United States Patent

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[54] **PERCUSSION HAMMER**
7 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **173/90,** 91/277, 173/126
[51] **Int. Cl.** **B25d 9/00**
[50] **Field of Search** 173/49, 90, 126, 128, 131; 91/277

[56] **References Cited**

UNITED STATES PATENTS

696,480	4/1902	Pierce	173/126
2,897,782	8/1959	Kennedy	173/126
2,990,022	6/1961	Mueller et al.	173/49
3,245,482	4/1966	Williams et al.	173/126
3,357,315	12/1967	Adams et al.	91/277

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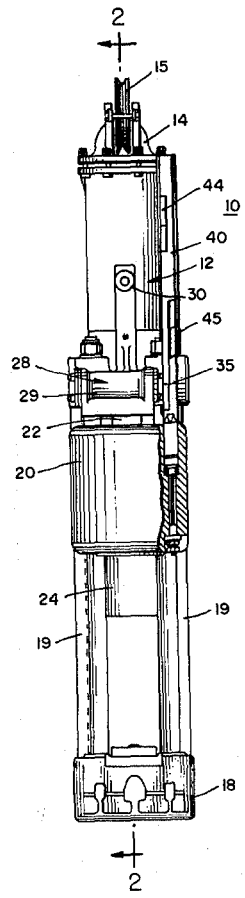
ABSTRACT: There is provided a percussion hammer of the type including a cylinder and a piston operable in the cylinder connected to a ram through a piston rod. Valve means are provided for cycling working fluid into and exhausting the working fluid from the cylinder to cycle the tool through power and return strokes. The cycling valve is controlled by a suitable actuator or slide bar connected to the ram and provided with cams for actuating a trip. The ram is provided with removable weights so as to permit alteration of the operating characteristics of the hammer. In addition there is provided an improved means of fastening the piston rod to the ram and of connecting the slide bar to the ram. A detent is provided for latching the valve trip in the desired position.



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SHEET 1 OF 3

FIG. 1

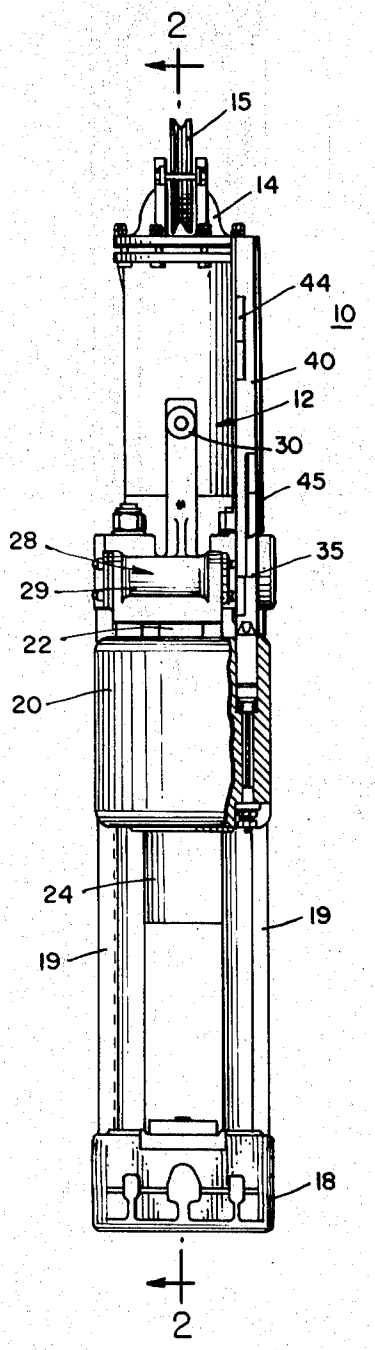

FIG. 2

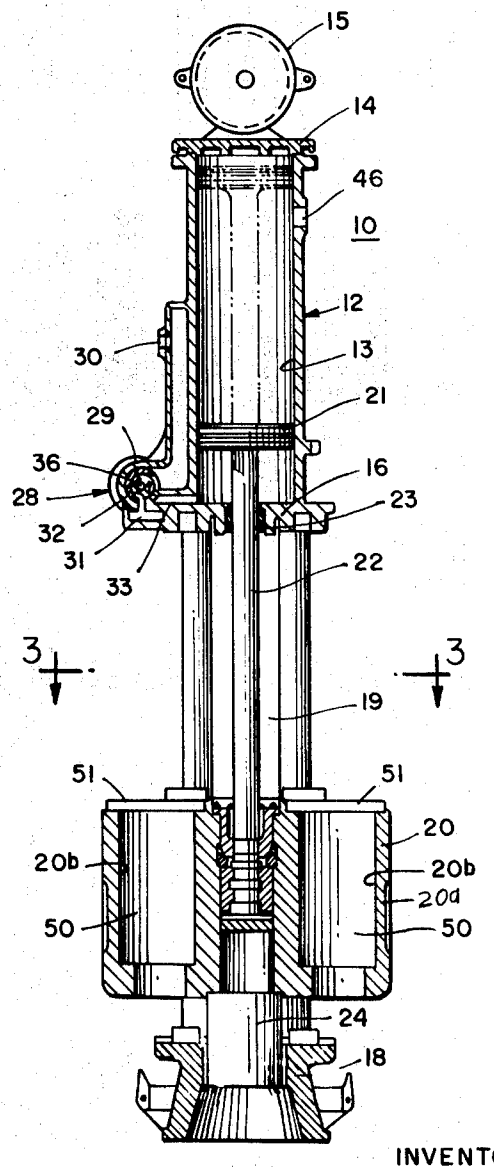

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FIG. 5

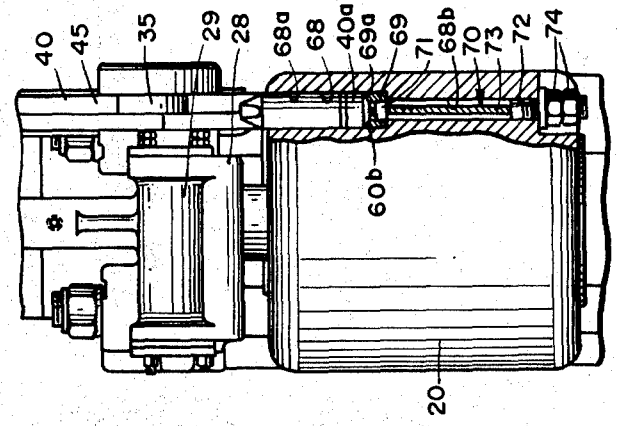

FIG. 8

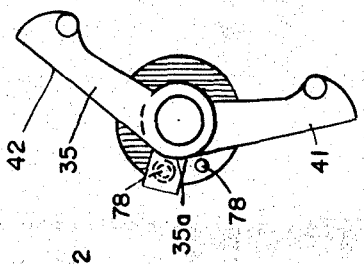

FIG. 7

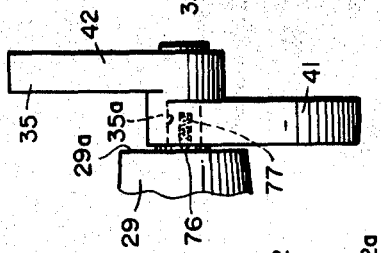

FIG. 6

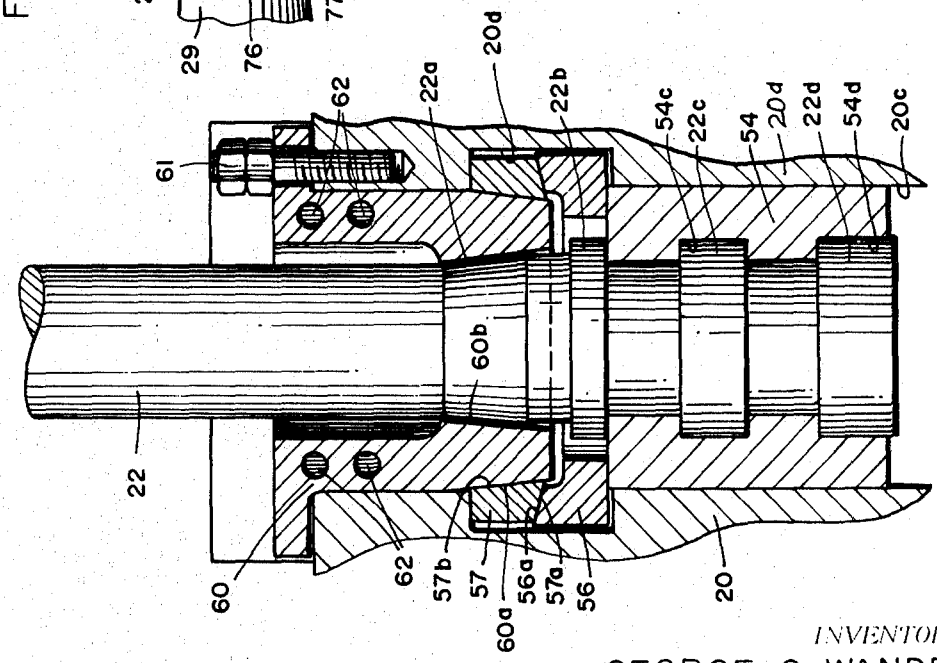

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FIG. 3

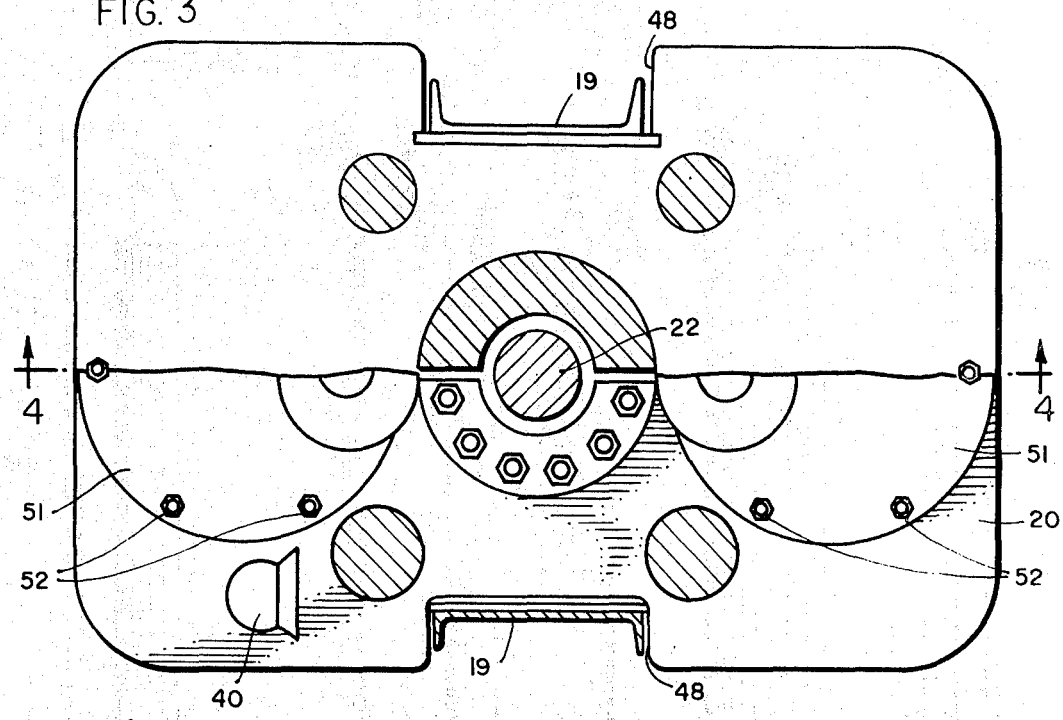
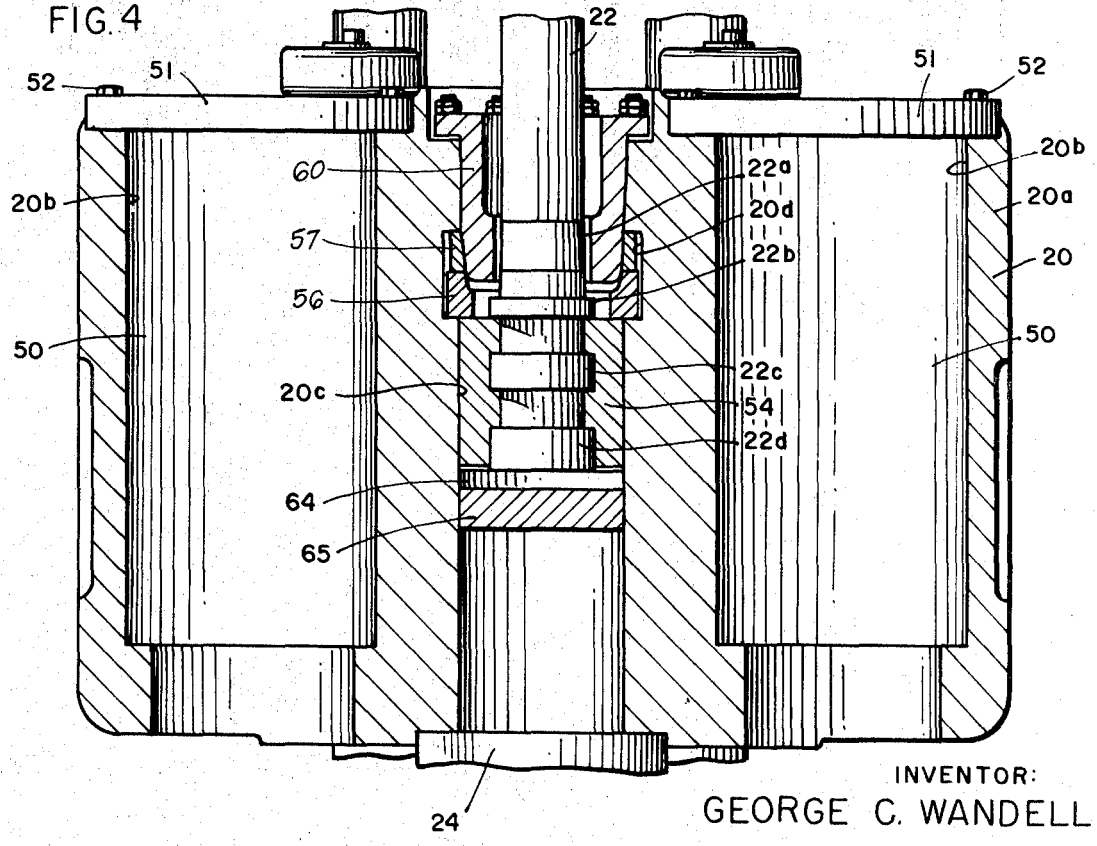


FIG. 4



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PERCUSSION HAMMER

The present invention relates to a percussion hammer, and more particularly to a percussion hammer of the type generally used for driving piles and the like. Such a hammer may be driven by steam, compressed air, or other working fluid.

Commercially available percussion hammers of the type used for driving piles and the like may be either of single-acting type wherein the ram and associated driving structure is raised by the working fluid is exhausted and the ram and associated driving parts are dropped by gravity, or a double-acting type wherein the ram and associated piston is driven through its power stroke by working fluid acting with the gravity. The present invention is described with reference to applications on a single-acting type hammer, but the principles described are equally applicable to percussion hammers of the double-acting type. Commercially such percussion hammers are manufactured in several different sizes. The size of a pile driving hammer is selected by the amount of energy that the hammer is capable of delivering, and is dependent in part on the weight of the ram. Because of the many requirements for different size hammers, it would be desirable to have available the means to convert one size of hammer to another, either in manufacture or in the field, with the least amount of effort and expense. Moreover heretofore certain difficulties have arisen with the manufacture, maintenance, and repair of percussion hammers. One area of difficulty has been the connections between the piston rod and the slide bar with the ram of the percussion hammer. Heretofore there has been employed ram keys and the slide bar keys with suitable locks that have been troublesome. In addition, difficulty has been experienced with the trip of the control valve bouncing after reaching its maximum positions.

Accordingly, it is an object of the present invention to provide a new and improved percussion hammer.

A further object of the present invention is to provide a percussion hammer which may readily be converted from one size to another, either during manufacture or in the field.

Yet a further object of the present invention is to provide a new and improved means for fastening a piston rod to the ram of a percussion hammer.

Still another object of the present invention is to provide a new and improved means for securing the slide bar of a percussion hammer to the ram thereof.

Still another object of the present invention is to provide means for minimizing instability of the control valve because of bounce and the like.

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 the specification.

In accordance with these and other objects there is provided an improved percussion hammer adapted for pile driving and the like. A commercial percussion hammer includes a cylinder with a piston operable in the cylinder. Suitable working fluid is cycled into and out of the cylinder to provide cycling of the piston. The piston is connected to a ram which in turn provides percussion blows on a base or head resting on a pile. Suitable valve and control means are provided for controlling the cycling of the working fluid. On such known valving arrangement is more fully described and claimed in U.S. Pat. No. 3,357,315 granted Dec. 12, 1957 to Adams et al. and assigned to the same assignee as the present invention. In accordance with the present invention the ram is provided with cavity means adapted to receive removable weights thereby providing for altering the amounts of energy that the hammer delivers per blow. Thus the hammer may be readily converted to different sizes both during manufacture and in the field. In addition, the ram is provided with a centrally located piston rod bore for receiving one end of the piston rod, and the lower

end of the piston rod is provided with an outwardly and downwardly extending taper. The piston rod is retained within the rod bore of the ram by a split bushing secured with the bore. Moreover the ram is provided with a counterbore for securing the slide bar, and an improved slide bar is operatively positioned to control the valve means connected to the ram by a flexible connector such as a cable connector, the lower end of which is bolted or otherwise secured through the ram. A trip detent for the valve mechanism is provided to more securely locate the valve controlling the working fluid.

Advantageously, the removable weights on the ram permit conversion of the pile driving hammer to a desired size, both during manufacture and in the field. Thus it is possible during manufacture to standardize a smaller number of hammers and parts; and permits the purchase and operation of a single hammer to be used where different pile driving energy requirements are present. The fastening of the piston rod to the ram and the rope wire fastening device securing the slide bar to the ram both permit elimination of the present ram and slide bar keys. The improved trip detent in the hammer improves the stability of the valve and prevents the valve from bouncing back after reaching its maximum positions.

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

FIG. 1 is a side elevational view of the improved percussion hammer, partly in broken away section;

FIG. 2 is a cross-sectional view of the percussion hammer of FIG. 2, taken along line 2–2 of FIG. 1;

FIG. 3 is an enlarged view of the ram according to the present invention taken along line 3–3 of FIG. 2;

FIG. 4 is a cross-sectional view of the ram of the improved percussion hammer, taken along line 4–4 of FIG. 3;

FIG. 5 is an enlarged fragmentary view of the slide bar to ram connection according to the present invention;

FIG. 6 is an enlarged view of the piston rod to ram connection; and

FIGS. 7 and 8 illustrate the trip detent on the valve trip according to the present invention.

Referring now to the drawings, and particularly to FIGS. 1 and 2 thereof, there is illustrated an improved percussion hammer 10 of the type adapted to drive piles and the like The percussion hammer 10 is operated by suitable working fluid, such as steam, in a known manner. The percussion hammer 10 includes a housing 12 defining a cylinder 13. The cylinder 13 is closed at its upper end by a cylinder head 14 having a head sheave 15, and is closed at its lower end by an end wall defining a stuffing box 16. The sheave 15 permits hoisting of the percussion hammer 10 by a crane or other suitable means for placement on top of a pile.

The housing 12 additionally includes a base 18 connected to the cylinder 13 by opposed side guide channels 19 and columns. A ram assembly 20 having a ram housing 20*a* is adapted to be reciprocated vertically guided by the columns. A piston 21 in the cylinder 13 is connected to the ram assembly 20 by a suitable piston rod 22 which extends through suitable packing 23 in the stuffing box 16.

The illustrated tool is of the single-acting type, wherein the work fluid enters the lower end of the cylinder 13 so as to raise the piston 21 along with its associated piston rod 22 and ram assembly 20 from the position illustrated in solid in FIG. 2 to the position illustrated in phantom therein. As the piston 21 approaches its top position the working fluid below the piston 21 is exhausted to the atmosphere, permitting the ram assembly 20 and its associated piston rod 22 and piston 21 to drop by gravity. A ram point 24 carried by the ram assembly 20 will strike a driving head (not shown) to provide percussion or driving loads to pile. The control of the working fluid into and out of the cylinder 13 is through a valve assembly 28, of known design, and more fully described in the above mentioned Adams et al. patent. However, briefly, the valve assembly 28 includes a steam chest 29 having a supply tap 30 for connection to a source of working fluid as steam. In addition the valve assembly 28 includes an exhaust passageway 31

opening to the atmosphere. A rotary valve element 32 rocks between the position illustrated in FIG. 2, connecting the steam chest 29 to the lower end of the cylinder 13 through a suitable passageway 33, counterclockwise to a second position wherein the passageway 33 is connected to the exhaust passageway 31 so as to exhaust the lower end of the cylinder 13. A trip 35 is connected to a shaft 36 carrying the valve element 32 and extending through the steam chest 29 so as to be in the path of a slide bar 40 secured to the ram assembly 20 for reciprocation therewith. The trip 35, as best illustrated in FIGS. 7 and 8, includes a pair of cam or cam arms 41 and 42, and the slide bar 40 has a pair of spaced cam members or cam actuating members 44 and 45 arranged to intercept respectively the cam arms 41 and 42 so as to rock the trip 35. Thus it will be understood that as the piston 21 with its piston rod 22 and associated ram assembly 20 reaches the bottom of the stroke, the cam 44 will intercept the arm 41 and rotate the valve element 32 to the position illustrated in FIG. 2, thus admitting pressurized fluid into the lower end of the cylinder 13 to raise the piston 21. As the piston 21 approaches the upper end of its stroke, the cam actuating member 45 will intercept the cam arm 42 and rock the valve element 32 clockwise, as viewed in FIG. 2, so as to exhaust the working fluid below the piston 21 and permit dropping of the ram assembly 20 and associated piston 21 and piston rod 22. An exhaust opening 46 near the upper end of the cylinder 13 permits exhaust of the fluid above the piston 21 during the up stroke of the piston 21, and moreover provides for a pneumatic cushion after the piston 21 passes the passageway 46.

The ram assembly 20 is provided with opposed grooves 48 defining tracks receiving the guide channels 19. Thus the ram assembly 20 is mounted for reciprocal motion between the guide channels 19. In accordance with a feature of the present invention, the ram assembly 20 is provided with means for receiving removable weights so as to permit conversion of the percussion hammer to different sizes of applied energy. Specifically, in the illustrated embodiment, the housing 20*a* of the ram assembly 20 is provided with a pair of upwardly opening cavities 20*b*, each containing a removable cylindrical weight 50. The top of each cavity 20*b* is closed by a coverplate 51 secured to the housing 20*a* in any suitable manner as with the bolts 52.

The ram housing 20*a* is provided with a centrally located piston rod bore for receiving and securing the lower end of the piston rod 22. To this end the piston rod bore 20*c* contains an enlarged annular portion 20*d* intermediate its length. The lower end of the piston rod is provided with an outwardly and downwardly tapered surface 22*a* terminating with a first enlarged annular portion 22*b*. A split bushing 54 is complementary to the lower end of the piston rod 20, having annular recesses 54*c*, 54*d* receiving enlarged annular portions 22*c* and 22*d* of the piston rod 22. The split bushing 54 is received within the piston rod bore 20*c* below the annular portion 20*d* thereof.

Within the annular portion 20*d* is positioned a pair of wedge rings, a first one 56, of which is of generally angular cross section having an upper surface 56*a* tapered upwardly and outwardly. The second wedge ring 57 is provided with a lower surface 57*a* tapered upwardly and outwardly complementally engaging the tapered surface 56*a* of the lower wedge ring 56, and additionally having an inner surface 57*b* tapered inwardly and downwardly. The wedge rings 56 and 57 are split to permit their assembly within the annular portion 20*d* of the ram housing 20*a*. A rod retaining gland 60 extends into the upper cylindrical portion of the piston rod bore 20*c*, secured to the housing 20*a* in any suitable manner as by the studs 61, and is provided with a lower outer chamber 60*a* tapering inwardly and downwardly so as to engage complementally the surface 57*b* of the wedge ring 57, and additionally is provided with an inner taper 60*b* loosely conforming to the tapered surface 22*a* of the piston rod 22, and tapering downwardly and outwardly as best illustrated in FIG. 6. A plurality of dowel pins 62 align the two sections of the gland 60.

It will be understood that the split bushing 54 is loosely held within the piston rod bore 20*c*, and aligned by the enlarged annular portions 22*c* and 22*d* of the piston rod. The complementary tapered surfaces 56*a* and 57*a* of the wedge of rings 56 and 57 provide for tightening of the rings within the annular portion 20*d* of the housing 20*a* as the upper ring 56 is wedged outwardly by the engagement of the chamfer 60*a* and tapered surface 57*b*. Thus the piston rod 22 is secured to the ram assembly 20 sufficiently loosely to permit minor misalignment and percussion movement of the parts without binding or wedging.

The lower end of the piston rod 22 rests against a ram plate 64, FIG. 4, bearing against a ram cushion 65 of lead or other suitable material. The ram plate 64 and ram cushion 65 are between the piston rod 22 and the ram point 24, transmitting the load of the piston 21 and the piston rod 22 to the ram point 24.

The slide bar 40 is secured to the ram assembly 20 for vertical movement therewith. More specifically, the ram housing 20*a* is provided with a counterbore through opening 68 having an enlarged upper portion 68*a* and a smaller or reduced diameter lower portion 68*b*, FIG. 5. The slide bar terminates in a lower cylindrical portion 40*a* received within the upper portion 68*a* of the through opening 68, seating against a lower seating ring 69. The seating ring 69 has an upper spherical surface 69*a*, and the slide bar 40 has a lower spherical surface 60*b* in engagement therewith. The slide bar 40 is retained within the through opening 68 by means of a flexible cable assembly 70 having an upper threaded fitting 71 threaded into a complementary threaded opening in the lower end of the slide bar 40, and having a a lower threaded fitting 72 connected therewith by means of a flexible rope 73. Suitable lock means, such as the nuts 74, fasten the slide bar 40 to the ram assembly 20.

The trip 35, in the illustrated embodiment, is provided with a recess 35*a* FIGS. 7 and 8, containing a detent ball 76 biased outwardly against a surface 29*a* of the steam chest 29 by a compression spring 77. The surface 29*a* is provided with a pair of depressions 78 so that the ball 76 will lock therein at the two positions of travel of the trip 35.

From the foregoing it will be understood that a percussion hammer according to the present invention is suitable for driving pile and like applications, and may readily be converted from one size to another by the mere addition of removable weights 50 to the ram assembly 20. Moreover, the piston rod 22 and the slide bar 40 are secured to the ram assembly 20 in a new and novel manner which eliminates many of the difficulties heretofore encountered. In addition, bouncing of the valve is eliminated by the addition of suitable detent means to lock the trip 35 into a desired position.

Although the present invention has been described by reference to only a single embodiment thereof, it will be apparent that numerous modifications and other embodiments may be devised by those skilled in the art.

I claim:

1. A percussion hammer of the type including:
a cylinder;
a piston operable in said cylinder;
a ram assembly provided with cavity means adapted to receive removable weights, said ram assembly having a centrally located piston rod bore for receiving one end of a piston rod;
removable weight means in said cavity means;
a piston rod connected to said piston and having one end extending into said bore, said one end having enlarged annular means;
a split bushing secured over said enlarged annular means;
a split piston-rod-retaining gland extending into said bore retaining said bushing;
means securing said retaining gland in said bore;
said bore being provided with a counterbore for securing a slide bar;

valve means for cycling working fluid into said cylinder, said valve means including a valve chamber and a multiposition valve element movable in said chamber;

a slide bar operatively positioned to control said valve means having a lower and fitting into said counterbore and a flexible connecter, one end of which is connected to the lower end of said slide bar and extending through said counterbore, said flexible connecter being secured within said counterbore; and

detent means retaining said valve element in one of its positions until actuation thereof by said slide bar to the other of its positions.

2. A percussion hammer of the type including:

a cylinder;

a piston operable in said cylinder;

a ram assembly having a centrally located piston rod bore for receiving one end of a piston rod, said bore being provided with an annular, enlarged portion intermediate its ends;

a piston rod connected to said piston and having one end extending into said bore, said one end having a plurality of enlarged annular portions, and having an outwardly and downwardly tapered surface;

a split sleeve engaging a portion of said one end and fitted within said bore;

a pair of split wedge rings adapted to wedge within said annular enlarged portion;

a split piston-rod-retaining gland extending into said bore around said rod and including a spaced complementary outwardly and downwardly extending chamfer converging said outwardly and downwardly tapered surface, said gland including a tapered surface engageable with one of said retaining rings wedging said ring outwardly;

means securing said retaining gland in said bore;

valve means for cycling working fluid into said cylinder; and

actuating means operatively connecting said valve means and said ram to control the sequence of fluid flow into and out of said cylinder providing for repetitively cycling said piston and ram.

3. A percussion hammer as set forth in claim 2 wherein the lower one of said retaining rings is of generally angular cross section, having an upper surface inclined upwardly and outwardly the upper one of said retaining rings having a lower surface complementary to said upper surface tapering upwardly and outwardly, said upper ring also having an inner surface tapering inwardly and downwardly and in engagement with an inwardly and downwardly tapering outer surface of said gland whereby said gland wedges said upper ring outwardly to wedge said retaining rings within said enlarged annular portion.

4. A percussion hammer as set forth in claim 2 including:

a ram point extending from the other end of said bore; and

a ram cushion between the lower end of said piston rod and said ram point.

5. A percussion hammer of the type including:

a cylinder;

a piston operable in said cylinder;

a ram assembly provided with a through counterbore for securing a slide bar;

a piston rod interconnecting said piston and said ram assembly;

a valve means for cycling working fluid into said cylinder;

a slide bar operatively positioned to actuate said valve means to control the sequence of fluid flow into and out of said cylinder to provide for said repetitive cycling of said piston and ram, said slide bar having a lower cylindrical portion fitting into said counterbore;

a flexible connecter having one end connected to the lower end of said slide bar and extending through said counterbore; and

means adjustably securing the other end of said flexible connecter in said counterbore.

6. A percussion hammer as set forth in claim 5 wherein said flexible connecter includes a length of flexible rope having threaded fittings at each end, one of said fittings being threaded into the lower end of said slide bar, the other of said fittings extending through said counterbore and locked therethrough by the last mentioned means.

7. A percussion hammer of the type including:

a cylinder;

a piston operable in said cylinder;

a ram assembly;

a piston rod interconnecting said piston and said ram;

valve means for cycling working fluid into said cylinder, said valve means including a valve chamber and a multiposition valve element movable within said chamber;

cam means for moving said valve element to a first position when said piston is near the bottom of its stroke to supply pressurized fluid in said cylinder to raise said piston and to a second position when said piston is near the top of its stroke to exhaust the working fluid from below said piston;

a slide bar operatively connected to said ram responsive to the position of said piston for moving said valve element between said positions; and

detent means retaining said valve element and said cam means in a desired one of said positions until actuation thereof to the other of its positions by said slide bar.