Aug. 9, 1966 S. STEFANUTTI 3,265,218

SIDE BOOM PIPE LAYER

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Fig. 1

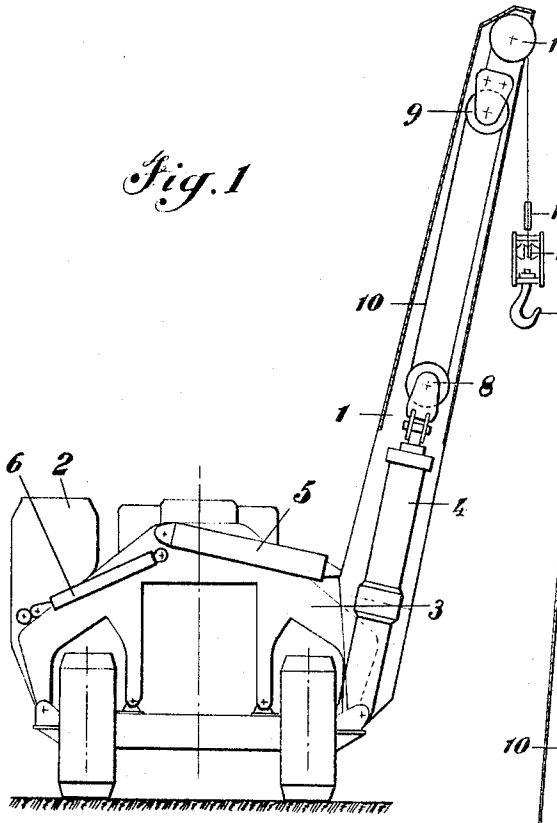
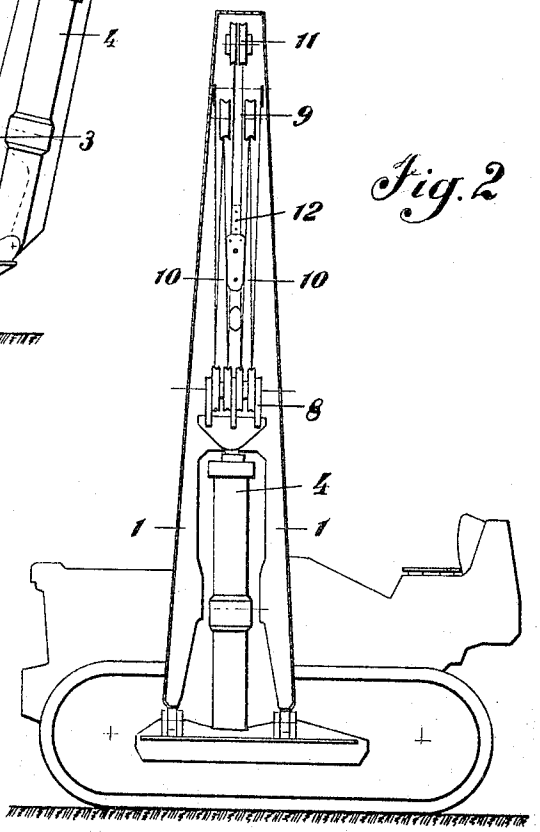


Fig. 2



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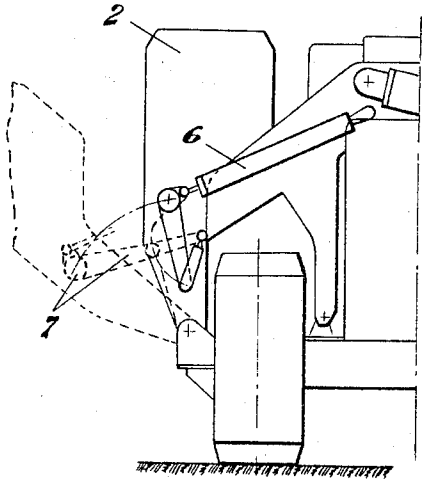
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Fig. 3



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SIDE BOOM PIPE LAYER

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The stationary and travelling pipe layers now in use are for the most part mechanically operated, by means of winches and cable both for the raising operation of the movable boom and the load hoisting boom.

An object of the present invention is to provide a wholly hydraulically operated side boom pipe layer having the ability of effecting noticeable travel of the hoisting hook, the travel of which can be so provided as to fully meet all the operational requirements peculiar to any specific rig, yet utilizing as a hoisting driving unit, a common hydraulic jack.

A further object of the invention is to provide a construction which permits a wide travel of the hook by means of a travel gearing up device comprising a particular type of running tackle.

Another basic feature of the side boom pipe layer is represented by a wide range of operating speeds, which can range with continuity from zero to the highest one allowed by the pump delivery by means of a flow regulating device connected into the feed hydraulic system; and this without resorting to the use of variable delivery pumps, which, as well known, are highly expensive and complicated.

Further features of the subject rig will be apparent from the specification given hereinafter by way of a non limitative example, which refers to an embodiment for the specific use of a side boom pipe layer, which provides the installation of the rig on a track-laying tractor.

In the drawings:

FIG. 1 shows the side boom pipe layer as seen from the front side of the tractor;

FIG. 2 is a side view of the same, with the raisable boom in cross section;

FIG. 3 shows a detail of the counterweight extension driving mechanism.

With reference to FIGURES 1 to 3, the movable jib or boom 1 acts as an overhanging beam.

It comprises a rectangular cross section beam having a box-type structure at the upper portion and divided into two members in the lower portion, so as to take a greatly elongated A-shape.

In the upper box portion there is enclosed the entire travel gearing up unit. Directly on the boom there is mounted also the load hoisting jack 4 which is hingedly secured at about midway of the cylindrical body.

The boom raising is controlled by means of the jack 5, fastened to the bridge 3.

On the bridge is anchored also the jack 6 controlling the extension of the counterweight unit 2.

However, the jack 6 does not act directly on the counterweight box, but controls a linkage 7 which, in the extended counterweight position, takes on itself all the load and the inertial stresses possibly transmitted by the ballasts.

The linkage 7 comprises a compass-like arrangement one rod of which is hingedly secured to the bridge and the other one, hingedly fastened to the counterweight box, is controlled through a lever fastened to the stem of the jack 6.

The linkage is divided in two members in order to give the assembly a high rigidity.

The connecting bridge 3 between the boom and the counterweight unit has the purpose of taking all the bending stresses resulting from the load on the boom and the counterweights, releasing on the tractor frame only the direct action of the weights. Moreover, the bridge has the purpose of completing the framework of the side boom pipe layer, so as to provide a rig structurally independent from the tractor to which it is applied and having in itself all the members required for the operation thereof, including the hydraulic system.

The bridge comprises a box structure, which is fastened to the truck at four points, of which two are inside and two outside the tracks.

The load hoisting unit comprises an assembly consisting of the jack 4 and the travel gearing up tackle, the basic components of which are the loose pulley set 8, the fast pulley set 9, the return pulleys 11 and the double loop of cables 10, mutually secured at 12 and wound about the roll 13, carried by the hook 14 which stabilizes the stresses.

In the example illustrated the travel gearing up is in the ratio of 4:1. However, this ratio can be increased within the limits allowed by the approach.

These limits are determined by the following formulas:

(1) $$T=Q\left(\frac{1}{\eta}+\frac{1}{\eta^2}+\frac{1}{\eta^3}\cdots+\frac{1}{\eta^n}\right)$$

(2) $$t_f=\frac{t_i}{\eta^n};\ \frac{t_i}{t_f}=\eta^n$$

where:

T=draw on the stem of the hoisting jack
Q=loading of the hook
n=travel gearing up ratio
η=efficiency of a single return on pulley
t_f=stress in the end section of the cable (in the proximity of the anchoring to the rig)
t_i=stress in the initial section of the cable (at the hook).

From these formulas it ensues that the determining factor for the approach is the value η^n; this because while it is at all times possible, within reasonable limits, to provide the required T (by a suitable dimensioning of the loading jack dividing the draw among a plurality of jacks in parallel), it is absolutely essential to maintain the stress ratio at the end sections of the cables, namely the value η^n, within limits sufficiently reduced; this in order to avoid that an excessive overload at the end section forces different sizes of the cables, and by consequence also of the pulleys, quite disproportionate to the actual value of the load suspended to the hook.

Once determined the acceptable overstress for the end section of the cable, it is also determined the limiting value of η^n: from this is strictly conditioned the tackle efficiency.

An example will help to explain all the positive importance that the efficiency assumes in this gearing up device.

If one considers at the limits of the acceptability an overstress at the end section of the cable of the order of 15%, one will have:

$$\frac{t_i}{t_f}=\frac{100}{115}=0.87=\eta^n$$

It ensues therefrom the following combinations of acceptable values:

For η in the range of from 0.935 to 0.958 one could assume $n=2$
For η in the range of from 0.958 to 0.97 one could assume $n=3$
For η in the range of from 0.97 to 0.973 one could assume $n=4$
For η in the range of from 0.973 to 0.98 one could assume $n=5$

For η in the range of from 0.98 to 0.981 one could assume $n=7$

For η equal to 0.99 $n=13$

As is evident from this numerical example, quite minor improvements in the tackle efficiency, are sufficient to greatly increase the travel gearing up which can be practically provided, while for low efficiency values, the travel gearing up system is not absolutely feasible.

The extremely high tackle efficiency essential for a satisfactory performance of the assembly has been obtained, by providing the tackle gearing up device according to the approach hereinbelow illustrated.

(a) The cable loop has been divided in two, so as to provide two quite symmetrical loops to balance the side load acting on the pulleys owing to the unavoidable non complanarity of the fast and loose pulleys;

(b) The slanting of the cables has been reduced to a minimum with a suitable study of the pulley setting up;

(c) The cables in the two loops are reversely wound, so as to self-compensate for the tendency of each component to rotate. The two cables are connected at the hook and are wound about a roll which permits balancing of the stress thereof;

(d) The grooves of the tackle pulleys are of the open type, with an angle of 90°, so as to eliminate any rubbing action of the cables against the walls of the grooves;

(e) The pulleys are mounted on pairs of ball bearings provided with side guard which prevents the leakage of the lubricating grease;

(f) The entire set of fast and loose pulleys and the related cable loop is dust- and weather-proofed by encasement in the body of the boom.

The main advantages afforded by a pipe layer according to the present invention are the following:

(I) Simplicity and economy of fabrication since there are eliminated all the mechanical assemblies included by the winches with related power output, change gear box, clutches, brakes and so forth.

These assemblies may be replaced by a hydraulic system obviously less expensive and of simpler construction.

(II) Capability of application to any car, since it does not require the power takeoff and releases on the rig itself, through the bridge, all the stresses being internal to the system.

(III) Maximum ease of operation, which requires an extremely reduced number of controls (flow distributors and regulator) of elementary operation.

(IV) Uniformity and smoothness of running, due to a flow regulator which permits a gradual speed change throughout the range from zero to maximum speed.

(V) Large visibility for the operator as the result of the extreme neatness and compactness of the rig, cleared of the assembly of brakes and tackles which brace the winch crane of the conventional type.

(VI) Maximum safety, owing to the absence of external cables, the presence of shut-off valves and the division in two of the load hoisting cables.

(VII) Minimum side unbalancing of the tractor, due to the absence of the sets of winches and to the ensuing more rational arrangement of the counterweights.

(VIII) Possibility of providing a compact and self-contained rig independent from the car to which it is applied.

(IX) Removal of the tendency of the hook to rotate, as the result of the self-balancing of the two cable components.

(X) Extremely high operational efficiency due to the simplicity of the different operating members and the highly reduced wear of the cables, as the result of the exceptionally high value of the gearing up tackle.

(XI) Ease of upkeep and replacements, due to the absence of mechanical assemblies.

(XII) Quick dismantling and ease of transportation, due to the easy separation of the assembly into three component members, namely: the movable boom complete with the raising mechanism, the counterweights and the body of the tractor.

While the present invention has been illustrated and described in a preferred embodiment thereof, it is however understood that structural modifications and variations could be made therein without departing from the scope and the spirit of the invention.

I claim:

1. A hydraulically operated pipe layer comprising a bridge, a boom hingedly connected to said bridge movable in a vertical plane, a first hydraulic hoisting jack mounted on said boom, a tackle connected to said jack mounted on said boom, a second hydraulic jack mounted on said bridge controlling the raising of said boom, a hook connected to said tackle, a support for said hook having a roll, said tackle comprising a pair of cables, each of which has one end anchored at the top of said boom and the other end wound on said roll to balance the stresses of said two cables.

2. A pipe layer as set forth in claim **1** wherein a bracket is fixedly connected to the piston on said hoisting jack, and said cables are symmetrically wound on loose pulleys mounted on said bracket and intermediate return pulleys are provided rigidly connected to said boom.

3. A pipe layer as set forth in claim **1** wherein pulleys are provided for said cables, said pulleys being of the open type with a groove at an angle of 90° to eliminate any rubbing action against the groove walls.

4. A pipe layer as set forth in claim **1** wherein said tackle is contained in a closed housing provided in the upper portion of said boom.

5. A pipe layer as set forth in claim **1**, wherein said boom is hingedly fastened on a side of said bridge, the opposite side of said bridge having a pair of extensible balancing counterweights, supported by a pair of compass-like means hingedly connected to said bridge and operated by a hydraulic jack.

6. A pipe layer as set forth in claim **5**, wherein said counterweights are controlled by a hydraulic system having an outlet flow rate reduced according to a constant ratio.

7. A pipe layer as set forth in claim **1**, wherein the drive of the hook and the movable boom raising is provided by means of a servodriving arrangement.

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