3,169,500 PILE PULLING MACHINE
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The present invention relates to pile pulling machines. Pile pulling machines are known which comprise a pulling mechanism, a pull rod and a striking plate and are suspended on a suspension device. These heretofore known pile pulling machines are so designed that the striking mass formed by a piston or cylinder is driven by a piston-cylinder system of an internal combustion engine. All pile pulling machines of this type have in common that the pile pulling system is suspended on a block and tackle of great pulling force which is conveyed to the pile to be pulled by the intervention of one or more pull rods or pulling pliers. The effect of this block and tackle is aided by a hammering mass acting in upward direction and striking against a striking plate which is connected to the upper end of the pull rod so that each hammer blow of the block and tackle will briefly be increased to a considerable extent. With such an arrangement, the striking mass formed by the piston or cylinder is thrown upwardly directly by the pressure of the steam, by compressed air, or by the pressure of explosion gases.

In most instances, with pile pulling machines the pulling bar is arranged centrally for reasons of strength and durability while the working cylinder is coaxially arranged with regard to the central pulling bar. Such an arrangement has the drawback that with diesel pile pulling machines, the required double seal of the piston on the cylinder wall and also on the pull rods extending through the cylinder causes considerable difficulties. Furthermore, such an arrangement makes it difficult to design the annular compression chamber in such a way that a satisfactory and complete combustion of the fuel to be injected will be assured. In addition thereto, the cooling and scavenging of the annular cross section of the cylinder causes considerable difficulties.

For the sake of completeness, it may be added that also compressed air-driven pile pulling machines are known which comprise a plurality of piston-cylinder systems which are coaxially arranged with regard to the pull rod of the striking mass for actuating the respective striking mass. These cylinder-piston systems move independently of each other and in view of their non-synchronous operation subject the entire machine to a considerable harmful stress.

It is, therefore, an object of the present invention to provide a pile pulling machine which will overcome the above mentioned drawbacks.

It is another object of this invention to provide a pile pulling machine in which the auxiliary power system will not exert any undue stress upon the machine.

It is also an object of this invention to provide a pile pulling machine according to the preceding paragraph, which will include means for limiting the pulling force exerted upon the central pull rod.

The above and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 illustrates partly in elevation and partly in section a pile pulling machine according to the invention.

FIG. 2 shows on a scale considerably larger than that of FIG. 1 a section through one of the cylinder-piston systems of FIG. 1.

The pile pulling machine according to the invention is characterized primarily in that a plurality of cylinder-piston systems designed as internal combustion engines work through connecting rods upon a striking mass common to all of said cylinder-piston systems.

In conformity with a further feature of the present invention, intermediate the suspension device, as for instance a block and tackle, and the pull rod there is arranged an adjustable spring head which is provided with means for limiting the pulling force exerted upon the centrally arranged pull rod. As a result thereof, the said central pull rod may be designed considerably lighter whereby the entire machine becomes lighter.

In further development of the pile pulling machine according to the present invention, the fuel injection pumps are controlled by cam means designed as longitudinal grooves in the circumferential surface of the piston rod. If desired, these grooves also may serve the purpose of preventing rotation of the piston rod.

To simplify the design, the cylinder heads may be designed so as to form the support for the cylinders. According to a further feature of the present invention, the pulling mechanism includes a universal joint and is provided with a plurality of adjustable fish plates, links or the like for connection with a plurality of suspension points of the pile or the like to be pulled. Such an arrangement has the important advantage that the specific stress on the pile or the like to be pulled is reduced at the suspension point in view of the distribution of the load over a plurality of suspension points. Such an arrangement also makes it possible to adjust the position of the individual bolts or links in conformity with the particular position of the suspension point on the pile or the like to be pulled.

It has also been found that with pile pulling machines according to the invention and with pile pulling machines with diesel operation in general, it is highly advantageous to provide the cylinder head with a glow plug. In this way, the specific property of the diesel operation with continuously glowing glow plug, namely that the working pressures are considerably less than with other diesel methods, is exploited for pile pulling machines whereby the reaction upon the suspension may be considerably reduced.

Referring now to the drawings in detail, the pile pulling machine comprises a plurality of cylinders 1 having their cylinder heads 2 mounted on a platform 3. Platform 3 is provided with a connecting member 24 which in turn is connected to a pull rod 7 by means of transverse bolts 32. Each of the cylinders 1 has reciprocably mounted therein a piston 101 (FIG. 2). The pistons 101 in cylinders 1 arranged axially parallel to each other, by means of their piston rods 102 drive a striking mass 5 which is guided on a central pull rod 7. The striking mass 5 conveys its power through the intervention of a striking plate 6 firmly connected to pull rod 7, through the latter, and through a joint 71 at the lower end of pull rod 7 as well as through suspension plates or bolts 72 onto plants, piles or the like 20.

The entire device is by means of pull rod 7 suspended on a spring head generally designated with the reference numeral 14 while the pull upon the large pull rod 7 may be adjusted for instance from 20 to 40 tons. The spring head 14 comprises a frame 14a the bottom 14b of which has a bore 14c through which extends the upper end of pull rod 7. This upper end has a groove 7a which is engaged by a plate 73 serving as an abutment means. Interposed between the bottom 14b and the plate 73 is a plurality of springs 17 which may be secured in their respective positions in any convenient manner. The spring head 14 has connected thereto a rod 74 with a handle 76a which latter has looped therearound a cable 16 leading to
pulling means, as for instance a winch, not shown in the drawing.

In conformity with the present invention, the spring head 14 has connected thereto trunnions 75 with grooves 75a around which are looped ropes or cables 16 the lower ends of which are looped around similar trunnions 76 on a beam 71a carried on a pivot 71 of member 72. The pulling equipment proper comprises bolts 72 which are swivelly connected to beam 71a and at the bottom are attached to pullings 20.

In operation, the pulling force is conveyed from the pulling means such as a winch through spring head 14, springs 17 and plate 73 to pull rod 7. In this way, in conformity with the selection of spring 17 it may be obtained for instance that not more than 40 tons of pulling power are conveyed to the pull rod 7. The ropes or cables 16 are so adjusted that they are slack when the pulling power is low. However, when the pulling power is increased, the springs convey the maximum power, for instance 40 tons, to the pull rod. When this maximum has been reached, the ropes or cables 16 will be taut, and the pulling force in excess of the desired maximum of 40 tons will be conveyed through said ropes or cables directly to the puller or the like to be pulled. This arrangement is of particular advantage when the upper soil layer consists of clay and the lower soil layer consists of gravel. Therefore, the pull must be adjustable.

The pulling equipment 71, 72 for connection with the rails of the like is so designed that selectively one or more connecting or suspension points may be used. Such an arrangement is of particular advantage when U-shaped profiles are involved inasmuch as in this way a tearing out of the suspension holes on the rails will be prevented by the reduced side pressure. Individual suspension bolts or links 72 may be rotatably arranged so that the pulling equipment 71, 71a, 72 may also be employed for Z-profiles.

The cylinders 1 are furthermore equipped with fuel pumps 9 with the fuel pipes 91 pertaining thereto and with an oil pump 12 with oil pipes 121. Fuel pumps 9 are operable for pumping fuel from a source, not shown, in response to reciprocation of a pump plunger in the pump which is brought about by roller 9a on the plunger which slides on an inclined groove 10 in piston rod 102.

The housing of valve 8 is provided with a connection 81 for connection with scavenging means, namely, a supply of air under pressure which, at a predetermined pressure in the cylinder will force valve 8 open and cause scavenging gas to pass axially through the cylinder and thereby blow the products of combustion out through port 103 while simultaneously supplying a new charge of clean gas to the cylinder. This will take place, of course, only when the piston has moved into position to open port 103.

The operation of the cylinder-piston systems itself will be evident from FIG. 2 showing a cross section through one of the cylinder-piston systems. As will be seen therefore, piston 101 is fixedly connected to piston rod 102 which latter is reciprocable in cylinder 1. Piston rod 102 is provided with two grooves 10 which serve as cam surfaces for operating the fuel injection pumps 9 to cause them to pump fuel on the downward stroke of the piston 101 and piston rod 102. At the same time, the said grooves 10 also prevent piston rod 102 and thereby piston 101 from rotation. A small lubricating pump 12 (FIG. 1) has a vertical plunger spring urged upwardly and said plunger having an upper end 12a which is engaged by member 5 on the retraction stroke of the said mass whereupon the pump is operated to lubricate the connecting rod. The lubricating oil is conveyed from a source, not shown, to pump 12 and then through conduits 121 to a groove 13 in the interior of cylinder 1. The cylinder piston systems work according to the known two-stroke diesel method with unidirectional scavenging—scavenging is along the cylinder axis. The scavenging is accomplished by means of valve 8 which is an automatic valve of standard construction and opens automatically as soon as the scavenging pressure exceeds the inner pressure of cylinder 1 following the opening of the outlet slots 103 by piston 101.

When the pistons 101 drop, they can pass over the outlet slots 103 in well known manner and compress the air trapped in the cylinders 1. Shortly prior to reaching the lower dead center points of the pistons, the fuel is injected into the cylinders and the engine will commence to run.

For purposes of facilitating the starting of the engines, a glow plug 11 extends into the precombustion chamber 22 and may be heated from the outside by means of a flame or other suitable means. This arrangement is of particular advantage with diesel pulling means inasmuch as with glow plug operation the working pressure is considerably lower so that a relatively low reaction is exerted upon the suspension 74, 16 and the means on which the latter is suspended.

The starting of the engines is accomplished by means of a heater 5 and by a glow plug 21 of standard design into the precombustion chamber. The glow plug may be manipulated manually to charge the lines leading up to the injectors. The glow plug, as mentioned before, is heated, as by a torch or the like. The mass 5 is then released and, since on its downward stroke, fuel pumps 9 are operated by the piston rod 102, fuel will be injected into the cylinders and the engine will commence to run. The air under pressure for scavenging the engines is, of course, made ready prior to the starting of the engines.

On the upward movement of the pistons 101, the holes 103 in the upper ends of their respective cylinders relieve the air from the upper ends of the cylinders so that this air does not interfere with the operation of the engines.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. In a machine for pulling piles, boards, and the like: a pull rod, a striking plate connected to said pull rod, connecting means supported by said pull rod for connection with the article to be pulled, a plurality of cylinder-piston systems, each of said cylinder-piston systems comprising a power operable reciprocable member, and a striking body coaxially arranged with regard to said pull rod and movable relative thereto for striking against said striking plate to thereby exert an impact on said pull rod, said striking body being common to and connected to all of said reciprocable members for simultaneous movement therewith.

2. In a machine for pulling piles, boards, and the like: a pull rod, an abutment plate connected to one end of said pull rod, a spring head comprising a bottom portion slightly mounted on said pull rod in spaced relationship to said abutment plate, spring means interposed between said bottom portion and said abutment plate, said spring head being provided with means for connection with a lifting device, a striking plate connected to said pull rod, connecting means supported by said pull rod for connection with the article to be pulled, means connecting said spring head with said connecting means operable to limit removal of the spring head upwardly for limiting the pulling force conveyed from the spring head to said pull rod, a plurality of piston-cylinder systems, each of said cylinder-piston systems comprising a power operable reciprocable member, and a striking body coaxially arranged with regard to said pull rod and movable relative thereto for striking against said striking plate to thereby exert an impact on said pull rod, said striking body being common to and connected to all of said reciprocable members for simultaneous movement therewith.
3. A machine according to claim 1, in which the cylinders of said cylinder-piston systems are provided with a cylinder head forming a support for said cylinder-piston systems.

4. In a machine for pulling piles, boards, and the like: a pull rod, striking plate means connected to said pull rod and arranged coaxially with regard thereto, a plurality of individual power operable cylinder piston systems respectively arranged on opposite sides of and in spaced relationship to said pull rod, each of said cylinder piston systems comprising a power operable reciprocable member, and a striking body coaxially arranged with regard to said pull rod and movable relative thereto for striking against said striking plate means to thereby exert a driving force on said pull rod, said striking body being common to and connected to all of said reciprocable members for simultaneous movement therewith.

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