Aug. 30, 1938. K. HAAGE 2,128,584

POWER RAM

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Fig. 1.

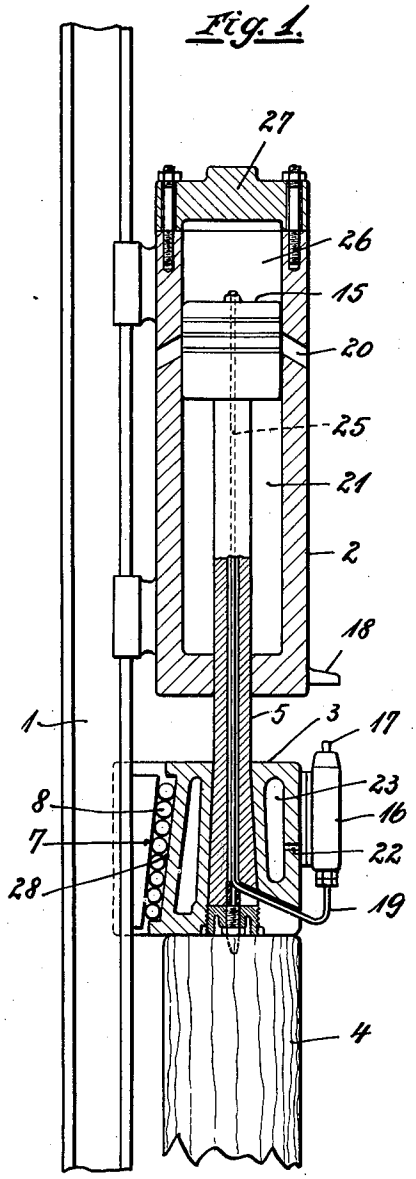


Fig. 3.

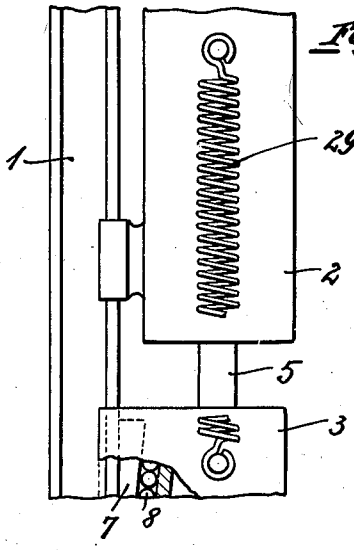
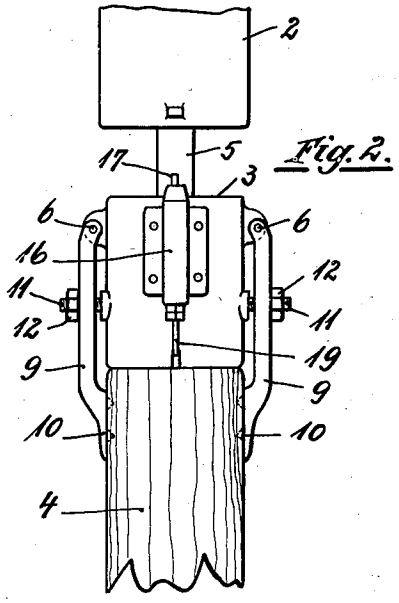


Fig. 2.



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2,128,584

POWER RAM

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5 Claims. (Cl. 61—76)

My invention relates to power rams for pile-driving and other work, more especially of the kind, in which the ram proper is constituted by the cylinder of an internal combustion engine, which is lifted by the combustion of fuel injected into the cylinder and on dropping hits the pile.

In power rams as hitherto in use the ram or pile driver is as a rule constituted by the piston of the engine, this piston being comparatively light in weight, while the cylinder or casing, in which the piston moves, is very heavy. This distribution of weights has been adopted for the reason that otherwise the cylinder or casing would be lifted off the pile to be driven under the pressure of the combustion gases forcing the piston downward.

In another type of rams a heavy mass is lifted by the gas pressure and thereafter allowed to drop freely. Obviously these rams involve the advantage of the high weight of the ram, but also the disadvantage of a comparatively small number of blows per unit of time.

In the power ram according to the present invention the advantage of a heavy-weight ram is combined with the advantage of a great number of blows, the stroke of the ram proper being reduced by an energy storing device, which is connected with a heavy part of the ram which follows the downward movement of the pile to be driven, being, however, prevented by an additional load from rising. By designing a power ram in this manner I am enabled to obtain an increased number of blows per unit of time in combination with a ram of large weight, for the reduction of stroke already leads to a reduction of the period of time required for the stroke. The energy stored during the rising of the ram thereafter accelerates the drop of the ram and thereby further reduces the time required for the drop.

In the drawing affixed to this specification and forming part thereof three modifications of a power ram embodying my invention are illustrated diagrammatically by way of example. In the drawing:

Fig. 1 is an axial section of the first modification, while

Fig. 2 is a part elevation showing a different mode of fixing the pile extension to the pile to be driven.

Fig. 3 is an elevation partly in axial section of a third modification.

Referring to the drawing and first to Fig. 1, 1 is the runner, 2 is the cylinder of the internal combustion engine, the cylinder forming the ram proper, and 3 is the pile extension, while 4 is the pile to be driven. In the pile extension 3 is fixed a piston rod 5 carrying at its extreme upper end the piston 15, on which the cylinder 2 is free to reciprocate in vertical direction. 16 is a fuel injection pump secured to the pile extension 3, the piston rod 17 of this pump projecting into the way of a check 18 formed at the lower end of the cylinder 2 in such manner that shortly before the ram cylinder hits the pile extension 3, the pump piston is forced downward, whereby a predetermined quantity of fuel stored in a cavity 23 of the pile extension and fed to the pump through a boring 22 is injected through the pipe 19 into the central boring 25 of the piston rod 5 and piston 15 into the combustion chamber 26 between the piston 15 and the cylinder cover 27, to be there ignited after the manner of a Diesel engine. The combustion of the mixture of fuel and hot compressed air in the chamber 26 causes the ram cylinder 2, which is guided by the runner 1, to rise, until the exhaust ports 20 have passed the piston and, being uncovered, allow the ram cylinder to drop again and to hit the pile extension 3, a fresh quantity of fuel being at the same time injected into the combustion chamber by the check 18 forcing the piston rod 17 downward.

The upward stroke of the ram cylinder 2 is limited and energy stored by means of a body of air enclosed in the closed bottom part 21 of the ram cylinder, which, on the cylinder rising, is compressed between the rear face of the piston 15 and the cylinder bottom which is packed relative to the piston rod 5 to prevent the enclosed air from escaping, forming an expansible cushion, whose tendency to expand will cause the ram cylinder 2 to drop onto the pile extension quicker and with higher force than it would do without such acceleration.

Obviously this acceleration and the increase in the number of blows brought about by it are limited by the weight of the pile extension 3. For as soon as this member is lifted off the pile, no further increase would be possible.

I therefore prefer coupling the pile extension 3 with a larger mass in order to enable the number of blows and the output of the ram to be increased further.

I may for instance fix the pile extension 3 to the pile 4, and in that case the highest degree of compression in the space 21 is determined by the sum total of the weights of the pile extension and the pile. One manner of fixing the pile extension to the pile is illustrated in Fig. 2 in which grippers 9 formed with jaws 10 are pivoted to the

pile extension 3 at 6, screw bolts 11 and nuts 12 allowing these grippers 9 to be pressed against the pile head so as to fix to it the pile extension.

Instead of this mode of fixation I may also insert between the pile extension 3 and the runner 1 an automatic jam, which prevents the pile extension from being lifted by the compressed air in the chamber 21 of the same cylinder, but allows it to follow the downward movement of the pile 4. This combination is illustrated in Fig. 1, where 7 is a wedge in gliding contact with the runner, while 8 is a row of rollers inserted between the inclined face of the wedge and another inclined face 28 of the pile extension. Obviously, whenever the force tending to lift the pile extension 3 exceeds the weight of this member, this latter will be prevented from rising by the rollers 8 inserted between the wedge 7 and the cam face 28. On the other hand the rollers 8 will not prevent the pile extension from following the downward movement of the pile 4.

In the modification illustrated in Fig. 3 the energy storing device is represented by a pair of coil springs 29, the ends of which are fixed to the pile extension 3 and to the ram cylinder 2, respectively, and which on the ram cylinder being lifted by the combustion gases are placed under tension, thus storing energy which is utilized, during the descent of the cylinder, for accelerating same.

Obviously I am enabled, according to this invention, to either considerably increase the output of the ram or to reduce the weight of the ram cylinder, thereby facilitating the handling thereof.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:

1. In a pile-driving power ram in combination, a ramming cylinder closed at both ends and a piston in said cylinder, both forming part of an internal combustion engine, a piston rod fixed to said piston and extending through the bottom of said cylinder, which gas-tightly embraces said rod, into contact with the pile to be driven, means for holding said piston rod down on the pile, means for injecting an explosive mixture into said cylinder above said piston and an elastic buffer combined with, and adapted to damp the lifting effect exerted on, said cylinder by the explosion of said mixture and to thereby accelerate the drop of said cylinder.

2. In a pile-driving power ram in combination, a ramming cylinder closed at both ends and a piston in said cylinder, both forming part of an internal combustion engine, a piston rod fixed to said piston and extending through the bottom of said cylinder, which gas-tightly embraces said rod, into contact with the pile to be driven, means for holding said piston rod down on the pile, means for injecting an explosive mixture into said cylinder above said piston, and an enclosed body of gas, enclosed between the bottom of said cylinder and below said piston, so as to be compressed by the rising cylinder and to counteract the lifting effect exerted on said cylinder by the explosion of said mixture and to thereby accelerate the drop of said cylinder.

3. In a pile-driving power ram in combination, a ramming cylinder closed at both ends and a piston in said cylinder, both forming part of an internal combustion engine, a piston rod fixed to said piston and extending through the bottom of said cylinder, which gas-tightly embraces said rod, into contact with the pile to be driven, means for holding said piston rod down on the pile, means for injecting an explosive mixture into said cylinder above said piston and a spring yieldingly coupling said cylinder with the projecting part of said piston rod.

4. In a pile-driving power ram in combination, a runner, a ramming cylinder, closed at both ends, guided by said runner and a piston in said cylinder, both forming part of an internal combustion engine, a piston rod fixed to said piston and extending through the bottom of said cylinder, which gas-tightly embraces said rod, into contact with the pile to be driven, means for holding said piston rod down on the pile, means for injecting an explosive mixture into said cylinder above said piston, and an elastic buffer combined with and adapted to damp the lifting effect exerted on said cylinder by the explosion of said mixture and to thereby accelerate the drop of said cylinder, and clamping means, operative in upward direction only, for clamping the projecting part of said piston rod to said runner.

5. In a pile-driving power ram in combination, a runner, a ramming cylinder, closed at both ends, guided by said runner and a piston in said cylinder, both forming part of an internal combustion engine, a piston rod fixed to said piston and extending through the bottom of said cylinder, which gas-tightly embraces said rod, into contact with the pile to be driven, means for holding said piston rod down on the pile, means for injecting an explosive mixture into said cylinder above said piston, and an elastic buffer combined with and adapted to damp the lifting effect exerted on said cylinder by the explosion of said mixture and to thereby accelerate the drop of said cylinder, and a wedging jam, operative in upward direction only, inserted between said runner and the projecting part of said piston rod.

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