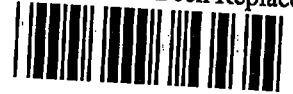


HYDRAULIC HAMMERS

This Sheet Has Been Replaced



This invention relates to a hammer device.

5 Hammer devices in the nature of pile drivers are used to drive piles into the ground by repeated application of largely vertical forces. A substantial weight may be repeatedly lifted and dropped onto the pile for this purpose.

An object of the invention is to provide a hammer device which is convenient and
10 efficient in use.

According to the present invention there is provided a hammer device for driving piles, comprising support structure, a hammer element mounted for reciprocatory movement towards and away from one end of the support structure and movement means
15 interconnecting the hammer element and support structure for moving the hammer element away from said one end and releasing the hammer element whereby, in use, with said one end of the support structure positioned adjacent an upper end of the pile, the hammer element may be lifted away from said one end by operation of the movement means such that, on subsequent operation of the movement means to release the hammer
20 element, the hammer element falls under gravity to impact at said one end of the support structure for imparting a driving force to the pile.

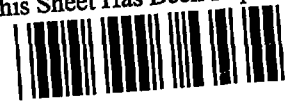
The movement means may be in the form of a hydraulically actuatable extensible link. There may be a plurality of such links. In particular, the movement means
25 preferably comprises one or more hydraulic rams.

The hammer device preferably has a guide member engageable with an upright guide for guiding the hammer device when positioning it for use above a pile to be driven.

30

The support structure may be in the form of a substantially enclosed hollow

THIS SHEET HAS BEEN
REPLACED



cylinder, the hammer element extending from a first end closest said one end of the cylinder to a remote end of the hammer element and being mounted within the cylinder for said reciprocatory movement in the lengthwise direction of the cylinder.

5 Preferably, too, the movement means is positioned within the cylinder.

The hammer element may itself be generally cylindrical, and guide means may be provided within the cylinder for guiding the hammer element during said reciprocatory movement. The guide means may comprise lengthwise extending elements on the
10 internal periphery of the cylinder engageable within lengthwise extending grooves in the hammer element. The guide elements may have removable lengthwise extending wear plates. The wear elements may be of generally L-shaped cross-section, having opposed side surfaces for engagement with side surfaces of a respective said groove and an outer transverse edge portion engageable with an inner edge of the respective groove.

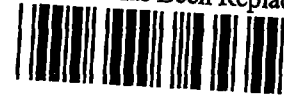
15

The cylinder may have, at the one end of the support structure, a pile engaging member, adapted to engage the upper end of a pile. The pile engaging member may be cup shaped for purposes of retention of the end of the pile therein. Preferably the engaging member is slidable in the direction of reciprocation of the hammer element.

20

There is preferably provided an impact structure, positioned between said engaging member and said first end of said hammer element. The impact structure may include shock absorbent material. Preferably, the impact structure is provided within an end member located at said one end of the cylinder, which end member is secured to the
25 cylinder, said end member carrying the engaging member.

Preferably the impact structure and engaging member are slidably retained in a space defined at said one end of the support structure. The space may be defined within a retaining structure at said one end of the support structure. The engaging member may
30 extend from an opening at one end of the retaining structure, the impact structure being positioned between the engaging member and an opposite end of the retaining structure.



Cushioning means may be provided within the retaining structure at said opposite end, and engageable by the impact structure when it is moved to said opposite end.

Resilient stop means may be provided at said one end of said support structure,
5 for engagement by the hammer element at its extreme of movement towards said one end.

The or each extensible link may be accommodated in a respective lengthwise extending groove in the outer periphery of the hammer element.

10

The hammer device may be provided with means for interconnecting the support structure with lifting means to enable the hammer device to be lifted and placed in position for pile driving.

15

The support structure may be in the form of a hammer cage.

The invention also provides pile driving apparatus including lifting structure from which the hammer device above described is suspended, arranged whereby the hammer device may be lifted by the lifting structure and then lowered into position on a pile.

20

The pile driving apparatus may comprise a movable unit which carries the lifting structure.

The invention is further described by way of example only with reference to the
25 accompanying drawings in which:

Figure 1 is a diagrammatic view of a pile driving apparatus including a hammer device constructed in accordance with the invention;

Figure 2 is an axial cross-section of the hammer device shown in Figure 1; and

Figure 3 is a transverse cross-section of the hammer device of Figure 1.

30

The pile driving apparatus 10 shown in Figure 1 includes an integrated power unit

12 drivable over a ground surface 16. Power unit 12 carries an upstanding leader 18 which is positionable at a desired vertical orientation by operation of hydraulic rams 20. At the upper end of leader 18, there is provided a top sheave 22. A hammer device 40 constructed in accordance with the invention is suspended from the leader 18 by cabling 5 26 which extends around the top sheave 22 and a lifting block 24 connected to upstanding lugs 30 at the top of the hammer device 40. The lower end of the hammer device is engageable with the upper end of the pile 32, by suitable positioning of the unit 12, operation of the rams 20, and manipulation of the cable suspension provided by the cabling 26 and sheaves 22, 24. The hammer device 40 is guided in this movement by 10 engagement between sidewardly extending guide members 42 on the hammer device 40 and guide tracks 45 on leader 18.

Turning now to Figures 2 and 3, the hammer device 40 is shown as including a support structure in the form of a hammer cage 46. Hammer cage 46 includes a hollow 15 cylinder 48 closed at its upper end by an end plate 50 which carries the lugs 30. The hammer cage is rigidly designed to be strong and sound proof.

A hammer element 64 of elongate cylindrical configuration is coaxially arranged within cage 46, so as to be slidable lengthwise therewithin. This is formed for example 20 of forged steel, in any event having substantial mass, such as 7,000 to 12,000 kilograms. The outer diameter of the hammer element 64 is less than the inner diameter of the cylinder 48, by a small amount sufficient to provide free sliding clearance.

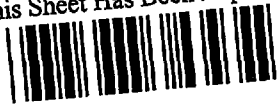
25 The hammer cage 46 may substantially enclose the hammer element 64.

There are two grooves 66 formed at diametrically opposed locations on hammer element 64. These extend lengthwise of the hammer element 64, from the lower end thereof to a location somewhat short of the upper end of the hammer element 64. Extensible hydraulic rams 68 are accommodated within these grooves, each having the 30 cylinder thereof secured to the inner surface of cylinder 48 by lugs 49 and the piston secured to the hammer element 64.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED



There is a retaining structure 52 at the lower end of cylinder 48. This includes an annular plate 54 secured to the lower end of cylinder 48, and a hollow cylindrical end member 55 bolted to the underside of plate 54. Within end member 55 at its lower end there is provided a downwardly depending generally cup shaped engaging member 56 which projects below the lower end of end member 55. Engaging member 56 is retained in position by an annular plate 58 which forms part of retaining structure 52 and is bolted to the underside of the member 55. In the space between the upper end of engaging member 56 and the underside of plate 54, there is provided an impact structure 60, formed of impact absorbent material and steel and having a central circular resilient cushion 62 formed for example of ropes and timber and centrally positioned on the upper side of the impact structure 60. Impact structure 60 also includes a circular lower resilient cushion 63 at its underside.

An annular rubber shock absorbing ring 79 is also provided in space 81, at the underside of plate 54. Both engaging member 56 and impact structure 60 are axially slidable in space 81. Downwards movement of engaging member 56 is limited by engagement of an outstanding peripheral rim 59 at the upper end of the engaging member. Upward movement of both is limited by engagement of cushioning structure 60 with ring 79.

20

By extending the rams 68 by application of pressurised hydraulic fluid thereto, the hammer element 64 may be raised from the position shown in solid lines Figure 1 to an upper position, shown by phantom lines 65 in Figure 2, at which the upper end of the hammer element 64 is held adjacent the upper end of cylinder 48. By release of fluid pressure within the rams 68 and egress of hydraulic fluid from the rams 68, this holding is released to allow the hammer element 64 to fall. Falling is arrested when a reduce diameter lower end portion 70 of the hammer element 64 passes through a central opening 72 in plate 54 to impact upon cushion 62 or when a shoulder 67 of the hammer element 64 engages a steel stopper 69 at the lower end of cylinder 48. In any event, arrest of downward motion of the hammer element 64 causes a blow to be delivered to the upper end of the pile 32 accommodated by engaging member 56. The force



generated is transmitted to the engaging member 56 via the impact structure 60 and thence to the pile. Shock arising from any upwards re-bounce of the impact structure 60 and engaging member 56 is absorbed by engagement of the impact structure with the ring 79.

5

In addition to the lengthwise extending grooves 66, hammer element 64 also has two further grooves 74 in the periphery thereof, these extending lengthwise from end to end of the hammer element 64. Lengthwise extending guide elements 76 are affixed to the inner periphery of the cylinder 48, and these project into the grooves 74 for the purpose of guiding the hammer element 64 in its sliding movement within the cage 46. As shown in Figure 3, elements 76 each comprise an inner generally rectangularly sectioned lengthwise extending guide portion 78 having a generally L-shaped wear element 80 secured thereto by bolts 82. The wear elements 80 each have side portions 84 which engage with adjacent sides of the respective groove 74 and an outer end portion 86 which engages with the inner transverse surface of the respective groove 74.

Further guide elements 85 for hammer element 64 are provided within cylinder 48. These are positioned on internal hollow reinforcement bars 90 which extend lengthwise of the cylinder 48 on the inner surface of an outer wall of the cylinder.

20

The guide members 42 are affixed at upper and lower locations to the side of cage 46. As particularly shown in Figure 3, each has a pair of opposed hook portions 83 which engage over the guide tracks 45.

By repeated operation of the rams 68, that is by application of pressurised hydraulic fluid thereto, to lift the hammer element 64, and by subsequent release of hydraulic pressure in the rams, to permit the fluid to escape therefrom, the hammer element 64 is repeatedly lifted and allowed to fall to deliver blows to the pile 32 for driving it into the ground. The operation of the hydraulic rams to effect this may be controlled by a suitable electrical control system which is, for example, effective to control the rate of delivery of blows and the height to which the hammer element 64 is

30

in each case lifted before release.

The described device 40 has been found particularly satisfactory in use. The enclosure of the hammer element 64 ensures safe and convenient operation. Noise is
5 lessened, and it is possible to effect precise control of the rate of progress of the driving.

The arrangement of the slidable impact structure 60 within the space 81 enclosed by retaining structure 52 bounded at the lower end by the slidable engaging member 56 and at the upper end by the rubber shock absorbing ring 79 has been found to be
10 particularly effective.

The described construction has been advanced merely by way of explanation, and many modifications and variations may be made thereto without departing from the spirit and scope of the invention which includes every novel feature and combination of
15 features herein disclosed.

This Sheet Has Been Replaced



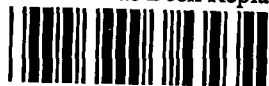
THIS SHEET HAS BEEN
REPLACED

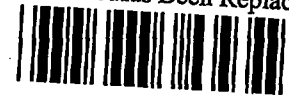
CLAIMS:



1. A hammer device for driving piles, comprising support structure, a hammer element mounted for reciprocatory movement towards and away from one end of the support structure and movement means interconnecting the hammer element and support structure for moving the hammer element away from said one end and releasing the hammer element whereby, in use, with said one end of the support structure positioned adjacent an upper end of the pile, the hammer element may be lifted away from said one end by operation of the movement means such that, on subsequent operation of the movement means to release the hammer element, the hammer element falls under gravity to impact at said one end of the support structure for imparting a driving force to the pile.
2. A hammer device as claimed in claim 1 wherein the movement means comprises a hydraulically actuatable extensible link.
3. A hammer device as claimed in claim 2 wherein the movement means comprises one or more hydraulic rams.
4. A hammer device as claimed in any preceding claim having a guide member engageable with an upright guide for guiding the hammer device when positioning it for use above a pile to be driven.
5. A hammer device as claimed in any preceding claim wherein the support structure is in the form of a substantially enclosed hollow cylinder, the hammer element extending from a first end closest said one end to a remote end of the hammer element and being mounted within the cylinder for said reciprocatory movement in the lengthwise direction of the cylinder.
6. A hammer device as claimed in claim 5 wherein the movement means is positioned within the cylinder.

This Sheet Has Been Replaced

THIS SHEET HAS BEEN
REPLACED



7. A hammer device as claimed in any preceding claim wherein the hammer element is generally cylindrical and guide means is provided within the cylinder for guiding the hammer element during said reciprocatory movement.
- 5 8. A hammer device as claimed in claim 7 wherein said guide means comprises lengthwise extending elements on the internal periphery of the cylinder engageable within lengthwise extending grooves in the hammer element.
9. A hammer device as claimed in claim 8 wherein the guide means comprises
10 removable lengthwise extending wear plates.
10. A hammer device as claimed in claim 9 wherein the wear plates are of generally U-shaped cross-section, having opposed side surfaces for engagement with side surfaces of a respective said groove and an outer transverse edge portion engageable with an inner
15 edge of the respective groove.
11. A hammer device as claimed in claim 10 wherein at the one end of the support structure there is provided a pile engaging member, adapted to engage the upper end of a pile.
20
12. A hammer device as claimed in claim 11 wherein the engaging member is slidable in the direction of reciprocation of the hammer element.
13. A hammer device as claimed in claim 12 wherein an impact structure is positioned
25 between said engaging member and said first end of said hammer element.
14. A hammer device as claimed in claim 13 wherein the impact structure includes shock absorbent material.
- 30 15. A hammer device as claimed in claim 13 or claim 14 wherein the impact structure is provided within an end member located at said one end of the support structure, which





end member is secured to the cylinder, said end member carrying the engaging member.

16. A hammer device as claimed in any one of claims 12 to 14 wherein the impact structure and engaging member are slidably retained in space defined at said one end of
5 the support structure.

17. A hammer device as claimed in claims 16 wherein said space is defined within a retaining structure at said one end of the support structure.

10 18. A hammer device as claimed in claim 17 wherein the engaging member extends from an opening at one end of the retaining structure, the impact structure being positioned between the engaging member and an opposite end of the retaining structure.

19. A hammer device as claimed in claim 18 including cushioning means is provided
15 within the retaining structure at said opposite end and engageable by the impact structure when it is moved to said opposite end.

20. A hammer device as claimed in any preceding claim wherein resilient means is provided at said one end of said support structure, for engagement by the hammer
20 element at its extreme of movement towards said one end.

21. A hammer device as claimed in any preceding claim having means for interconnecting the support structure with lifting means to enable the hammer device to be lifted and placed in position for pile driving.

25

22. A hammer device as claimed in any preceding claim wherein said support structure is formed as a hammer cage.

23. A hammer device as claimed in any preceding claim wherein the support structure
30 substantially totally encloses the hammer element.





24. A pile driving apparatus including lifting structure from which the hammer device as claimed in claim 21 is suspended, arranged whereby the hammer device may be lifted by the lifting structure and then lowered into position on a pile.
- 5 25. A hammer pile driving apparatus as claimed in claim 24 comprising a movable unit which carries the lifting structure.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

ABSTRACT

A hammer device for driving piles, having a hammer element (64) mounted within a hammer cage (46) for reciprocatory movement. Hydraulic rams (68) are provided in the hammer cage (46) interconnecting the hammer element (14) and hammer cage (46) for moving the hammer element (14) away from one end of the hammer cage (46) and releasing the hammer element (64) whereby, on release, the hammer element (64) falls under gravity to effect driving of the pile.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED

FIG 1

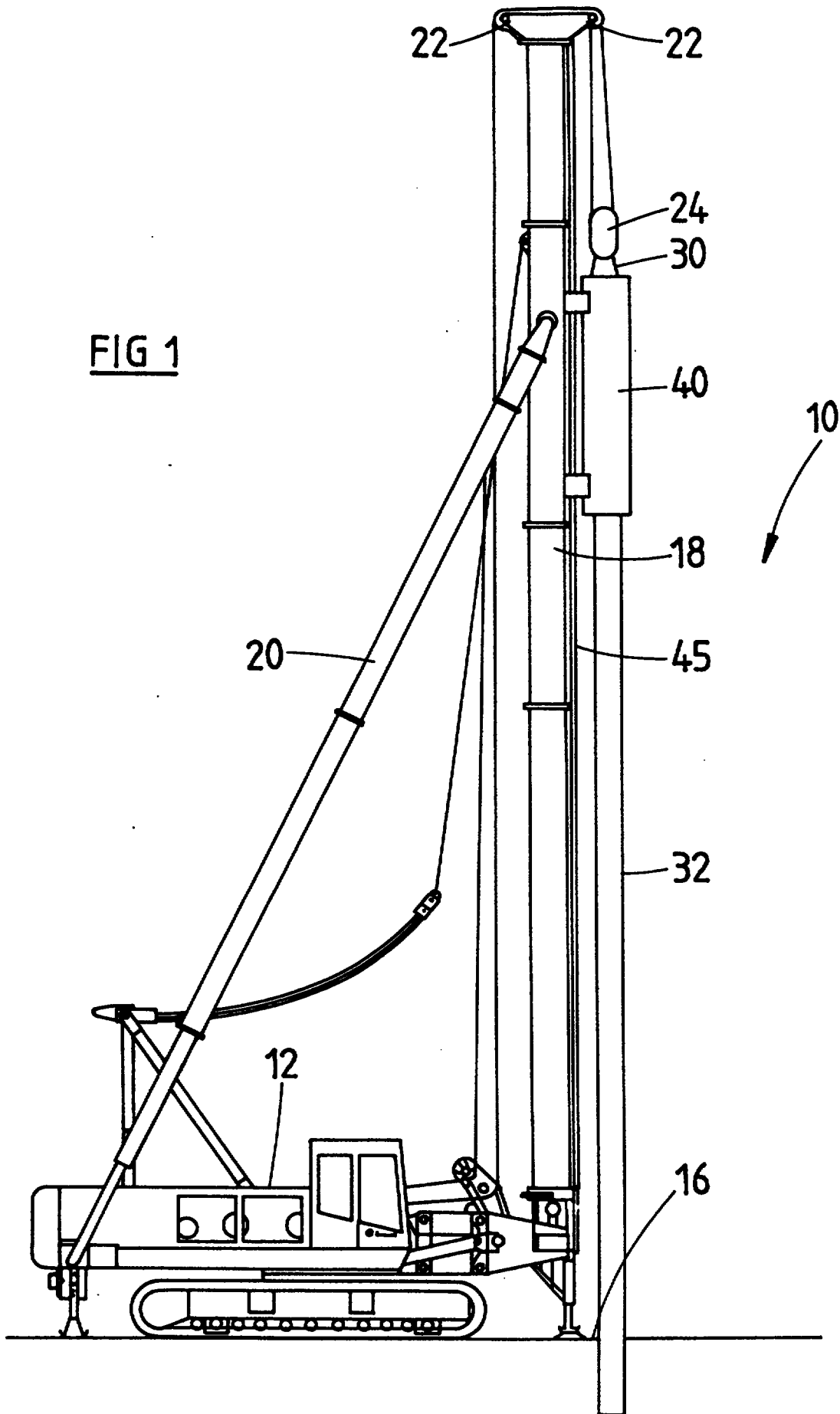


FIG 2

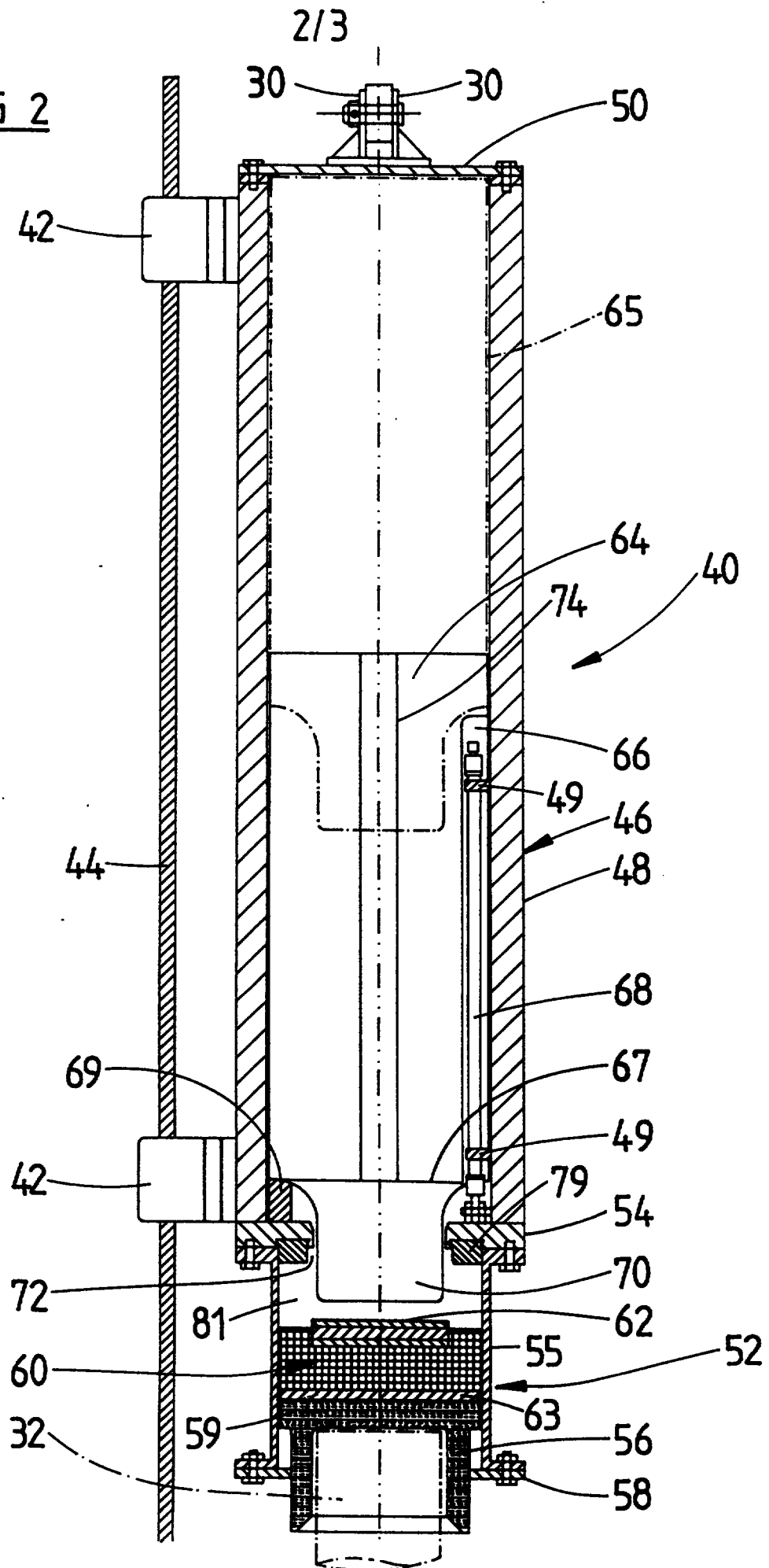
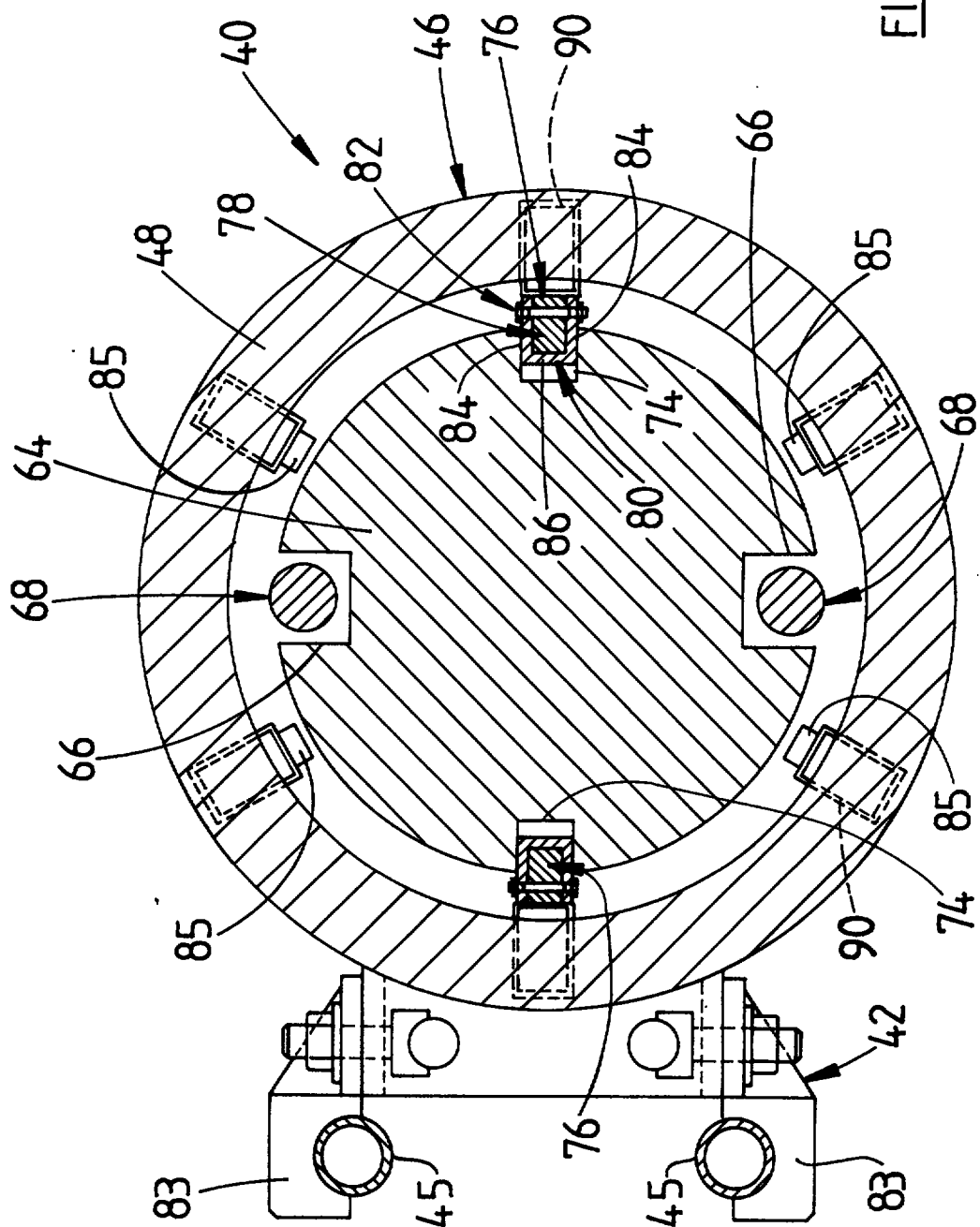
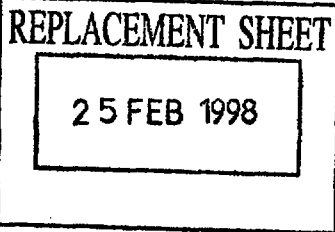


FIG 3



9704313-7



12

25 FEB 1998

HYDRAULIC HAMMERS

ABSTRACT

5 A hammer device for driving piles, having a hammer element (64) mounted within a hammer cage (46) for reciprocatory movement. Hydraulic rams (68) are provided in the hammer cage (46) interconnecting the hammer element (14) and hammer cage (46) for moving the hammer element (14) away from one end of the hammer cage (46) and releasing the hammer element (64) whereby, on release, the hammer element (64) falls under gravity to effect driving of the pile.

Fig 1

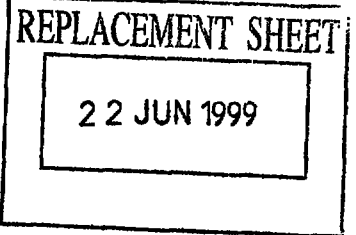
This Sheet Has Been Replaced



22 Jun 1999

-1-

HAMMER DEVICE



This invention relates to a hammer device.

5 Hammer devices in the nature of pile drivers are used to drive piles into the ground by repeated application of largely vertical forces. A substantial weight may be repeatedly lifted and dropped onto the pile for this purpose.

10 An object of the invention is to provide a hammer device which is convenient and efficient in use.

According to the present invention there is provided a hammer device for driving piles, including a support structure, a hammer element which is generally cylindrical mounted for reciprocatory movement towards and away from one end of the support structure, guide means provided within said support structure for guiding the hammer element during said reciprocating movement and movement means interconnecting the hammer element and support structure for moving the hammer element away from said one end and releasing the hammer element whereby, in use, with said one end of the support structure positioned adjacent an upper end of the pile, the hammer element may be lifted away from said one end by operation of the movement means such that, on subsequent operation of the movement means to release the hammer element, the hammer element falls under gravity to impact at said one end of the support structure for imparting a driving force to the pile and wherein said guide means includes lengthwise extending elements on an internal periphery of said support structure engageable within
25 lengthwise extending grooves in the hammer element.

The movement means may be in the form of a hydraulically actuatable extensible link. There may be a plurality of such links. In particular, the movement means preferably comprises one or more hydraulic rams.

30

The hammer device preferably has a guide member engageable with an upright

guide for guiding the hammer device when positioning it for use above a pile to be driven.

5 The support structure may be in the form of a substantially enclosed hollow cylinder, the hammer element extending from a first end closest said one end of the cylinder to a remote end of the hammer element and being mounted within the cylinder for said reciprocatory movement in the lengthwise direction of the cylinder.

10 Preferably, too, the movement means is positioned within the cylinder.

The hammer element may itself be generally cylindrical, and guide means may be provided within the cylinder for guiding the hammer element during said reciprocatory movement. The guide means may comprise lengthwise extending elements on the internal periphery of the cylinder engageable within lengthwise extending grooves in the
15 hammer element. The guide elements may have removable lengthwise extending wear plates. The wear elements may be of generally L-shaped cross-section, having opposed side surfaces for engagement with side surfaces of a respective said groove and an outer transverse edge portion engageable with an inner edge of the respective groove.

20 The cylinder may have, at the one end of the support structure, a pile engaging member, adapted to engage the upper end of a pile. The pile engaging member may be cup shaped for purposes of retention of the end of the pile therein. Preferably the engaging member is slidable in the direction of reciprocation of the hammer element.

25 There is preferably provided an impact structure, positioned between said engaging member and said first end of said hammer element. The impact structure may include shock absorbent material. Preferably, the impact structure is provided within an end member located at said one end of the cylinder, which end member is secured to the cylinder, said end member carrying the engaging member.

30

Preferably the impact structure and engaging member are slidably retained in a

space defined at said one end of the support structure. The space may be defined within a retaining structure at said one end of the support structure. The engaging member may extend from an opening at one end of the retaining structure, the impact structure being positioned between the engaging member and an opposite end of the retaining structure.

- 5 Cushioning means may be provided within the retaining structure at said opposite end, and engageable by the impact structure when it is moved to said opposite end.

Resilient stop means may be provided at said one end of said support structure, for engagement by the hammer element at its extreme of movement towards said one end.

10

The or each extensible link may be accommodated in a respective lengthwise extending groove in the outer periphery of the hammer element.

- 15 The hammer device may be provided with means for interconnecting the support structure with lifting means to enable the hammer device to be lifted and placed in position for pile driving.

The support structure may be in the form of a hammer cage.

- 20 The invention also provides pile driving apparatus including lifting structure from which the hammer device above described is suspended, arranged whereby the hammer device may be lifted by the lifting structure and then lowered into position on a pile.

- 25 The pile driving apparatus may comprise a movable unit which carries the lifting structure.

The invention is further described by way of example only with reference to the accompanying drawings in which:

- 30 Figure 1 is a diagrammatic view of a pile driving apparatus including a hammer device constructed in accordance with the invention;

Figure 2 is an axial cross-section of the hammer device shown in Figure 1; and

22 JUN 1999

-4-

Figure 3 is a transverse cross-section of the hammer device of Figure 1.

The pile driving apparatus 10 shown in Figure 1 includes an integrated power unit 12 drivable over a ground surface 16. Power unit 12 carries an upstanding leader 18 which is positionable at a desired vertical orientation by operation of hydraulic rams 20. At the upper end of leader 18, there is provided a top sheave 22. A hammer device 40 constructed in accordance with the invention is suspended from the leader 18 by cabling 26 which extends around the top sheave 22 and a lifting block 24 connected to upstanding lugs 30 at the top of the hammer device 40. The lower end of the hammer device is engageable with the upper end of the pile 32, by suitable positioning of the unit 12, operation of the rams 20, and manipulation of the cable suspension provided by the cabling 26 and sheaves 22, 24. The hammer device 40 is guided in this movement by engagement between sidewardly extending guide members 42 on the hammer device 40 and guide tracks 45 on leader 18.

Turning now to Figures 2 and 3, the hammer device 40 is shown as including a support structure in the form of a hammer cage 46. Hammer cage 46 includes a hollow cylinder 48 closed at its upper end by an end plate 50 which carries the lugs 30. The hammer cage is rigidly designed to be strong and sound proof.

A hammer element 64 of elongate cylindrical configuration is coaxially arranged within cage 46, so as to be slidable lengthwise therewithin. This is formed for example of forged steel, in any event having substantial mass, such as 7,000 to 12,000 kilograms. The outer diameter of the hammer element 64 is less than the inner diameter of the cylinder 48, by a small amount sufficient to provide free sliding clearance.

The hammer cage 46 may substantially enclose the hammer element 64.

There are two grooves 66 formed at diametrically opposed locations on hammer element 64. These extend lengthwise of the hammer element 64, from the lower end thereof to a location somewhat short of the upper end of the hammer element 64.

22 JUN 1999

-5-

Extensible hydraulic rams 68 are accommodated within these grooves, each having the cylinder thereof secured to the inner surface of cylinder 48 by lugs 49 and the piston secured to the hammer element 64.

5 There is a retaining structure 52 at the lower end of cylinder 48. This includes an annular plate 54 secured to the lower end of cylinder 48, and a hollow cylindrical end member 55 bolted to the underside of plate 54. Within end member 55 at its lower end there is provided a downwardly depending generally cup shaped engaging member 56 which projects below the lower end of end member 55. Engaging member 56 is retained
10 in position by an annular plate 58 which forms part of retaining structure 52 and is bolted to the underside of the member 55. In the space between the upper end of engaging member 56 and the underside of plate 54, there is provided an impact structure 60, formed of impact absorbent material and steel and having a central circular resilient cushion 62 formed for example of ropes and timber and centrally positioned on the upper
15 side of the impact structure 60. Impact structure 60 also includes a circular lower resilient cushion 63 at its underside.

An annular rubber shock absorbing ring 79 is also provided in space 81, at the underside of plate 54. Both engaging member 56 and impact structure 60 are axially
20 slidable in space 81. Downwards movement of engaging member 56 is limited by engagement of an outstanding peripheral rim 59 at the upper end of the engaging member. Upward movement of both is limited by engagement of cushioning structure 60 with ring 79.

25 By extending the rams 68 by application of pressurised hydraulic fluid thereto, the hammer element 64 may be raised from the position shown in solid lines in Figure 2 to an upper position, shown by phantom lines 65 in Figure 2, at which the upper end of the hammer element 64 is held adjacent the upper end of cylinder 48. By release of fluid pressure within the rams 68 and egress of hydraulic fluid from the rams 68, this holding
30 is released to allow the hammer element 64 to fall. Falling is arrested when a reduce diameter lower end portion 70 of the hammer element 64 passes through a central

22 JUN 1999

-6-

opening 72 in plate 54 to impact upon cushion 62 or when a shoulder 67 of the hammer element 64 engages a steel stopper 69 at the lower end of cylinder 48. In any event, arrest of downward motion of the hammer element 64 causes a blow to be delivered to the upper end of the pile 32 accommodated by engaging member 56. The force generated is transmitted to the engaging member 56 via the impact structure 60 and thence to the pile. Shock arising from any upwards re-bounce of the impact structure 60 and engaging member 56 is absorbed by engagement of the impact structure with the ring 79.

In addition to the lengthwise extending grooves 66, hammer element 64 also has two further grooves 74 in the periphery thereof, these extending lengthwise from end to end of the hammer element 64. Lengthwise extending guide elements 76 are affixed to the inner periphery of the cylinder 48, and these project into the grooves 74 for the purpose of guiding the hammer element 64 in its sliding movement within the cage 46. As shown in Figure 3, elements 76 each comprise an inner generally rectangularly sectioned lengthwise extending guide portion 78 having a generally U-shaped wear element 80 secured thereto by bolts 82. The wear elements 80 each have side portions 84 which engage with adjacent sides of the respective groove 74 and an outer end portion 86 which engages with the inner transverse surface of the respective groove 74.

Further guide elements 85 for hammer element 64 are provided within cylinder 48. These are positioned on internal hollow reinforcement bars 90 which extend lengthwise of the cylinder 48 on the inner surface of an outer wall of the cylinder.

The guide members 42 are affixed at upper and lower locations to the side of cage 46. As particularly shown in Figure 3, each has a pair of opposed hook portions 83 which engage over the guide tracks 45.

By repeated operation of the rams 68, that is by application of pressurised hydraulic fluid thereto, to lift the hammer element 64, and by subsequent release of hydraulic pressure in the rams, to permit the fluid to escape therefrom, the hammer element 64 is repeatedly lifted and allowed to fall to deliver blows to the pile 32 for

22 JUN 1999

-7-

driving it into the ground. The operation of the hydraulic rams to effect this may be controlled by a suitable electrical control system which is, for example, effective to control the rate of delivery of blows and the height to which the hammer element 64 is in each case lifted before release.

5

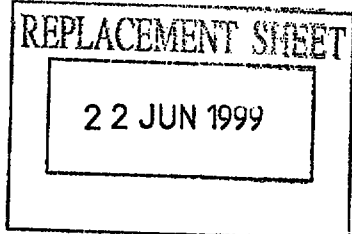
The described device 40 has been found particularly satisfactory in use. The enclosure of the hammer element 64 ensures safe and convenient operation. Noise is lessened, and it is possible to effect precise control of the rate of progress of the driving.

10

The arrangement of the slidable impact structure 60 within the space 81 enclosed by retaining structure 52 bounded at the lower end by the slidable engaging member 56 and at the upper end by the rubber shock absorbing ring 79 has been found to be particularly effective.

15

The described construction has been advanced merely by way of explanation, and many modifications and variations may be made thereto without departing from the spirit and scope of the invention which includes every novel feature and combination of features herein disclosed.



CLAIMS:

1. A hammer device for driving piles, including a support structure, a hammer element which is generally cylindrical mounted for reciprocatory movement towards and
5 away from one end of the support structure, guide means provided within said support structure for guiding the hammer element during said reciprocating movement and movement means interconnecting the hammer element and support structure for moving the hammer element away from said one end and releasing the hammer element whereby, in use, with said one end of the support structure positioned adjacent an upper end of the
10 pile, the hammer element may be lifted away from said one end by operation of the movement means such that, on subsequent operation of the movement means to release the hammer element, the hammer element falls under gravity to impact at said one end of the support structure for imparting a driving force to the pile and wherein said guide means includes lengthwise extending elements on an internal periphery of said support
15 structure engageable within lengthwise extending grooves in the hammer element.
2. A hammer device as claimed in claim 1 wherein the movement means comprises a hydraulically actuatable extensible link.
- 20 3. A hammer device as claimed in claim 2 wherein the movement means comprises one or more hydraulic rams.
4. A hammer device as claimed in any preceding claim having a guide member engageable with an upright guide for guiding the hammer device when positioning it for
25 use above a pile to be driven.
5. A hammer device as claimed in any preceding claim wherein the support structure is in the form of a substantially enclosed hollow cylinder, the hammer element extending from a first end closest said one end to a remote end of the hammer element and being
30 mounted within the cylinder for said reciprocatory movement in the lengthwise direction of the cylinder.



6. A hammer device as claimed in claim 5 wherein the movement means is positioned within the cylinder.

7. A hammer device as claimed in claims 1 or 6 wherein the guide means includes
5 removable lengthwise extending wear plates.

8. A hammer device as claimed in claim 7 wherein the wear plates are of generally U-shaped cross-section, having opposed side surfaces for engagement with side surfaces of a respective said groove and an outer transverse edge portion engageable with an inner
10 edge of the respective groove.

9. A hammer device as claimed in claim 8 wherein at the one end of the support structure there is provided a pile engaging member, adapted to engage the upper end of a pile.
15

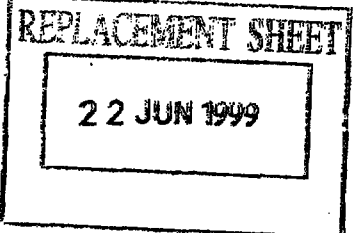
10. A hammer device as claimed in claim 9 wherein the engaging member is slidable in the direction of reciprocation of the hammer element.

11. A hammer device as claimed in claim 10 wherein an impact structure is positioned
20 between said engaging member and said first end of said hammer element.

12. A hammer device as claimed in claim 11 wherein the impact structure includes shock absorbent material.

25 13. A hammer device as claimed in claim 11 or claim 12 wherein the impact structure is provided within an end member located at said one end of the support structure, which end member is secured to the cylinder, said end member carrying the engaging member.

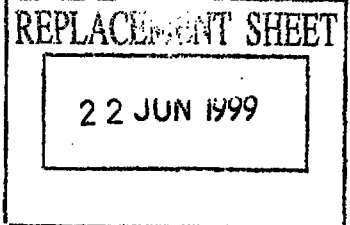
14. A hammer device as claimed in any one of claims 10 to 12 wherein the impact
30 structure and engaging member are slidably retained in space defined at said one end of the support structure.



15. A hammer device as claimed in claims 14 wherein said space is defined within a retaining structure at said one end of the support structure.
16. A hammer device as claimed in claim 15 wherein the engaging member extends from an opening at one end of the retaining structure, the impact structure being positioned between the engaging member and an opposite end of the retaining structure.
17. A hammer device as claimed in claim 16 including cushioning means is provided within the retaining structure at said opposite end and engageable by the impact structure when it is moved to said opposite end.
18. A hammer device as claimed in any preceding claim wherein resilient means is provided at said one end of said support structure, for engagement by the hammer element at its extreme of movement towards said one end.
19. A hammer device as claimed in any preceding claim having means for interconnecting the support structure with lifting means to enable the hammer device to be lifted and placed in position for pile driving.
20. A hammer device as claimed in any preceding claim wherein said support structure is formed as a hammer cage.
21. A hammer device as claimed in any preceding claim wherein the support structure substantially totally encloses the hammer element.
22. A pile driving apparatus including a lifting structure from which the hammer device as claimed in claim 19 is suspended, arranged whereby the hammer device may be lifted by the lifting structure and then lowered into position on a pile.
23. A hammer pile driving apparatus as claimed in claim 22 comprising a movable unit which carries the lifting structure.



HAMMER DEVICE



ABSTRACT

5 A hammer device for driving piles, having a hammer element (64) mounted within a hammer cage (46) for reciprocatory movement. Hydraulic rams (68) are provided in the hammer cage (46) interconnecting the hammer element (14) and hammer cage (46) for moving the hammer element (14) away from one end of the hammer cage (46) and releasing the hammer element (64) whereby, on release, the hammer element (64) falls under gravity to effect driving of the pile.

Figure 1