ABSTRACT: A transportable crane or derrick comprising a mast or column pivotally mounted on the platform of a vehicle so as to be capable of being tilted with respect to the platform. The mast includes a main jib pivotally mounted at the head of the mast to pivot in the tilting plane of the mast. On the opposite side of the mast from the main jib there is mounted a sheave providing guide means for a cable having a load-carrying hook mounted thereon.
FIG. 1

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TRANSPORTABLE CRANE OR DERRICK

The present invention relates to a transportable crane or derrick comprising a crane mast or column mounted on the platform of a vehicle and capable of being tilted with respect to the platform, the mast carrying a main jib which pivots with respect to the mast.

It is well known to construct cranes in such a manner that, for travel, the mast or column together with the jib folded against it may be swung down to a horizontal position on the platform of the vehicle. At a building site or other point of use, the crane mast is raised into its upright operative position perpendicular to the platform. Cranes of this kind are distinguished by their high degree of mobility across country and the easy erection of the mast at the point of use. Hitherto such transportable cranes have, however, only been employed as single purpose equipment insofar as at the point of use they are first erected into an operative position in which, as stated, the mast is upright and the jib extends from it at an angle.

This deficiency of the above-mentioned known crane is overcome, according to the present invention, by such a disposition of the main jib with respect to the mast, preferably at the head of the latter, that the jib can be luffed in the plane of tilting the mast. Furthermore, this is achieved by the provision on the mast, at that side opposite the main jib and preferably at its head, of a sheave providing means for guiding a cable to a load-carrying hook. The mast is enabled, on the one hand, to be brought into such an operative position that it forms a rotary tower crane on the platform of the vehicle, with the jib swung out, and, on the other hand, by appropriately inclining the mast with respect to the above-mentioned platform and by folding the jib down against it, one provides a tilting mast or derrick suitable for carrying loads and having at its free end a sheave providing means for guiding a cable to a load-carrying hook. The mast is capable of being tilted in two opposite directions, in its plane of inclination, whereby the crane can be used in two different ways without requiring additional operating means.

In a preferred embodiment of the invention, the mast or column of the crane is tiltably mounted on a rotating platform on the chassis of the vehicle. The crane means can have a carrier for the counterweight comprising parallel barlike supports disposed slidably and arranged on the platform symmetrically with respect to a central line passing through the mast attachment point and the center of the platform. In addition to being guided on rails on the rotary platform, this counterweight is also adjustable on it from mutually opposed sides according to whether the crane is to be employed as a rotary tower crane or as a tilting mast derrick.

If, according to a further feature of the invention, a counterjib is provided which is pivotally mounted on the opposite side of the mast from the main jib and if it carriers at its free end a cable-guiding sheave, this counterjib can be employed as a short auxiliary jib when the equipment is acting as a derrick with the mast inclined. In this embodiment the lifting of the load can be achieved either by means of the load-carrying hook alone, which is movable at the free end of the short auxiliary jib, or it can be achieved both by the use of this load-carrying hook and at the same time additionally by raising the already-mentioned load-carrying hook which is movable by means of the sheave that is mounted directly on the mast. The common movement of the load by means of both hooks is particularly useful when the loads to be lifted are to be shifted in a predetermined direction, for example at building sites.

According to a further feature of the invention it is possible to use a mast made up to telescopic sections arranged so that the sections of the mast can be extended by means of a tension cable, and so that the extension takes place with an increasing angle of inclination of the mast with respect to the platform of the vehicle. In this arrangement, one end of the tension cable is preferably secured to the rotary platform.

According to a still further feature of the invention, in the above-mentioned crane, the telescopic sections of the mast are brought into their operative positions by the use of a fluid pressure ram. The main jib, which lies against the telescoped mast in the traveling position, is arranged to act as a tie rod which can be locked to the individual sections of the mast in turn. In this way the necessity for the provision of a special tie rod for this purpose is eliminated.

It has been found to be particularly advantageous for the tip of the jib to be connected by a cable of constant length to a counterjib pivoted to the mast of the crane on the opposite side. This counterjib is connected in turn to the load-carrying hook by means of a further cable of constant length fed over a direction-reversing sheave rotatably mounted on the platform. By means of this construction, the mast is caused to extend to its maximum height in every case while the desired inclination of the jib is obtained by appropriate adjustment of the load-carrying hook. The extending movement of the mast and the pivoting movement of the jib are mutually independent in this case. Since the load-carrying hook is arranged on the opposite side of the mast from the jib and in the manner of operation in point the equipment is not being used as a rotary tower crane, the winching arrangements provided can be employed to adjust the position of the jib.

According to a further preferred feature of the invention the movable telescoping portion can be slid into the traveling position by means of the guide portion pivoted to the platform, to an extent beyond the pivot point of the guide portion. This makes it possible to employ, in the traveling position, the otherwise wasted space between the pivot point of the guide portion and the front or rear end of the vehicle for the mast of the crane so that its individual sections can be made relatively long without increasing the overall length of the vehicle. At the same time a favorable weight distribution is obtained between the axles of the vehicle.

Preferably a number of hydraulic cylinders, arranged either side by side or superimposed, are used for the telescoping of the mast. Such an arrangement results in a relatively short length for a hydraulic cylinder in conjunction with a large overall stroke.

The means for accomplishing the foregoing objects and other advantages, which will be apparent to those skilled in the art, are set forth in the following specification and claims, and are illustrated in the accompanying drawings dealing with several embodiments of the present invention. Reference is made now to the drawings in which:

FIG. 1 is a side elevation of a first embodiment of the inventive transportable crane in which a three-section mast is employed as a simple derrick so that the vehicle operates as a jib crane;

FIG. 2 shows a longitudinal section through the carrier for the counterweight, in its retracted condition;

FIG. 3 shows the carrier of FIG. 2 in a side elevation and in its extended condition;

FIG. 4 shows the carrier of FIGS. 2 and 3 in plan view and in its extended condition;

FIG. 5 shows the mast of FIG. 1 being used as a derrick mast, i.e., the vehicle of the invention operating as a simple jib crane, a special arrangement being provided for automatically extending the mast with an increasing angle of tilt;

FIG. 6 shows the crane according to FIG. 1 employed as a rotary tower crane, the overall length of the mast or tower being varied to luff the jib;

FIG. 7 shows the vehicle of FIG. 1 in its position ready for erection and directly before erection of the mast;

FIGS. 8 to 10 show the steps of extension of the individual sections of the mast with the main jib acting as a tie rod;

FIG. 11 shows a further embodiment of the inventive transportable crane in its travelling position, the mast being made up to two sections;

FIG. 12 shows the vehicle of FIG. 11 with the mast half extended;

FIG. 13 shows the vehicle of FIG. 11 with the mast half extended and partially erected;

FIG. 14 shows the vehicle of FIG. 11 with the mast fully extended and partially erected and thus in the operative position for acting as a jib crane;
FIG. 15 shows, in plan view, the position of the hydraulic cylinder for the travelling condition of the vehicle of FIG. 11; FIG. 16 shows the position of the cylinder as in FIG. 15 but diagrammatically (it is not a side elevation); FIG. 17 shows, in plan view, the position of the cylinder for the half-extended position of the mast shown in FIG. 12; FIG. 18 shows diagrammatically the position of the cylinder as in FIG. 17; FIG. 19 is a section through the cylinder assembly taken along the line IX in FIG. 17; FIG. 20 is a section taken along the line X in FIG. 17; FIG. 21 shows, in plan view, the position of the cylinder for the fully extended position of the mast shown in FIG. 14; FIG. 22 shows a diagrammatic representation of the position of the cylinder as in FIG. 21; and FIG. 23 shows the transportable crane of FIGS. 11-22 in its position of operation as a rotary tower crane.

Referring to FIG. 1, the chassis 1 of a vehicle 2 carries on it a rotary platform 3 which can turn about a vertical axis 4. Supported on the rotary platform 3 is a crane mast or column 6 which pivots with respect to the platform about a horizontal axis 5. The angular position of the mast or column with respect to the platform 3 is adjustable to the desired value by means of a hydraulic ram 7. The mast or column 6 comprises sections 8, 9 and 10 which can be brought to the desired extended position by means of a pressure fluid ram 11 mounted within the mast or column. A main jib 13, which is pivotally connected to the head 12 of the mast 6, is provided at its free end with a cable-guiding sheave 14. On the side of the mast 6 opposite the main jib 13, there is mounted a short counterjib 15 which can be brought to any desired angular position by means of a retaining cable 16. An auxiliary bracket 17 is connected to the counterjib 15 at its bearing point and pivots with it. Load-carrying hooks 18 and 19 are secured, via sheaves 20 and 21, to cables 22 and 23 which are guided through the sheaves. On the rotary platform 3 there are counterweight means 24, which can be moved in and out according to the magnitude of the loads suspended on the hook 18 or 19. These loads are movable by means of a cable 26 from a cable drum or winch 25.

Referring now to FIGS. 2 to 4, which show the counterweight means 24 in detail, bars 30, which form a carrier for a counterweight 31, are slideable by means of a crank drive 29 engaging racks 27 and 28. The moment arm over which the counterweight 31 acts can thereby be adjusted to match the magnitude of the load carried by the crane. Where the equipment is to be employed as a rotary tower crane, as shown in FIG. 6, the carrier 30 and the counterweight 31 are slid from the locating side into guides provided for them in the rotary platform 3.

As shown in FIG. 5, the extension of the telescoping sections 33 and 34 of the mast or column 35 is effected by a tension cable 32 so that they extend to a correspondingly increasing extent with increasing extension of the ram 36, the latter increasing the angle of elevation of the mast with respect to the platform 37 of the vehicle 38, because the tension cable is secured at one end to an eye 39, fixedly mounted on the rotary platform 40 and its other end to an eye 41 fixedly mounted on the column section 34.

FIG. 6 shows the use, mentioned earlier, of the inventive equipment as a rotary tower crane erected on the rotary platform 41 of a vehicle 42. Again, the column comprises three sections 43, 44 and 45 which can be adjusted to any desired vertical position by means of a ram 46 and are supported in their upright position with respect to the platform 41 by means of a ram 48. Before the main jib 48 is swung up about a pivot point 47, said main jib 48 lies parallel to the longitudinal axis of the mast column. A cable run 49 passes from the free end 50 of the main jib 48 to the free end 51 of a counterjib 52 and is securedly anchored there. From this fixed point, the cable 49 passes over an auxiliary bracket 53, having a common pivot point 54 with the counterjib 52, to an eye 55 fixedly mounted on the rotary platform 41 where it is likewise secured.

When the sections 43 to 45 are extended, under the action of the ram 48, the jib 48 is swung to a position 48' and the counterjib moves to a position 52'. The cable 49 then extends along dashed line 49' between anchorage points 50' and 55'. On further extension of the sections 43 to 45, the main jib can also be brought to a position 48'' and the cable run 49'' now extends between anchorage points 50'' and 55. The counterweight 56, on carrier 57, is moved to the required extended position with respect to the platform 41.

Before the mast of FIG. 6, comprising the sections 43 to 45, is brought to the vertical position shown in the drawing, it lies in the horizontal position shown in FIG. 7 parallel to the chassis 58 of the vehicle 59. In this position the main jib 13 still lies on the section 43 of the column and the cable 49 is already connected in the manner described to its anchorage points 50, 51 and 55. On actuation of the ram 46 the mast comprising the sections 43 to 45 is erected. Then operation of the ram 46 causes the main jib 48 to swing out and up in the manner described earlier and simultaneously extends the individual sections of the mast.

FIGS. 8 to 10 show the unfolding of the equipment from the fully mobile position shown in FIG. 11 to FIG. 12, with the mast shown in FIG. 10. This last-mentioned position differs from that of FIG. 7 in that in the position shown in FIG. 7 the cable run 49 is present and the counterjib 52 is swung away from the mast. In particular, in the mobile position shown in FIG. 8, the sections 43 to 45 are telescoped together and the counterjib 52 is folded against the side of the mast. With the components of the structure in the side position, equipment can be readily moved by means of the vehicle 42.

In FIG. 9 the two movable sections 44 and 45 have been extended from the fixed section 43 by the use of the ram 46. In this position there is a locking section between an eye 60 on the fixed section 43 and the main jib 13, resulting in maintenance of the position of the section 45 on return movement of the section 44 under the action of the ram 46. The main jib 13 thus acts as a tie rod.

On return movement of the section 44, with respect to the section 45, the position shown in FIG. 10 is reached in which the sections 44 and 45 are now locked together by the use of a pin inserted at a point 61. The locking engagement at the eye 60 is released and the cable run 49, shown in FIG. 8, is set up, whereupon the further erection of the column comprising the sections 43 to 45 and the raising of the main jib can be performed as explained earlier with reference to FIGS. 6 and 7.

If it is desired that on lifting of the main jib there should not be a simultaneous change in the overall length of the mast, this result can be achieved by appropriate securing or retention of the counterjib so that the main jib can be raised independently of the position, at any given instant, of the head of the mast.

There is now explained in the following, in conjunction with FIGS. 11 to 23, a further embodiment of the transportable crane according to the invention in which the lifting of the main jib is obtained without a change in the height of the mast.

The vehicle shown in FIGS. 11 to 14 is provided with a platform 3 to which the guide portion 61 of the mast of the crane is pivoted at 5. The platform 3 is provided with a counterweight 24 so that, according to the manner of operation of the crane as a rotary tower crane or as a jib crane, the counterweight can be mounted on the front or the rear part of the platform. That part of the mast which projects forward beyond the pivot point 8 of the guide portion 61 can, according to the form of construction, be disposed either above the roof of the driver's cabin or alongside a driver's cabin which only takes up part of the width of the vehicle.

As shown in FIG. 12, the movable telescoping part 62 of the mast is extended about halfway by operation of the hydraulic cylinder assembly, which is shown in FIG. 7 to 7 mounted in the lower part of the guide portion 61 underneath the movable or extending portion 62 of the mast. During the extending movement, the main jib 63, which is pivoted to the head 67 of the mast, is raised and guided on the guide portion 61 by a roller 69. The roller 69 can be mounted in bearings on the jib, as shown in FIG. 12.
or two or more rollers 69e can be mounted on the guide portion 61, as shown in FIG. 13.

In FIG. 13 the mast is shown partially erected by means of a multistage hydraulic ram 7. This causes the mast to pivot about the pivot point 5.

FIG. 14 shows the mast in its fully extended position in the operating condition as a derrick-jib crane, with a hook 71 serving to lift the load. A cable extends from the latter over a sheave 72 to the cable drum or winch 73 mounted on the platform. Together with a bracket or counterjib 74, the sheave 72 is mounted on the head 67 of the mast on the opposite side of it from the main jib 68.

FIGS. 15 to 22 illustrate a preferred hydraulic cylinder arrangement for extending the mast.

As can be seen in FIGS. 15 and 16, there are three hydraulic cylinders 75, 76 and 77, the two cylinders 75 and 76 being arranged in parallel and actuated in common. It would also be possible to envisage an asymmetrical construction in which, for example, the cylinder 76 is omitted and the cylinder 75 is of correspondingly increased dimensions. Their attachment points 78 and 79 lie at the lower end of the movable extending portion 62 of the mast (see also FIG. 20). The attachment point 80 of the middle hydraulic cylinder 77 is at the lower end of the fixed guide portion 61 of the mast. The three piston rods 81, 82 and 83 are pivotally connected to a common transverse bar 84 which, on extension of the cylinder 77, is guided over the length of the stroke of the latter in guide rails 88 (shown in FIG. 19) provided on the extending portion 62. The extension of the mast occurs in the manner described in the following.

Starting with the parts in the position shown in FIGS. 15 and 16, the cylinders 75 and 76 are actuated so that the piston rods 81 and 82 are retracted. This displaces the extending portion 62 of the mast from its position shown in FIG. 11 to that shown in FIG. 12. At the end of this movement the three cylinders reach the position shown in FIGS. 17 and 18. Following this, or simultaneously with it, the middle cylinder 77 is actuated and causes the piston rod 83 to extend. This causes the movable portion 62 to become fully extended from the position shown in FIG. 12 to that shown in FIG. 14. The final position of the three cylinders is shown in FIGS. 21 and 22.

In FIGS. 11 to 23 the telescoping mast of the crane is illustrated as comprising an outer guide portion 61 and a single movable portion 62. The movable part can, however, comprise several portions to obtain very great extension heights and these again would be capable of sliding within one another by means of cylinder arrangements such as those described above or similar to those described.

FIG. 23 shows the crane of FIGS. 11 to 14 in its operative condition as a rotary tower crane. The counterweight 24 is now mounted on the rear end of the platform 3, as viewed in the direction of travel of the vehicle. The tip 84 of the main jib 68 is connected by a constant length tension cable 85 to the outer end of the counterjib 74. A further constant length tension cable 86 extends from counterjib 74 over a direction-reversing sheave 87, mounted on the rotary platform 3, to the load hook 71, which is not being employed as a load hook in this condition of operation. By this arrangement the luffing of the main jib 68 can be effected by causing the load hook to be fixed, or being lowered by its associated winch or drum 73. As can be seen in broken lines, the main jib 68 can be raised more and more steeply the higher the load hook is raised. In this manner, in contrast to the construction shown in FIG. 10, the height of the mast remains unchanged for all positions of the jib. The features described above could be combined as required in order to obtain a crane which matches the needs of the moment in the optimum manner.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

We claim:

1. A transportable multipurpose crane or derrick comprising a vehicle having thereon a platform which is rotatable about a vertical axis, mast means pivotally mounted on said platform, means for tilting said mast means with respect to said platform between a vertical and a horizontal position, main jib means pivotally mounted on that side of said mast means which is uppermost when the mast is tilted towards a horizontal position to be swung out thereforefrom in the plane of tilting of said mast means, sheave means mounted on said mast means on the side thereof opposite said main jib means, a load-carrying hook, cable means bearing said hook on a free end thereof and passing over said sheave means, winch means operatively connected to drive said cable means, said mast means comprising a plurality of telescopic sections, pressure fluid operated ram means operatively connected to position said sections, and said main jib means being folded against said mast means during travel and in this position serving as a tie rod selectively fixed to said mast sections during the extension of said mast means.

2. A crane or derrick according to claim 1 further comprising counterjib means pivotally mounted on said mast means on the side thereof opposite the main jib means, a cable-guiding sheave mounted on the free end of said counterjib means, first constant length cable means connected between the free ends of said main jib means and said counterjib means, direction reversing sheave means mounted on the platform, second constant length cable means connected to the free end of said counterjib means, about said reversing sheave means, and to said load-carrying hook.

3. A crane or derrick according to claim 1 further comprising counterweight means having at least one bar means slideably mounted in said platform with counterweights fixedly mounted on the free end thereof, said bar means and counterweights being symmetrical with respect to a line through the attachment point of said mast means to said platform and the center of rotation of said platform.