This invention relates to vibratory and impulse pile drivers and is concerned in particular with pile gripping means associated with such drivers.

According to the invention, pile gripping means forming part of a vibratory or impulse pile driver comprise a grip body with a fixed jaw, and a pivoted jaw rockable towards and away from the fixed jaw by means of fluid pressure application means such as a piston acting in a hydraulic cylinder. The fixed jaw has a flat face but the opposed face of the movable jaw is convex and in this manner, the gripping force exerted by the jaws will increase automatically with the thickness of the sheet pile being gripped as is a benefit of the point of contact on said convex face. Preferably a power unit for supplying pressurised fluid to the hydraulic cylinder is housed within the grip body.

In order that the invention may be clearly understood and readily carried into effect reference is directed to the accompanying drawings wherein:

FIGURE 1 is a perspective view of a mechanical pile driver of a vibratory or impulse type, having secured thereto a pair of pile grips according to the present invention.

FIGURE 2 is a side view partly in section of one of the pile grips of FIGURE 1.

Referring to the drawings, reference numeral 3 indicates the vibratory or impulse pile driver which is itself of conventional form and does not therefore require further particularization. Reference numeral 4 indicates the body of a pile grip secured thereto and reference numeral 5 is a pair of sheet piles being driven, the pile driver 3 being suspended and operated in the usual manner. The body 4 of the grip carries two pile grips arranged in parallel, and indicated by the references A and B in FIG. 1. Each grip includes a fixed clamping jaw 6 and a complementary pivoted yoke arm jaw 7 which is rockable on a pivot pin 8 towards and away from fixed jaw 6 by means of a piston forming part of the jaw 7. The piston is slidable in a hydraulic cylinder 10 integral with the grip body 4. The hydraulic fluid supply to the cylinder is generated by an electric motor 11 driving a pump 14 through V belt 12 and pulleys 13, suitable flow and return pipes to be described in more detail hereinafter being indicated generally by the reference 15. The fluid supply generation means is mounted in the body 4 as will be described hereinafter and is suitably enclosed by a cover 4a.

As has already been mentioned, the pile grips A and B, are arranged in parallel and their respective jaw faces are therefore co-planar to clamp two adjacent piles 5a and 5b that are in communication in known manner. A single pair of jaws may alternatively be provided for certain applications.

Each sheet pile is gripped between the flat face of the anvil jaw 6 and the opposed face of the jaw 7 which has a convex face as shown in the illustrated pile being gripped in a zone C. If a thicker and heavier pile is gripped then the jaws are more widely spaced and a greater clamping force is applied at, say, zone D, since the moment arm of the gripping zone about the pivot 8 is reduced. A hydraulic seal 16 fitted around the piston 9 has a degree of flexibility able to accommodate the very small changes in attitude of the piston in the cylinder due to its rotation about the pivot pin 8 when clamping varying pile sheet thicknesses. In this connection, it will be noted that to minimise the effect of these angular changes on the sealing effect of the ring 16, the ring is located in a plane that is coincident with the axis of the pivot 8.

Since piles are usually driven according to a plan dictated by constructional needs, it is desirable to be able to attach a pile driver to the pile by remote control. To achieve this, one jaw, in this case jaw 6, is made longer than the other so that its protruding part can initially be brought against the top of a pile. On lowering the driver on to the pile the grip will then guide itself into position to clamp the pile. When hydraulic pressure is applied to the piston in the cylinder 10, the jaw 7 is swung towards the jaw 6 and as long as this pressure is maintained the pile is gripped between the clamping jaws.

The pump 14 is mounted inside an oil tank or reservoir 17 the top wall of which serves as a base for the motor 11. The pump outlet is connected to the cylinder 10 through pipe 15a. The outlet is also connected to a bleed valve 18 so that excess pressure fluid is pumped back to the oil tank by escaping through the bleed valve 18 to a pipe 15b. In the illustrated construction, the pipe 15b leads first to a cooling system 19 which is provided if sustained running of the pump is required. A hand-operated relief cock (not shown) is provided in the pipe 15a.

When the motor 11 is switched off compression springs 20 become operative to pull the rockable yoke arm 7 in the counter-clockwise direction sense thereby opening the clamping jaws. Oil in the cylinder 10 is returned to the reservoir by escaping through the bleed valve 18.

When the motor and pump are running, the hydraulic pressure generated is such as to easily overcome the load of the springs 20 and apply the requisite moment to the yoke arm 7 to enable a sheet pile to be securely gripped between the jaws.

The motor 11, pump 14 and tank 17 are assembled as a unit which includes opposed flanges 17a extending from each side of the top of the tank 17. Opposed lugs 22 extend inwardly from the body walls, and through aligned bosses in the flanges and lugs the unit is attached to the body by means of tie bolts 24 and springs 21. The unit is thereby resiliently supported in the vertical direction so that the impulse accelerations of the driver are not freely transmitted to the unit. To steady the unit against transverse movements, swinging link arms 23 are pivoted between the body and the motor casing.

It will be appreciated that the hydraulic pressure for pile gripping is necessarily the equivalent of a static force and although a dynamic system for maintaining this force has been described, an alternative system can be used comprising, for example, a hydraulic accumulator with pressure-sensitive actuation of the pump by the motor. Such a system or other alternative pressurising device may be equally effective for the purpose of the invention and may not need cooling coils.

The illustrated embodiment of the invention provides a pile grip which is self attaching to adjacent sheet steel piles and will withstand vigorous vertical oscillatory forces when used in conjunction with vibratory or impulse pile drivers to which the pile grip is firmly secured.

The dual clamps (one for each pile of a pair being driven) are intended to apply a clamping force large enough to resist sliding.

What I claim and desire to secure by Letters Patent is:

1. Pile gripping means comprising, a body, a first jaw fixed to said body, a pivot on said body, a movable second jaw rotatable on said pivot towards
and away from said first jaw, said first and second jaws having, respectively, a flat gripping face and a convex gripping face thereon, fluid pressure application means located between the second jaw and the body and actuable to away the second jaw relative to the body about said pivot, whereby application of pressure through said means causes the second jaw to approach the first jaw and grip a pile between the jaws at a location radially spaced from the pivot, said convex gripping face being so arranged that said location is relatively near to the pivot for a thick pile section and is relatively distant from the pivot for a thin pile section.

2. Pile gripping means according to claim 1, further comprising mounting means within and supported from said body to carry fluid pressure generation means for said application means, said mounting means comprising respective elements secured to the body and the supply means and an intermediate element connecting said respective elements and permitting resilient movement therebetween about a mean position and in a direction generally in parallel to the extent of the gripping jaw faces.

3. Pile gripping means according to claim 2 wherein said intermediate elements of the mounting means comprise springs between said body and supply means, elements being deformed by said relative movement and said mounting means further including a restraint device connected between the supply means and the body to limit relative movement therebetween transverse to said direction.

4. Pile gripping means according to claim 1 further comprising supply means mounted on said body for said fluid pressure application means, said supply means comprising a fluid reservoir, a pump, a driving motor for said pump and a bleed valve, ducting connecting said reservoir to the pump and the pump to the fluid pressure application means, said bleed valve having an inlet in communication with the ducting from the pump outlet and an outlet opening to the reservoir.

5. Pile gripping means according to claim 2 further comprising a fluid reservoir, a pump drawing a supply from said reservoir and a driving motor secured to a wall of the fluid reservoir for said pump.

6. Pile gripping means comprising, in combination, a support structure, a first jaw fixed to said structure, a pivot on said structure above said first jaw, a yoke arm rotatably mounted on said pivot, a second jaw fixed to said yoke arm to face said first jaw, respective flat and convex gripping faces on said first and second jaws, resilient means connected between the yoke arm and said structure urging the second jaw away from the first jaw, a fluid pressure cylinder and a piston arranged between the yoke arm and said structure, fluid pressure generating means connected to the interior of the cylinder, said piston being slidable within the cylinder on a line offset from said pivot whereby application of fluid pressure from said generating means to the cylinder and piston creates a moment acting about said pivot, said moment being adapted to act against said resilient means to urge the convex gripping face of the second jaw towards the flat gripping face of the first jaw.

7. Pile gripping means according to claim 6 further comprising sealing means between said piston and cylinder comprising a planar resilient sealing ring, the axis of said pivot lying substantially in the plane of said ring.

8. Pile gripping means according to claim 6 further comprising vertically resilient mounting means provided on the support structure, said means carrying the fluid pressure generating means.

9. Pile gripping means according to claim 6 wherein the fluid pressure generating means comprises a liquid reservoir, a pump and a motor driving said pump, the pump and motor being secured to the reservoir and the reservoir comprising engagement elements attached to said mounting means.

10. Pile gripping means according to claim 6 wherein said fixed jaw extends downwardly below the movable jaw.

11. In an impulse or vibratory pile driver, pile gripping means arranged below the generator of the driver and comprising, in combination, a body, a pivot axle extending transversely across said body in an upper region thereof, a fixed gripping jaw secured to the body in a lower movable region thereof, a movable gripping jaw jour- nalled on said pivot axle and dependent therebelow, said fixed and movable jaws having respective flat and convex faces that are mutually opposed, a resilient member interconnecting the movable jaw and the body at a side of the body remote from the pivot axle to exert a moment about said axle urging said jaws apart, a fluid pressure cylinder and a piston slidable in said cylinder being interposed between said movable jaw and the body adjacent said resilient member, a motor and a pump driven by the motor, spring elements mounting said pump and motor to the body on a side remote from the pivot axle and said resilient member, said spring elements permitting relative movement of the motor and pump to the body in the direction of the working impulses of the driver, conduit means from said pump to the interior of the cylinder and fluid from said fluid pressure fluid therein whereby a pressure force is generated between the piston and cylinder, said force acting in opposition to the moment exerted by the resilient member to pivot the movable jaw upon said axle towards the fixed jaw.

12. In a vibratory or impulse pile driver, the improved pile gripping means comprising a gripping means body secured to and dependent from the driver, a first fixed jaw secured to said body and having a flat gripping face lying in a vertical plane, a pivot on said body being directed horizontally and parallel to said first jaw vertical plane, a yoke arm swingable on said pivot, a second jaw having a convex gripping face being secured to said yoke arm to be movable therewith and away from said first jaw, a fluid pressure cylinder and a piston slidable within said cylinder, said piston and cylinder being located between the body and said yoke arm on an axis offset from said pivot whereby application of fluid pressure to the interior of the cylinder will swing the second jaw towards the first jaw, resilient means interconnected between the body and the yoke arm, said means being offset from said pivot to exert a moment thereabout urging the second jaw away from the first jaw, fluid supply means within the body comprising a motive power unit, a fluid pressure generating unit drivingly connected to said power unit and fluid conduit means between said pressure generating unit and the cylinder interior, mounting means for said power and pressure generating units permitting resilient vertical displacement of the units relative to the body.

13. In a vibratory or impulse pile driver according to claim 12 the further improvement comprising two sets of pile gripping jaws arranged in parallel on a common body below the driver, the flat faces of the respective fixed jaws being co-planar.

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