July 9, 1963 C. V. ADAMS 3,096,831

POWER HAMMER

Filed Dec. 27, 1960

Fig. 1

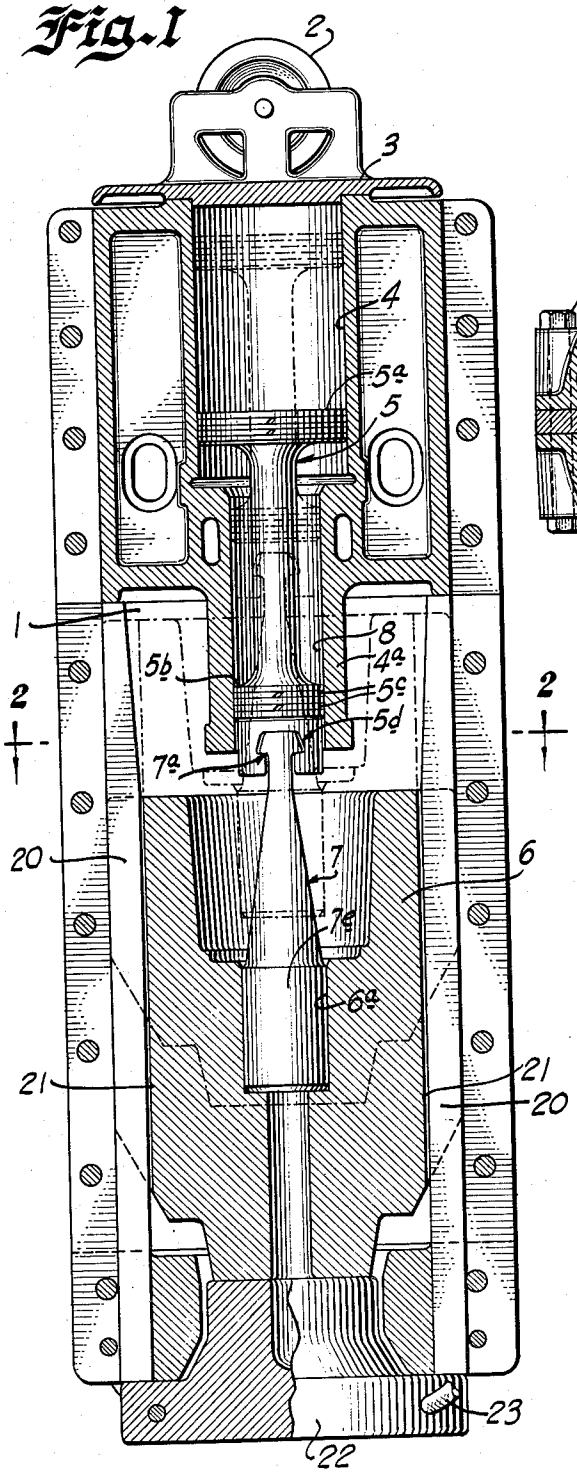


Fig. 2

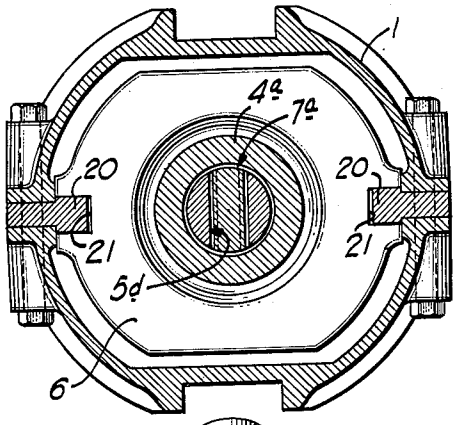
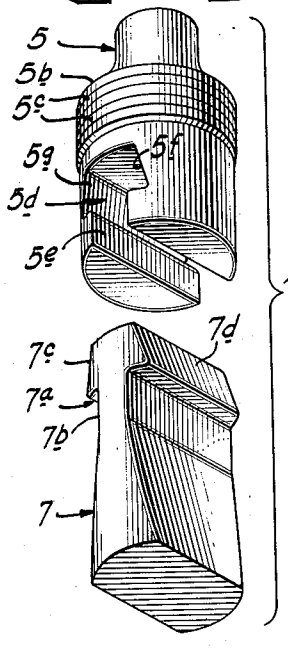


Fig. 3



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United States Patent Office

3,096,831
Patented July 9, 1963

3,096,831

POWER HAMMER

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Filed Dec. 27, 1960, Ser. No. 78,366
8 Claims. (Cl. 173—127)

This invention relates broadly to power hammers and more particularly to the type of power hammers known as pile hammers, in which a ram is automatically operated by motive fluid supplied to the cylinder to impart motion to the ram. A known power hammer is described and illustrated in my prior Patent No. 2,004,180, issued June 11, 1935.

The power hammer includes a cylinder member and a piston member operatively positioned within the cylinder. Motive fluid is supplied to the cylinder to automatically operate the piston. A heavy weight or ram is operatively connected to the piston to deliver heavy pile driving blows against an anvil which in turn transmits the blows to the pile. One type of hammer known as the single-acting hammer utilizes the motive fluid on the upstroke of the piston to raise the ram and thereafter exhausts the motive fluid to permit the piston and the ram to fall by gravity and strike a blow. Another type of hammer known as the double-acting hammer not only utilizes the pressure of the motive fluid against the piston to raise the ram, but also to accelerate the downstroke of the ram. Moreover, pile hammers may be of either the open type or the sub-aqueous or closed type. The open type of pile driving hammer has exposed working parts. On the other hand, the closed type has the working parts in a suitable housing, as illustrated in my above-mentioned prior patent. Such closed hammers having no exposed working parts are desirable for the protection they afford against water, sand and other destructive or corrosive elements particularly when driving piles over water.

Heretofore it has been known to connect the piston and ram through a piston rod having an enlarged spherical head and fitted within a split bushing, as clearly illustrated in my prior aforementioned patent. The bushing is then bolted or pinned to the ram. While this arrangement has proven satisfactory when used with the open type of pile hammers, difficulties have been encountered with this connection in closed hammers. While the cause of the difficulty is not fully understood, it is believed to arise in part because of the loose parts in the closed housing.

It is therefore an object of the present invention to provide an improved pile driving hammer.

Another object of the present invention is to provide an improved closed type power hammer.

A further object of the present invention is to provide a pile hammer having an improved connection between the piston and the ram.

A further object of the present invention is to provide an improved connection between the piston member and ram member of a closed type pile hammer.

Further objects and advantages of the 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.

Briefly stated, in accordance with the present invention, the piston member of a pile driving hammer is provided with a slot in one end thereof, and a connecting rod member having one end secured to the ram of the hammer is provided with a complementary tongue at its other end which is received and thereby locked in the slot of the piston. In an illustrated embodiment, the slot is a T-

slot and the complementary tongue is T-shaped. However, it is to be understood that other slot and tongue configurations, such as cylindrical or square, may be used. In one embodiment, the connecting rod is secured to the ram by an interference fit between the connecting rod and an aperture in the ram. While the aforedescribed connection is equally applicable to open and closed types of pile hammers, it is particularly advantageous on closed type hammers since, as explained above, the prior connections have not been entirely satisfactory when used on the closed type hammers.

The nature of the invention will be better understood when described in connection with the accompanying drawing, in which:

FIG. 1 is a sectional elevational view of a power pile hammer incorporating the present invention;

FIG. 2 is a cross-sectional view of the pile hammer of FIG. 1 taken along line 2—2 of FIG. 1; and

FIG. 3 is an exploded isometric view of the improved rod and piston connection.

The structure and operation of a power hammer is illustrated and described in my prior aforementioned patent and need not be fully described herein. However, briefly, the power hammer comprises a suitable housing 1 provided with sheaves 2 which may be arranged upon a cylinder head 3 to receive cable or like flexible members controlling the vertical movement of the hammer. The cylinder head 3 is attached to a cylinder block 4 within the housing 1. A piston member 5 having a main piston 5*a* in the cylinder 4 is operatively connected to a ram 6 through a piston or connecting rod 7. The lower end 4*a* of the cylinder is reduced in diameter to provide an auxiliary cylinder chamber 8 receiving an auxiliary piston 5*b* of piston member 5 which forms a seal at the lower end of the cylinder 4. The usual piston rings 5*c* may be employed to assure a tight fit.

For operating the power hammer motive fluid is supplied to the cylinder 4. The power hammer disclosed herein is adapted to be operated by any suitable motive fluid such as steam or compressed air.

Timed movement of a valve (not shown), more fully described in my prior aforementioned patent, controls the fluid to the upper cylinder so that during the entire cycle fluid will be supplied at full pressure below the piston, and will be supplied at the same or full pressure above the piston during the cushioning period of upstroke and accelerating period of the downstroke. As the piston 5 reaches its lowermost position or position of impact, as illustrated by the solid lines of FIG. 1, the motive fluid in the cylinder above the piston is exhausted to atmosphere or otherwise. Fluid will again be admitted to the cylinder above the piston appreciably before the end of its upstroke, illustrated in phantom in FIG. 1. The purpose of admitting this fluid is to allow it to act as a cushion for the accelerating piston. Moreover, the motive fluid thereafter remains in the chamber above the piston during the downstroke so that the energy of this fluid is superimposed upon the dead weight of the ram, piston and connecting rod during the downward or power stroke of the hammer. The housing 1 is provided with a plurality of ram guides 20 which cooperate with vertical slots 21 in the ram 6 to guide the ram for vertical movement in the housing 1. To receive the force of the pile driving blows of the hammer 6, there is provided an anvil 22 which is loosely positioned at the lower end of the hammer through a flexible cable or chain 23 which tie the anvil 22 to the housing 1.

To connect the piston member 5 and connecting rod 7, the piston member 5 is provided with a slot 5*d* at its lower end for the reception of the connecting rod 7. The slot 5*d* is generally T-shaped and comprises generally a neck or narrow outer slot 5*e* communicating with

a wider inner slot 5*f* of trapezoidal shape, the side walls 5*g* of which are inclined toward each other away from the narrow slot 5*e*. The connecting rod 7 has a generally complementary T-shaped tongue 7*a* including a narrow portion 7*b* having substantially parallel sides, and a generally trapezoidal cam portion 7*c* having sides 7*d* thereof which are inclined toward each other away from the body of the connecting rod 7. While the tongue 7*a* is generally complementary to the T-slot 5*d*, sufficient clearance is provided between the sides of the tongue and the sides of the T-slot so that the connecting rod 7 and piston member 5 may tolerate a small amount of misalignment. Misalignment between the connecting rod 7 and piston member 5 in the longitudinal direction of the slot and tongue is provided for by relative longitudinal displacement of the tongue 7*a* with respect to the T-slot 5*d*.

To secure the connecting rod 7 to the ram 6, the ram 6 is provided with a central aperture 6*a* of slightly smaller diameter than the cooperating portion of the connecting rod 7. The cooperating portion of the connecting rod 7 comprises a cylindrical section 7*e* slightly larger than the diameter of the aperture 6*a*, which is an interference fit with the ram 6; the ram 6 is pressed or shrunk on the section 7*e*.

In operation, the piston 5, connecting rod 7, and ram 6 are raised vertically upwardly from the position shown in solid lines in FIG. 1 to the position shown in phantom in FIG. 1 due to the pressure exerted by the motive fluid on the underside of piston 5*a*. Just before the assembly reaches its uppermost position, motive fluid is permitted to enter the upper portion of the cylinder above piston 5*a* thereby cushioning the movement of the assembly. This pressure, along with the dead weight of the assembly, will force the ram 6, connecting rod 7, and piston member 5 to exert a downwardly directed blow on the anvil 22, which, in turn, will transmit the blow to a pile (not shown).

While the hammer disclosed herein is designed principally as a power pile driver, it is equally applicable for analogous purposes, as, for example, where a percussive blow is used, such as in rock drilling, riveting machines, concrete breaking or tamping or the like. Moreover, the present invention has particular applicability to sub-aqueous or closed type of power hammers, since the enclosed type of power hammers have been subjected to particular difficulties with the prior known connections, as enumerated above. While the applicant has illustrated and described a single preferred embodiment of his invention, it is understood that it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

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

1. A power hammer comprising a cylinder member, a piston member operating in said cylinder member and having a slot in one end thereof, means for supplying motive fluid to said cylinder to operate said piston, a ram, and a connecting rod member having a complementary tongue at one end loosely positioned in said slot providing clearance between the sides of said tongue and said slot to allow for slight misalignment between the piston member and the connecting rod member and having its other end secured to said ram.

2. A power hammer comprising a cylinder member, a piston member operating in said cylinder member and having a T-slot in one end thereof, means for supplying motive fluid to said cylinder to operate said piston, a ram, and a connecting rod member having a T-shaped tongue at one end loosely positioned in said T-slot providing clearance between the sides of said T-shaped tongue and said T-slot to allow for slight misalignment between the piston member and the connecting rod member and having its other end secured to said ram.

3. A power hammer as set forth in claim 2 above wherein said ram is provided with a central aperture and said connecting rod contains a cylindrical section at its other end slightly larger in diameter than said aperture and positioned in said aperture in interfering fit therewith.

4. A pile driving hammer of the closed type comprising a housing, a fluid cylinder member within said housing, a fluid piston member operatively positioned in said cylinder member and having a T-slot in its lower end, guide means in said housing, a ram vertically reciprocally movable on said guide means and provided with a central aperture opening upwardly, a connecting rod having a T-shaped tongue at one end thereof loosely positioned within said T-slot and having a cylindrical section at its other end thereof of slightly greater diameter than said aperture and positioned within said aperture thereby forming a tight interfering fit with said ram, and means for supplying motive fluid to said cylinder to operate said piston so that said ram, connecting rod and piston are effective to produce power blows, and an anvil positioned to receive said blows and transmit said blows to a pile.

5. A pile driving hammer as set forth in claim 4 above wherein said hammer is of the double acting type.

6. A pile driving hammer of the closed type comprising a housing, a fluid cylinder member within said housing, a fluid piston member operatively positioned in said cylinder member and having a slot in its lower end, guide means in said housing, a ram vertically reciprocally movable on said guide means and provided with a central aperture opening upwardly, a connecting rod having a complementary tongue at one end thereof loosely positioned within said slot and having a cylindrical section at its other end thereof of slightly greater diameter than said aperture and positioned within said aperture thereby forming a tight interfering fit with said ram, and means for supplying motive fluid to said cylinder to operate said piston so that said ram, connecting rod and piston are effective to produce power blows, and an anvil positioned to receive said blows and transmit said blows to a pile.

7. A piston and rod connection for use in a power hammer of the type including a piston member operating in a cylinder member with means for supplying motive fluid to the cylinder to operate the piston, a ram provided with a central aperture, and a connecting rod member having one end slightly larger in diameter than the aperture and positioned within said aperture in interfering fit therewith, said connection comprising a T-shaped tongue formed at the other end of said connecting rod member and positioned in a T-slot in one end of said piston member.

8. A piston and rod connection as set forth in claim 7 above wherein clearance exists between the sides of the T-shaped tongue and the T-slot to allow for slight misalignment between the piston member and the connecting rod member and wherein said tongue can move longitudinally in said slot to provide for misalignment between said connecting rod member and said piston member in a longitudinal direction.

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