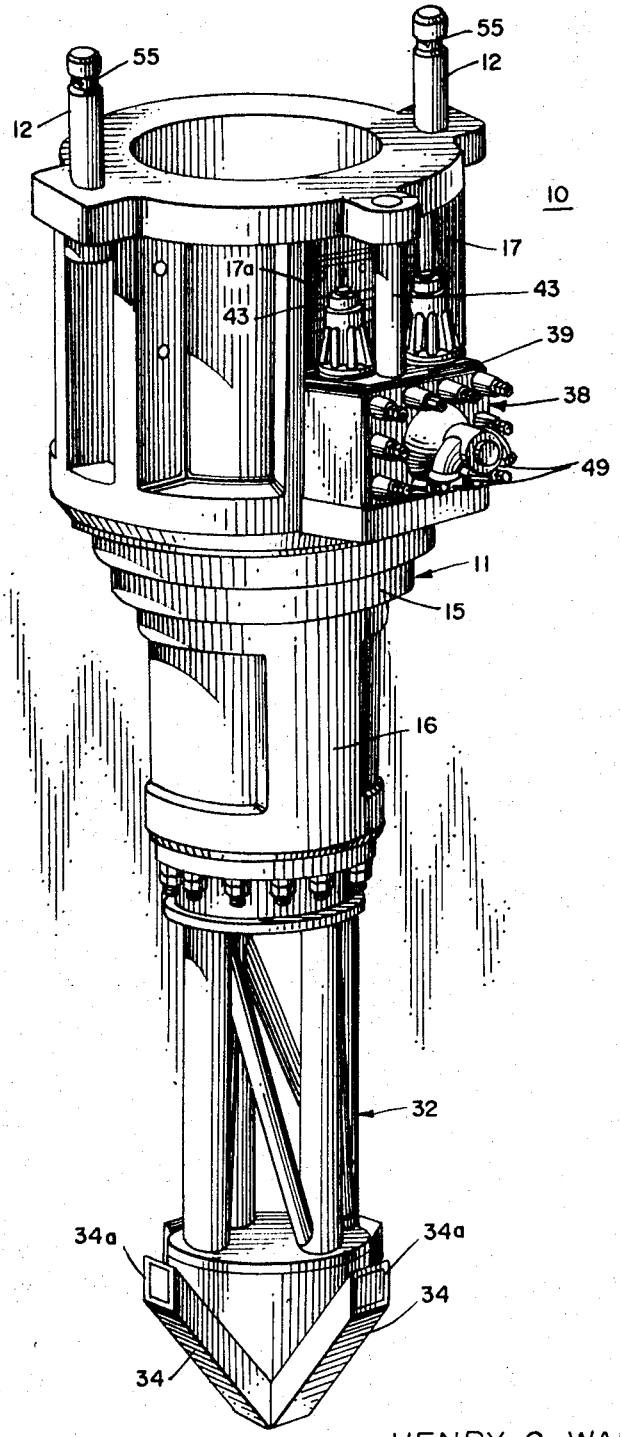

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FIG. 2

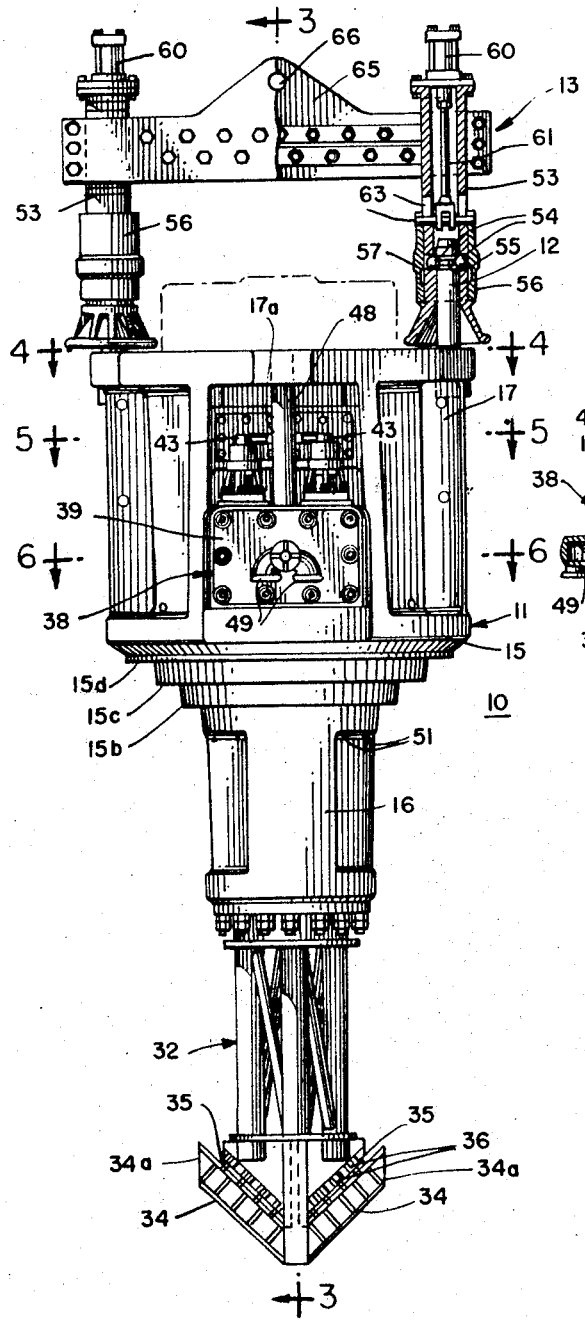

FIG. 3

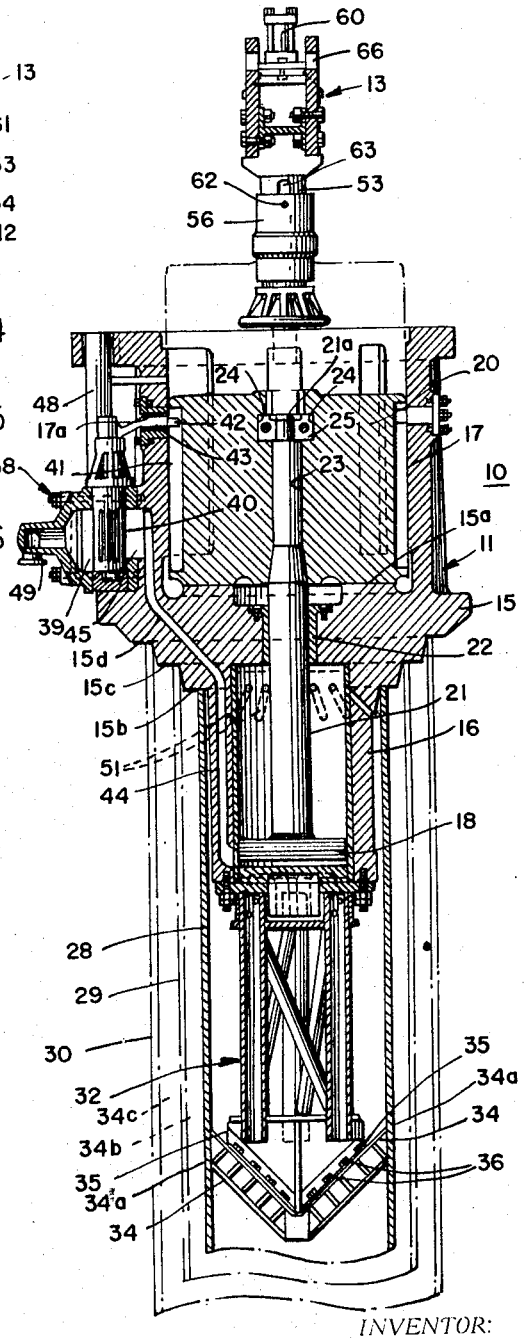

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FIG. 4

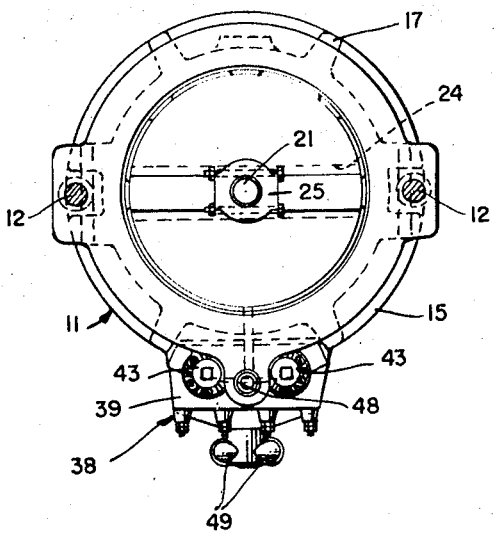


FIG. 5

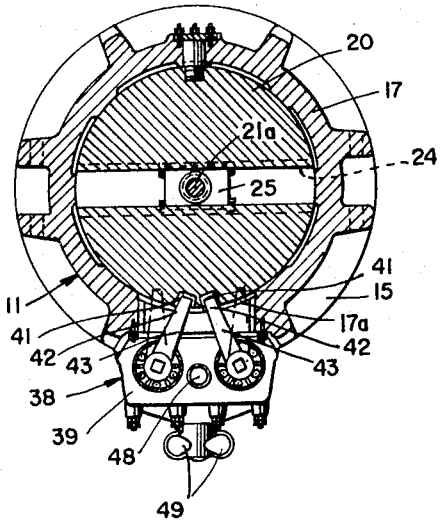


FIG. 6

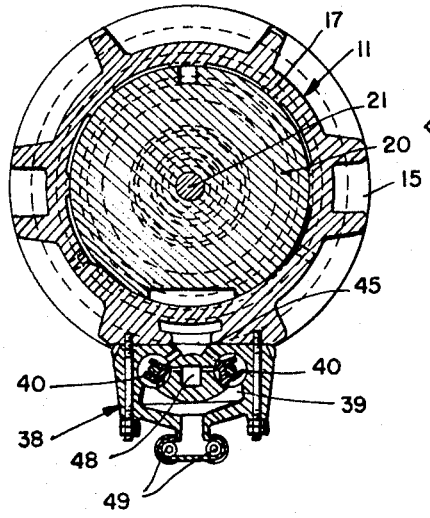
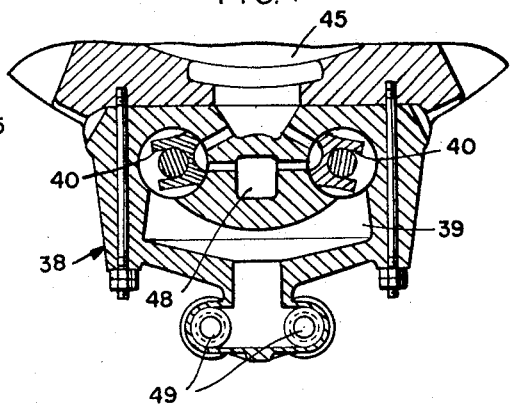


FIG. 7



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3,454,112

PILE DRIVING HAMMER

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Int. Cl. B25d 9/02
U.S. Cl. 173—128 10 Claims

ABSTRACT OF THE DISCLOSURE

There is provided a single-acting pile driving hammer for free riding and guiding on the top of a hollow tubular pile. The hammer is provided with an intermediate anvil with a ram reciprocably mounted above the anvil and a power cylinder and piston below the anvil. A piston rod interconnects the piston and ram. Guide mechanism is provided engageable with the inner surface of a pile to maintain axial alignment of the hammer and the pile. The housing of the hammer is provided with lifting horns and a quick release lifting bail is attachable to the lifting horns to permit the hammer to ride freely on top of a pile.

The present invention relates to pile driving hammers.

It is the commercial practice in the power driving of piles with a pile driving hammer to suspend the hammer from a crane, resting the anvil of the hammer on the top of the pile being driven. However there are certain difficulties which arise from the support of the pile driving hammer with a crane during the pile driving operation. It is necessary, for example, to provide leaders or guides for the anvil or head of the pile driving hammer so that it may move downwardly during each stroke of the hammer with the pile being driven. Moreover a crane is tied up continuously during the pile driving operation. Additionally it has been common practice to employ an accessory cap interposed between the hammer anvil and the pile to transmit the driving blows to the pile.

Accordingly one object of the present invention is to provide a new and improved pile driving hammer which overcomes the above mentioned difficulties.

Another object of the present invention is to provide a new and improved pile driving hammer which is capable of retaining its orientation with respect to a pile being driven.

A further object of the present invention is the provision of a new and improved pile driving hammer having a quick disconnect lifting bail so that the pile driving hammer may be free riding on the top of a pile.

Yet another object of the present invention is the provision of a new and improved pile driving hammer having an improved piston, ram and valve gear arrangement.

Still another object of the present invention is the provision of a new and improved pile driving hammer.

Further objects and advantages of the present invention will become apparent as the following description proceeds 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 many other objects of the present invention there is provided an improved pile driving hammer for driving piles including a housing defining a cylinder at one end and ram guiding structure at the other end, with an anvil portion intermediate thereof. A ram is reciprocably mounted within the ram driving structure and a piston is reciprocably mounted within the cylinder. The piston and ram are operatively interconnected by a piston rod extending through the

anvil portion. The anvil portion is adapted to ride on the top of a pile, and guide mechanism is provided engageable with the side wall of a pile to maintain axial alignment of the hammer and a pile. A quick disconnect lifting bail is also provided engageable with lifting horns extending from the housing of the hammer so that the hammer may readily be released from the crane used to haul it to the top of a pile.

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

FIG. 1 is a perspective view of a pile driving hammer according to the present invention;

FIG. 2 is an elevational view of the pile driving hammer of FIG. 1;

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

FIG. 4 is a cross sectional view of the pile driving hammer of FIG. 2, taken along line 4—4 of FIG. 2;

FIG. 5 is a cross sectional view of the pile driving hammer of FIG. 2, taken along line 5—5 of FIG. 2;

FIG. 6 is a cross sectional view of the pile driving hammer of FIG. 2, taken along line 6—6 of FIG. 2; and

FIG. 7 is an enlarged detail view of the valve gear, drawn to a larger scale illustrating the valve members in an exhaust position.

Referring now to the drawings, there is illustrated a pile driving hammer **10** including a housing **11** having upwardly projecting lifting horns **12** and a quick release lifting bail **13** engageable with the lifting horns **12** to provide for lifting of the pile driving hammer **10**.

The housing **11** defines an integral anvil portion **15**, a cylinder **16** below said anvil portion, and a ram guiding structure **17** above the anvil portion **15**. A piston **18** is reciprocably mounted within the cylinder **16**. A ram **20** is reciprocably mounted on the ram guiding structure **17**. Formed integrally with the piston **18** is a piston rod **21** extending through a packing **22** in the anvil portion **15** secured to the ram **20**. To provide the connection between the piston rod **21** and the ram **20**, the ram **20** is provided with an axial opening **23** through which the piston rod **21** extends, and is further provided with a pair of transverse channel-shaped recesses **24** which receive a split ring **25** clamped to a reduced diameter portion **21***a* of the piston rod **21**.

The pile driving hammer is of the type known as a single-acting type, wherein working fluid such as steam is introduced into the lower or closed end of the cylinder **16** thereby raising the piston **18**, piston rod **21** and ram **20** to its uppermost position, as illustrated in phantom in FIGS. 2 and 3. The steam below the piston **18** is then exhausted to the atmosphere and the ram with the associated piston rod **21** and piston **18** drops by gravity, striking the anvil surface **15***a*, FIG. 3 of the anvil portion to transmit a power or working blow through the anvil **15** to a pile. In the illustrated embodiment the anvil portion **15** is provided with a plurality of concentric stepped rings **15***b*, **15***c* and **15***d* to receive the upper edge of a pile **28**, FIG. 3, of a size to be driven. The stepped concentric rings **15***b*, **15***c*, **15***d* are sized to accept piles of standard varying diameters, so that, as illustrated in phantom, piles **29** and **30** may be used with the hammer **10**, the shoulders on the steps positioning the hammer on the top edge of the pile. In the illustrated embodiment the pile **28** is a four-foot diameter piling, pile **29** is a five-foot diameter piling, and pile **30** is a six-foot diameter piling.

To maintain axial alignment of the pile driving hammer **10** with relation to the top of the pile **28**, there is provided a suitable guide mechanism or structure, generally illustrated at **32** extending downwardly from the cylinder **16**. The guide structure **32** includes a plurality

of adjustable fingers **34** at its lower end, adjustably bolted to suitable structural members **35** by means of bolts **36** so that the outer edge **34***a* of the fingers **34** can be spaced outwardly to engage the inner wall surface of a selected size of pile **28**, **29** or **30** as indicated in phantom as **34***b*, **34***c* in FIG. 3.

Control of the piston **18** is by a valve gear mechanism **38** within a fluid chamber **39** including a pair of rotary valve elements **40**. The valve gear mechanism **38** is controlled by a pair of surface cams **41**, FIG. 5, defined as grooves in the longitudinal side surface of the ram **20**, and each receiving a valve actuator portion **42** or cam a valve arm **43** secured to the top of the valve elements **40** extending out of the steam chest **39**. The surface cams **41**, upon vertical reciprocation of the ram **20**, will reciprocate the valve arms **43** between the position illustrated in solid in FIG. 5 to the position illustrated in phantom therein.

To control the reciprocation of the piston **18** and associated ram **20**, there is provided a plurality of fluid passageways interconnecting the steam chest **39**, valve elements **40** and the cylinder **16**. More specifically, referring to FIGS. 3 and 6, there is provided a passageway **44** interconnecting a valve chamber **45** and the cylinder **16**. An exhaust passageway **48** extends from the valve gear mechanism **38**, and a pair of fluid inlet fittings **49** provide for the connection of the fluid chest **39** to the source of working fluid such as steam. The valve elements **40** rock about their central axis from the position illustrated in FIG. 6 wherein the steam chest **39** is connected to the valve chamber **45** and passageway **44** to the cylinder **16**, to the position illustrated in FIG. 7 wherein the cylinder **16** is exhausted to the atmosphere through the passageway **44**, valve chamber **45**, and exhaust passageway **48**.

Thus it will be understood that when the ram **20** is at its bottom position, as illustrated in solid in FIG. 3, the valve arms **43** will engage within the surface cams **41** in the position illustrated in FIGS. 5 and 6 so that the valve elements **40** are in the position supplying steam to the bottom of the cylinder **16**, thus raising the piston **18** and associated ram **20**. However when the ram **20** approaches the top of its stroke, the valve arms **43** will be shifted to the position illustrated in phantom in FIG. 5, to move the valve elements **40** to the position illustrated in FIG. 7, wherein the lower closed end of the cylinder **16** is exhausted to the atmosphere.

A plurality of vent openings **51** in the cylinder **16** above the uppermost travel of the piston **18** prevents the retarding of the piston **18** because of pressure differentials created by movement of the piston within the cylinder **16**.

In accordance with another feature of the present invention, the pile driving hammer **10** may be free riding on the top of a pile, being maintained in the desired orientation by the stepped rings on the anvil **15** and by the guide structure **32**. To this end the lifting bail **13** is readily separable from the lifting horns **12**. As best illustrated in FIG. 2, the lifting bail is provided with a pair of attaching cylinders slideably positionable over the respective lifting horns **12**. Each of the cylinders **53** carries a plurality of lock balls **54** engageable within an annular recess **55** defined in the lifting horns **12**. The balls **54** are held in locking position within the recesses **55** by a reciprocably mounted lock cylinder **56** which, in the illustrated position, prevents outward movement of the lock balls **54**, but which is vertically movable until an annular recess **57** in its inner side wall aligns with the balls **54** to permit them to move outwardly, thus disengaging from the lifting horns **12**. The vertical positioning of the lock cylinder **56** is under the control of a lock cylinder **60**, which may conveniently be controlled by the same fluid driving the piston **18**, or which may have an independent control such as an electric solenoid. The control cylinders **60** are connected to the lock cylinders **56** through a piston rod **61** and crosshead **62** extending through elongated slots **63** in the attaching cylinders **53** to engage the lock cylinders **56**. A lifting arm **65** interconnects the pair of attaching cylinders **53**, and is provided with an eye or opening **66** for receiving a hook or other supporting structure of a crane or like device.

From the above detailed description, the operation of the pile driving hammer is believed clear. However, briefly, it will be understood that the pile driving hammer is capable of driving the pile without being connected to any sort of a crane or lifting device after having been released from the lifting mechanism on top of a pile. The guiding mechanism of the hammer will maintain the proper orientation of the hammer with the pile. More specifically the hammer is lifted by a suitable lifting mechanism such as a crane through the lifting bail **13**, and set on top of a pile such as pile **28**, FIG. 3. The pile driving hammer **10** is properly oriented on the pile **28** with a stepped ring of the anvil portion **15** maintaining proper alignment with the upper edge of the pile. At the same time the adjustable fingers **34** of the guide structure **32** engage the inner wall surface of the pile **28**. In this position, the cylinder **16** and associated piston **18** ride within the pile **28** while the anvil **15** rests on the upper edge of the pile, and the ram **20** with the associated ram guiding structure **17** riding above the ram **15**. Once the pile driving hammer **10** has been thus set in place on top of a pile **28**, the control cylinders **60** are actuated to raise the lock cylinders **56** and permit the lock balls **54** to move into the annular recesses **57** and disengage from the lifting horns **12**. The lifting bail **13** may then be separated from the pile driving hammer **10** to free the crane for other lifting jobs.

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

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

1. A pile driving hammer for driving piles comprising:
- a housing defining cylinder means and having an anvil portion adapted to engage the upper edge of a pile;
- a ram in said housing mounted to strike said anvil portion during a power stroke;
- drive means in said housing for reciprocating said ram to provide repetitive power strokes; and
- guide mechanism engageable with the side wall of a pile to maintain axial alignment with the hammer and pile.

2. A pile driving hammer as set forth in claim **1** including lifting means connected to said housing, and a quick release lifting bail attached to said lifting means to permit said hammer to ride freely on a pile.

3. A pile driving hammer as set forth in claim **1** wherein said cylinder means defined in said housing is below said anvil portion, and a piston is reciprocably mounted in said cylinder means; and wherein said ram is above said anvil portion, and means interconnects said ram and said piston, and valve gear means controlling the admission and release of drive fluid to said cylinder to reciprocate said piston to provide drive strokes to said ram.

4. An internal pile driving hammer for driving hollow tubular piles comprising:
- a housing defining cylinder means and having an anvil portion adapted to engage the upper edge of a pile;
- a ram in said housing mounted to strike said anvil portion during a power stroke;
- drive means in said housing for reciprocating said ram to provide repetitive power strokes; and
- guide mechanism spaced below said anvil portion adapted for insertion to a pile to maintain orientation of the hammer with the pile.

5. An internal pile driving hammer as set forth in claim 4 wherein said anvil is provided with a plurality of concentric stepped rings on its lower face to provide positioning of the hammer on piles of various diameters.

6. An internal pile driving hammer as set forth in claim 5 wherein said cylinder means extends below said anvil portion and is adapted to be positioned within a pile, and a piston is reciprocably mounted in said cylinder means, and wherein said ram is positioned above said anvil portion, and means interconnects said ram and said piston, including valve gear means for controlling the admission and release of drive fluid to said cylinder to reciprocate said piston to provide drive strokes to said ram.

7. An internal pile driving hammer as set forth in claim 6 including lifting means connected to said housing, and a quick release lifting bale attached to said lifting means to permit said hammer to ride freely on a pile.

8. An internal pile driving hammer as set forth in claim 5 wherein said guide mechanism is adjustable to provide for orientation thereof with the inner surfaces of piles of various diameters.

9. A pile driving hammer for driving piles comprising:

a housing defining a cylinder and ram guiding structure and an anvil portion intermediate said cylinder and said structure;

a ram reciprocably mounted relative to said ram guiding structure positioned to stike said anvil portion during a power stroke;

a piston reciprocably mounted in said cylinder;

a piston rod extending through said anvil portion and interconnecting said piston and said ram; and

valve gear means controlling the admission and release of drive fluid to said cylinder to reciprocate said piston and ram.

10. A pile driving hammer as set forth in claim 9 wherein said valve gear means includes at least one rotatably mounted valve element, and a valve arm operatively connected to said valve element having an actuator portion extending through said ram guiding structure, said ram being provided with a cam groove in its surface, said valve actuator riding in said cam groove to operate said valve element.

References Cited

UNITED STATES PATENTS

1,917,066	7/1933	Schalscha	173—128 X
2,068,045	1/1937	Wohlmeyer	173—129 X
3,013,541	12/1961	Adams	173—128 X
3,178,893	4/1965	Fiore	61—53.7 X
3,194,326	7/1965	Bodine	175—56
3,389,757	6/1968	Teter	61—53.7 X

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