DRIVING AND EXTRACTION DEVICES FOR PILES, TUBING, SHEET PILING AND THE LIKE
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In order to effect the driving of piles, sheet-piling, tubes, etc.—which will hereinafter be designated by the generic term “piles”—or to effect their extraction, it is known to associate with the pile an alternating-impulse generating unit mounted directly on and wholly supported by the pile. The impulses produced by the said generator are also transmitted directly to the pile and ensure either its driving, when additive to the effect of gravity or its extraction if the effect of gravity is compensated, and an upwardly-acting active force is applied by any appropriate means. The applicants have proposed an apparatus of this kind in their Patent No. 2,743,585.

With this method of actuating, i.e. driving and extraction, advantageous results have been obtained by giving the impulse generator, which is always directly mounted on the pile, a certain freedom of movement with respect to the pile. If this freedom of movement is limited, at least in one direction, it enables these impulses to be transformed into shocks or percussions. Methods and devices for ensuring in this way the operations of driving and extraction have been described in our co-pending patent application Serial 347,720, now U.S. Patent 2,942,427.

The present invention has for its object improvements in driving and extraction devices of this kind, by employing in a general manner the shocks or percussions which result from the transformation of impulses supplied by a generator mounted in a framework which is mounted on the pile. These improvements enable the power, the effectiveness and the frequency of the used shocks to be increased, and improve the efficiency and increase the possibilities of driving and extraction in vertical, inclined or horizontal positions.

In accordance with these improvements, the driving and extraction device is characterised in that between the percussion generator and a support rigidly fixed to the pile, opposite the zone at which the percussions are applied, is arranged an elastic damping member which absorbs and recovers the impulses produced in the direction opposite to that of the effect desired. In addition, the mass of the impulse generator may be variable and adjustable.

In particular, the elastic member is formed by one or a number of springs. In order to regulate the tension of this spring or springs, a jack is interposed between these and their support which is fast with the pile. This jack may be actuated during the work of working and thus enables the spring to be regulated during operation with a view to obtaining the most effective frequency of the percussions and their optimum effect.

The device in accordance with the invention may be adapted to piles of different forms and sizes as well as to the various kinds of ground in which they are to be driven. It can thus replace a whole range of machines of different types and powers, ensuring a great simplification of tooling and economy in transport of the equipment.

The accompanying drawings show by way of examples various forms of application of the device according to the invention.

FIG. 1 shows the elastic-action device which can be regulated during driving.
FIG. 2 shows the use of the same device during extraction.
FIG. 3 shows its use for horizontal drilling.
FIG. 4 is a view in cross-section of a beating apparatus in accordance with the invention.

In FIG. 1, the reference 1 indicates the impulse generator, which is preferably a machine with fly-wheels, and eccentric weights, of the type described in the above-mentioned patent. This generator 1 is employed to drive a member of any kind, for example the sheet-piling 2. The driving cap or platform 3 is rigidly fixed to a jack 4. Between the jack 4 and the impulse generator 1, in accordance with the invention, there is placed a spring 5. The length of the spring 5 and therefore its tension are regulated so as to give the most favorable driving frequencies, in accordance with the characteristics of the ground and of the piling, and during the operation of driving this latter.

A member 6, rigidly fixed to the impulse generator 1, lifts when the centrifugal force produced by the rotation of the eccentrically-weighted fly-wheels of the generator 1 is greater than the tension of the spring 5 and the weight of the generator. Thus, for each position of the jack 4, to which corresponds a clearly-defined tension of the spring, there will also correspond a minimum speed of the generator at which the latter will lift to give a percussion force on the driving cap or platform 3. Thus, if it is desired during the course of driving, to increase the minimum percussion efforts produced by the generator 1, that is to say to increase the speed of rotation of the fly-wheels, if the mass of the eccentric weights is left constant, the tension of the spring will also be increased to the desired value.

In other words, if the tension of the spring is greater than the centrifugal force of the generator, the sheet-piling 2 is subjected only to the normal alternating impulses given by this centrifugal force. The percussion effect appears when the centrifugal force exceeds the tension of the spring and starts from the moment when the frictional effects due to the ground on the member to be driven become sufficiently large.

The spring with adjustable tension which, according to the invention, has been recognised as very advantageous to arrange in a suitable manner between the driving cap or platform 3 rigidly fixed to the member 2 to be driven and the impulse generator 1, has for its object—in addition to the possibility which it provides of increasing the driving frequency for a pre-determined mass of the moving part—to increase the force of percussion during driving by restoring the energy stored-up on the upward stroke, and to recover and restore the energy of rebound due to the elasticity of the member to be driven. It is thus possible to obtain percussion forces very much greater than the alternating forces given by the impulse-generator.

The frame for the impulse generator comprises cap or platform 3 and pillars 7 which are rigidly coupled to a supporting plate 8, in which the jack 4 is mounted. The jack 4 consists of a cylinder 14 arranged in the support plate 8. A piston 15 is movable within the cylinder 14 by means of pneumatic or hydraulic pressure through orifice 16 in order to adjust the tension on spring 5. The impulse-generator 1 can slide along the pillars 7 by virtue of its link-plate guides 9.

In order to extract any desired member which is driven into the ground, the same device is employed in an inverted position (see FIG. 2). With this device, the ex-
traction of the pile can be effected without any auxiliary tractive force, such force only becoming necessary from the point of view of the friction of the pile in the ground and is insufficient to compensate for the weight of the pile. This advantage is important, since it avoids the use of heavy and expensive means of traction; it is especially appreciable in the case of work on aquatic sites.

In the case in which it is necessary to drive horizontally, for tubing for example, the procedure according to the invention utilises a device similar to that shown in FIG. 3, in which 2 is the member to be driven (a tube), 1 is the impulse generator, 3 the driving cap or platform 4 the jack, 5 the spring, 7 the guiding rods, the unit moving by means of the rollers 10 on the rails 11, and 12 is an additional jack.

This device operates in the following manner:

At the beginning of the driving operation, the jack 12 replaces the effect of gravity which acts in the case of vertical or inclined driving operations.

From the moment when the member to be driven has penetrated sufficiently far into the ground for the effect of friction of the ground on this member to prevent any appreciable return, the action of the jack 12 is no longer necessary, and the driving of the said member continues under the effect of percussions towards the ground, following a method of operation similar to that described for extraction.

In view of the magnitude of the force which it is possible to apply by the use of the impulse generator and of percussion, it has proved advantageous to provide an intermediate member to transmit the percussion to the member to be driven. This transmitting member of percussion forces is of adjustable elasticity or compressibility.

FIG. 4 shows the construction of a driving or impulse-generating device in accordance with the invention, which carries into effect the various devices which have been referred to above.

1 is the impulse generator with four eccentrically-weighted fly-wheels 20 driven by the motor 21 and arranged with their axes at right angles, these axes being located in two different superposed planes in order to reduce the overall width of the device. The operation and the possibilities of the device are the same as those described in the patent previously referred to. In particular, if so desired, there can be produced in addition to the vertical percussion, an alternating horizontal movement of rotation, it being understood that the expressions "vertical" and "horizontal" should be replaced by: along the plane or perpendicularly to that axis, in the case of driving inclined piles.

The pile to be driven is shown at 2, the driving cap or platform 3 being fixed to the pile by a clamping device 22. The cushion 23 of adjustable elasticity is interposed between the impulse generator 1 and the cap or platform 3. This cushion is of rubber with an internal cavity.

The spring 5 may be of the spiral type as shown or may be composed of Belleville washers. Its tension may vary from 1 to 10 tons, in any given type.

In order to modify the weight of the moving portions, adjustable counter-weights or additional masses are provided, composed for example of rings 24 of heavy metal.

The whole of the elastic and adjustable damping devices described and shown may be replaced by a hydraulic or like device. A device of this kind furthermore, enables both the operations of extraction and driving to be effected without initial adjustment, without inversion.

What we claim is:

1. A device for actuating piles, tubing, sheet piling and the like, both for driving and for extraction, comprising a frame adapted to be rigidly fixed to the pile, said frame comprising a base plate guiding means mounted on said base plate parallel to the axis of the pile, a cross member coupled said guiding means at their extremity, a generator of alternating impulses mounted on said frame and adapted to slide on said guiding means, means for transforming said impulses into unidirectional percussions consisting of elastic means being disposed between said frame and said impulse generator, said elastic means being supported on one of the faces of the generator which has an alternating motion and on the side opposite to that at which said percussions are transmitted to said base plate, said elastic means absorbing, recovering, and returning the impulses of opposite direction to the direction of said percussions.

2. In a device for actuating piles, tubing, sheet piling and the like for the purpose of driving and extraction, comprising a frame having a base plate adapted to be fixed on said pile, a generally of alternating impulses mounted the spring synchronized eccentrically weighted flywheels mounted on said frame, the improvement which consists of guiding means mounted on said base plate parallel to the axis of said pile, said frame having a cross member coupling the extremity of said guiding means, said impulse generator mounted on said frame so as to be able to move with respect to said frame by sliding on said guiding means, said flywheels producing the alternating impulses, elastic means mounted between said frame and said generator for transforming the alternating impulses into percussions, said elastic means being supported on one of the faces of the generator and on the side opposite to that at which said percussions are transmitted to the base plate, said elastic means absorbing, recovering, and returning the impulses of direction opposite to the direction of said percussions, and means to adjust the tension of said elastic means.

3. In a device for actuating piles, tubing, sheet piling and the like, with a view to their driving and extraction, comprising a frame having a platform adapted to be fixed on said pile, a generator of alternating impulses having synchronized eccentrically weighted flywheels mounted on said frame, the improvement which consists of guiding means disposed parallel to the axis of said pile and being mounted on said platform, a cross member mounted on said frame and coupling the extremity of said guiding means, said impulse generator mounted on said frame so as to be able to move with respect to the platform by sliding on said guiding means, means for transforming the alternating impulses in one of two directions into percussions consisting of elastic means disposed between said frame and said generator, said elastic means being supported on one of the faces of the generator and on the side opposite to that at which said percussions are transmitted to said platform, said elastic means absorbing, recovering, and returning the impulses of direction opposite to the direction of said percussions, and a tension-regulating jack being interposed between said elastic means and said frame.

4. A device for actuating tubing, sheet piling and like members comprising a platform adapted to be rigidly fixed to one of said members, guiding rods mounted on said platform, an impulse generator for producing impulses having eccentrically-weighted flywheels, said generator being adapted to receive adjustable additional masses and being slideable on said guiding rods, an elastic member disposed between said generator and said platform, a supporting member mounted on the extremities of said guiding rods, an adjustable jack mounted on said supporting member, and a spring interposed between said jack and said generator, wherein the motion is regulated by said jack and the impulses produced by said generator move said generator in one direction against said spring to store energy therein and whereby said generator is moved in the opposite direction by said impulses and energy stored in said spring to deliver percussions to said platform.

5. A machine of the class described comprising a frame having a platform adapted to be rigidly secured to a member to be driven and extracted respectively, guiding
means mounted on said platform parallel to the axis of said member, a cross member mounted on said frame coupling the extremities of said guiding means, an impulse generator slidably mounted on said guiding means in response to impulses for producing and transmitting percussions to said member to be driven in accordance with the direction said member is to be driven, and means mounted in said frame opposite to the direction in which said member is to be driven for storing energy produced by the impulses and for applying unidirectional percusions through said generator to the member to be driven.

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