

- [54] CRANE
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212/4, 11, 14; 280/43.23

909,994 11/1962 Great Britain..... 214/392

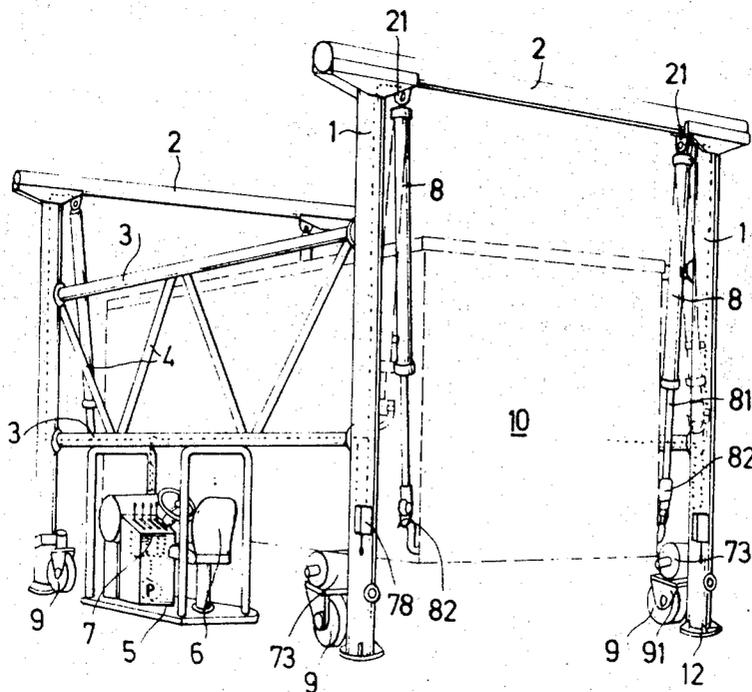
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[57] ABSTRACT

A gantry or portal crane has two longitudinally spaced portals which are connected by longitudinally extending structural members to form therewith a self-supporting structure. The lower ends of the uprights of the portals are provided with wheels which can be swung to a lower position engaging the ground and an upper position removed from the ground in which the lower ends of the portals rest directly on the ground. The upper ends of the portals are provided with transverse members each carrying two transversely spaced hydraulic and cylinder piston units which are connected for universal pivoting movement to them, and which are provided at their free ends with engaging portions for engaging a load. A hydraulic system is provided utilizing four separate hydraulic circuits each connected with one of the cylinder and piston units, a central control by means of which all of the cylinder and piston units can be operated in unison, and individual control valves located on the uprights of the portals by means of which each of these cylinder and piston units can be individually operated.

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9 Claims, 6 Drawing Figures



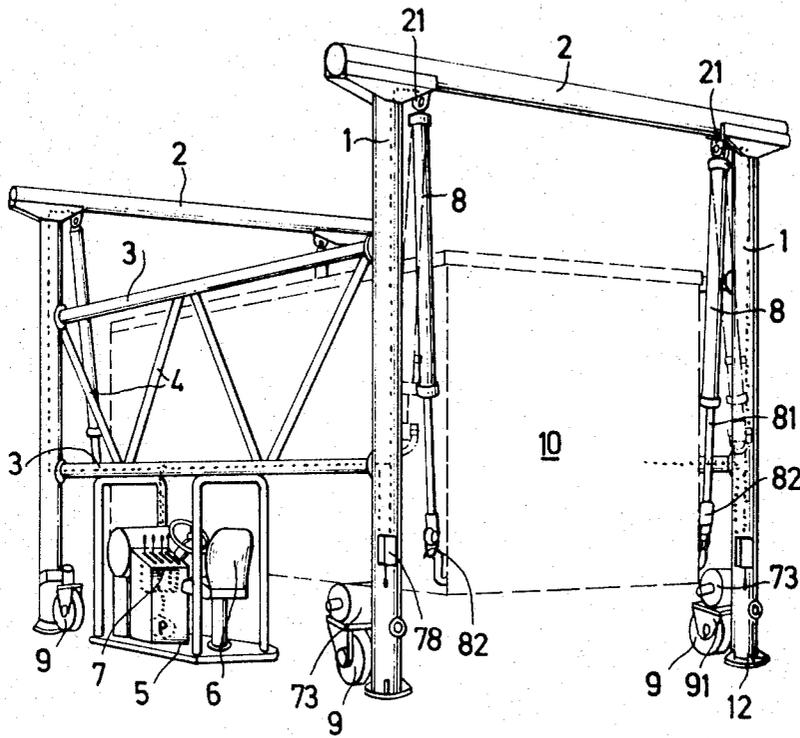


Fig. 1

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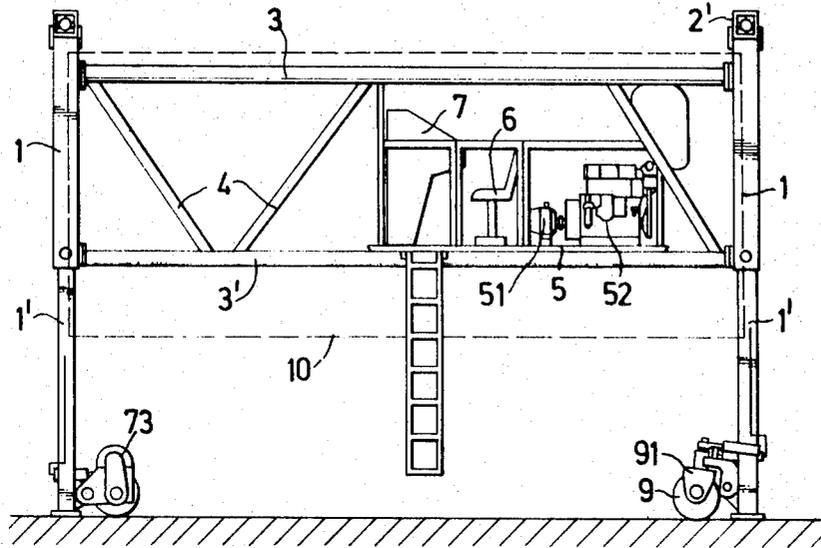


Fig. 2

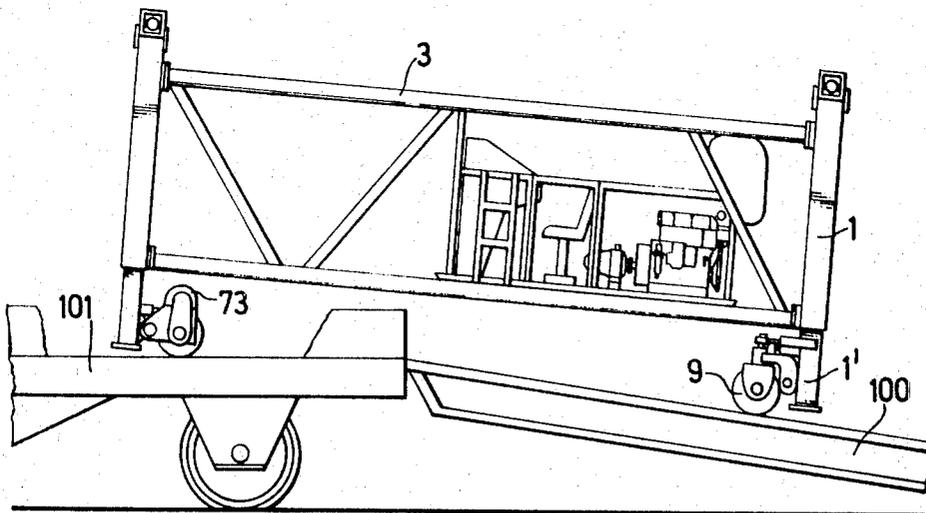
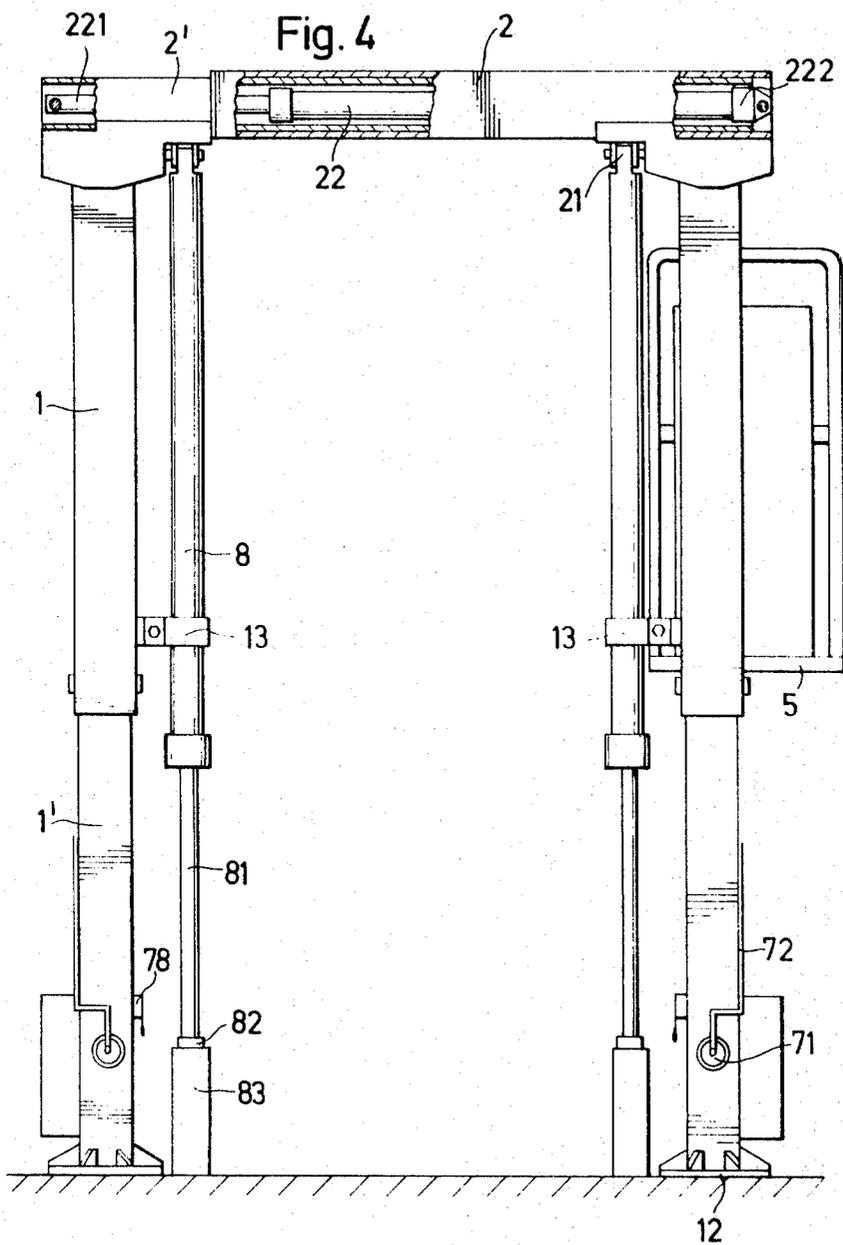


Fig. 3

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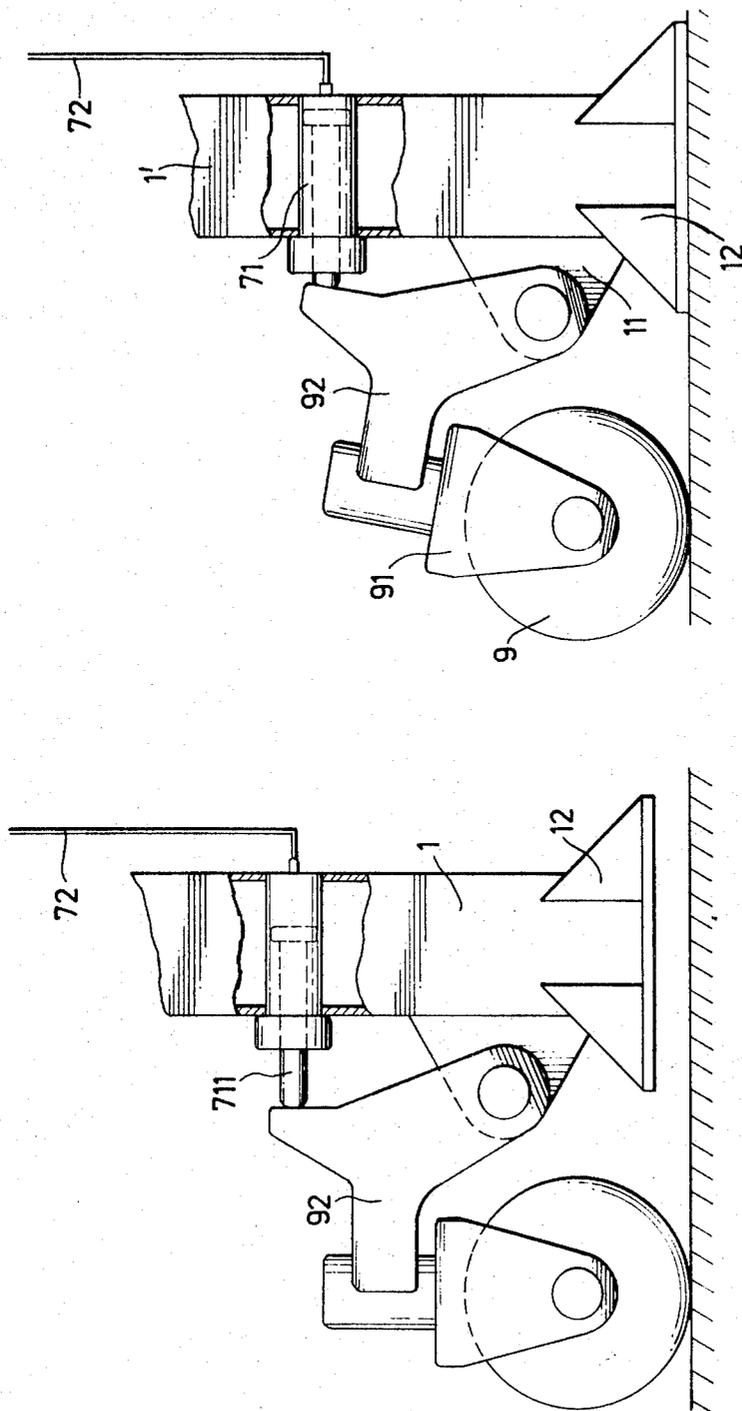


Fig. 6

Fig. 5

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CRANE

BACKGROUND OF THE INVENTION

The present invention relates generally to a lifting apparatus, and more particularly to a crane. Still more particularly, the present invention relates to a gantry or portal crane.

Cranes of this type are already known. They utilize two longitudinally spaced portals which are connected by structural members extending between them and uniting them into a self-supporting structure. The uprights of the portals are provided with wheels or rollers so that when the crane engages a load, it can be displaced from one location to another to which it is intended to deliver the load. This latter feature, however, poses a problem, because due to the forces acting upon the crane during such displacement, resulting both from the load the crane carries and also from stresses originating on uneven surfaces over which it must move, these known cranes are exceedingly massive and strong in their construction and therefore cumbersome. They are, and necessarily must be, provided with a central hydraulic system which acts both upon the drive, the steering mechanism and the load-lifting elements of the crane, and this is a rather expensive structural feature.

Experience has shown, however, that in many cases it is merely necessary to lift a load — for instance off a vehicle —, or to deposit a load, or to perform similar operations without having to engage the load with the crane and to move the crane bodily to another location. The art, having recognized this more limited requirement, already provides a type of crane in which the wheels secured to the portals will automatically be raised against a biasing force — and the lower ends of the uprights of the portals will automatically be lowered into engagement with the ground — as the crane engages a load which acts upon it in downward direction. However, it has been found that this construction brings with it a substantial danger of accidents because with a crane so constructed it is possible for the crane to roll and become displaced on an uneven surface before the lower ends of the portal uprights have fully descended into engagement with the ground.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to provide an improved crane of the type under discussion which is not possessed of the aforementioned disadvantages.

More particularly, it is an object of the present invention to provide such an improved crane which is less expensive in its construction than those known heretofore.

An additional object of the present invention is to provide such an improved crane which can be operated in a simple manner and which requires less and simpler servicing than was known heretofore.

An additional object is to provide such an improved crane which can more readily be used in different situations and which can be transported more easily than those known.

A concomitant object is to provide such an improved crane which can be controlled by a single operator despite its own size and the size and weight of loads which it is capable of handling.

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In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides, briefly stated, in a crane comprising a pair of longitudinally spaced portals each having at least two uprights provided with upper end portions connected by a traverse, and with lower end portions. Longitudinally extending structural members connect the portals to form therewith a self-supporting structure and displacing means at the lower end portions is provided for displacing the structure along the ground. At least a pair of load-engaging elements are pivotally connected to and depend from each traverse and these elements each comprise a hydraulic cylinder connected to the respective traverse, a piston displaceable on the cylinder and having an outwardly projecting piston rod provided with a free end, and an engaging portion on the free end for engaging a load. Furthermore, the novel crane comprises a hydraulic circuit for the elements including a plurality of hydraulic circuits each associated with one of the elements, central control means associated with all of these circuits for operating all of the elements in unison, and individual control means each associated with one of these circuits for operating the elements individually.

A crane constructed in accordance with the present invention overcomes the disadvantages outlined above with respect to the prior art. It also achieves the advantages which have been set forth as desirable, and in particular it makes possible the handling of large-dimensioned and heavy loads under the control of only a single operator. This is highly advantageous, not only because it avoids the expense involved in having a second operator connect and disconnect the load from the crane, but also in that it avoids the danger to such a second operator which exists where a crane is centrally controlled by the first operator and where the second operator can communicate with the first operator at the central control stand only by shouting whereas visual communication may often be completely lacking, for instance if the crane engages large-dimensioned containers which block the view.

The individual control means is preferably provided within ready reach of the engaging portions on the free end of the respective piston rods, so that the operator can manipulate the engaging portion of a given piston rod with one hand, and control the cylinder and piston unit with which the piston rod is associated, with the other hand. Normally, the individual control means will advantageously be located on the uprights of the respective portals. They will usually be in form of control valves interposed in the hydraulic circuit associated with the respective cylinder and piston unit.

The cylinder and piston units utilized according to the present invention are pivoted for universal movement, for instance by means of ball-joint connections. The use of hydraulically controlled cylinder and piston units in itself is not novel, but it is known from the prior art only to use them individually or to mount them at the four corners of a load-lifting structure where they are always engaged at one and the same point. The utilization of a universal pivot mount has not heretofore been proposed.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages

thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic perspective view illustrating a crane, according to the present invention, with a load in lifted condition;

FIG. 2 is a side view of a further embodiment;

FIG. 3 shows the embodiment of FIG. 2 in a telescoped condition;

FIG. 4 is an enlarged detailed view of FIG. 2, seen from the left-hand side thereof;

FIG. 5 is an enlarged detailed view illustrating the wheel mount of the crane according to the present invention in a position in which the wheel is ready for displacement of the crane; and

FIG. 6 is a view similar to FIG. 5 but illustrating the wheel mount in a position in which the crane rests on the lower end portions of the uprights in the portals.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly the embodiment illustrated in FIG. 1, it will be seen that the crane shown there is a crane construction of light steel tubes which, however, are sufficiently strong for lifting and operating purposes. The crane has two portals which are longitudinally spaced and which each have two upright posts 1 and a traverse 2 connecting the upper end portions. The portals are connected by longitudinally extending structural members 3,3' which in turn are connected by diagonal braces 4. A control platform or gondola 5 is suspended from one of the structural members 3' so as to be located closely above the ground and carries a seat 6 for an operator and a central hydraulic control unit 7 including the not separately illustrated hydraulic pump and drive therefor. By locating the gondola 5 closely above the ground, we obtain the advantage that the operator can readily move about, that is move from the gondola 5 to any other part of the crane, simply by stepping down onto the ground rather than having to climb down, as is customary in the known portal cranes where the control platform is located high above the ground. Furthermore, the operator is afforded a clear view of the entire loading area when the load engaged by the crane is in raised condition.

According to the invention each of the transverses 2 has connected to it by means of known ball and socket joints two hydraulically operable cylinder and piston units 8. Thus, these units 8 can be universally pivoted which makes it possible to move the connecting elements 82 provided at the free end portions of their piston rods 81 to various different locations, making it possible to engage the load 10—which is shown in FIG. 1 in broken lines—at different locations depending upon individual requirements. Thus, if for instance the portals are spaced from one another longitudinally by a distance of 6 meters, the units 8 can engage the load 10 at different locations within the range of 5 and 7.5 meters. It goes without saying, of course, that the capability of lateral pivoting movement of the units 8 can be reduced to lesser figures if this is desired.

The hydraulic system for raising or lowering the load 10 utilizes four independent hydraulic circuits each of which is associated with one of the units 8. This assures

that the units 8 cannot influence one another, for instance, as a result of differential loading. Each of these circuits can be controlled from the central control, so that all of the units 8 can be controlled and operated in unison.

In addition, however, each of the units 8 can be individually controlled, for which purpose there is located within reach of the operator of the respective piston rod 81—preferably, and as illustrated in FIG. 1 on the upright 1 adjacent to the respective unit 8 is mounted—an individual control valve 78 which is interposed in the associated circuit and permits raising or lowering of the piston and piston rod to make it possible for the operator to engage the engaging portion 82 at a desired location of the load 10. When thus all four engaging portions 82 have been individually secured to the load 10 in this manner, further raising or lowering movements of the units 8 can be centrally controlled in unison from the central control 7 located on the gondola 5. Because of this arrangement, the cylinders 8 will all operate in unison and entirely equally, and the speed of lowering will advantageously be maintained constant via flow-limiting valves of known construction. Of course, the individual control valves 78 make it possible to operate the units 8 rapidly for extending or retracting the piston rods when the units 8 are not connected with a load or when they are connected only with a light load.

The crane is movable and for this purpose the lower end portion of each of the uprights 1 is provided with a wheel 9 which is turnably journaled in a bifurcated mounting member 91. The mounting members 91 in turn are pivotably connected, as shown by comparison of FIGS. 5 and 6, via an arm 92 to member 11 secured to the lower end portion of the respective upright 1. The member 11 may for instance be welded to the respective upright 1 and the latter are each provided with a base plate 12. In each of the uprights 1 there is mounted a transversely positioned hydraulic cylinder 71, the piston rod 711 of which abuts against the arm 92 as shown in FIG. 6 so that, when hydraulic fluid is admitted to the respective cylinder 71 via the associated conduit 72, pressure of the piston rod 711 on the associated arm 92 displaces the respective wheel to ground-engaging rolling position, forcing thereby the associated upright 1 to be lifted off the ground as shown in FIG. 6.

Hydraulic motors 71 with associated gear drives are provided for driving the wheels of one of the portals and it is advantageous that the construction of these drives is such that the crane can negotiate the commonly-used ramps having an incline of 14°. There are also provided hydraulic brakes (not illustrated) which are so dimensioned that they can reliably hold the device under operating circumstances.

When the crane is to be moved on its wheels, the hydraulic system is switched to drive mode in which one of the the four independent hydraulic circuits acts to supply the cylinders 71 and the non-illustrated steering mechanism. The remaining three circuits can be individually or jointly switched for supplying the hydraulic motors 73 and this makes it possible to obtain three different drives speeds within which by suitable drive control the speed can be continuously varied.

It will be appreciated that the location of the central control means 7 on the gondola 5 has an additional advantage beyond those mentioned earlier, namely that

the entire gondola with the control unit, as well as the pump and the drive therefor, can be constructed as a unit and can be replaced in case of necessity. Also, this construction facilitates maintenance work.

The arrangement and mounting of the wheels in the manner described corrects the danger of accidents inherent in the prior-art constructions because accidental rolling displacement of the unit is avoided. Furthermore, overpressure valves in the supply conduits leading to the cylinder and piston units controlling the displacement of the wheels, can assure that lifting of the load with the wheels in downwardly displaced rolling condition does not lead to damage, for instance of the wheel axles. The weight of the crane itself is relatively small and this makes it possible to use the simple wheel mounts which have been disclosed, and also to use solid-rubber wheels rather than the balloon wheels which are customary in the prior art. Of course it is also possible to utilize a hydro-pneumatic spring arrangement for even load distribution to all four wheels, if desired.

Under certain circumstances, for instance when the crane is to be transported from one location to another, it is desirable to be able to vary its overall dimensions, and more particularly to decrease them temporarily. For this purpose, the cylinder and piston units which normally lift the load, and which as previously pointed out are universally mounted by means of ball and socket joints or the like, are constructed as double-acting cylinder and piston units capable of providing both push and pull action. Hence, sections can be provided which can be connected with the free ends of the piston rods of these units, and the cylinders of the units can be arrested in upright position by being secured to the upper end portions of the respectively associated uprights of the portals. This construction makes it unnecessary to provide separate hydraulic means for moving the portal uprights from the transport position because the piston rods, extended by the extending sections, can now bear against the ground when their associated pistons are operated, thereby causing the uprights — which of course in this construction consist of telescopic sections — to be upwardly extended or telescoped apart. Once they have reached the desired extended positions, the telescopic sections of the uprights are then arrested with reference to one another and the cylinders can be retracted and the extending sections removed so that the cylinders will now be used for engaging a load in the manner discussed earlier. The affixing and removal of the extending sections is of course greatly simplified by the provision of the individual control valves which are located within reach of the respective cylinder and piston units, and the individual control of each such unit.

The traverses in such a construction may also be made telescopic in that each is provided with a separate cylinder and piston unit, the cylinder of which is connected with one and the piston or piston rod of which is connected with the other telescopic section of the respective traverse, so that the traverses may be shortened or lengthened in dependence upon operation of the respectively associated cylinder and piston unit. The filled cylinder chamber, that is the cylinder chamber filled with fluid, here eliminates the need for a separate mechanical arresting arrangement for arresting the telescopic sections of the traverses in desired position. It is advantageous to have the traverses be connected with the upper ends or laterally thereof of the uprights,

so that the interior of the telescopic sections of the traverses are readily accessible for maintenance purposes from their open ends.

With such a construction, the portals may be made both narrower and lower, and when the unit has been transported to the location where it is to be used, the portals can then be restored to their original size. The posts of the portals can be telescoped apart while the units are stationary, and the traverses may be telescoped apart while the unit moves slowly on its wheels. The unit can move on its own wheels, driven by its own drive, both as its various components are telescoped apart and as they are telescoped together to reduce the size of the unit. It can thus move onto and off conventional ramps, including to and from a transporter which may be used for transporting the unit over substantial distances where moving of the unit under its own drive would not be practicable.

Such an embodiment is illustrated in FIGS. 2—4. Here, the uprights of each portal are each composed of two telescopic sections 1 and 1' and the traverse of two telescopic sections 2 and 2'. The sections are preferably of quadratic or rectangular cross section. The longitudinally extending structural members are not telescoped and are again identified with reference numerals 3 and 3', being connected by the diagonal braces 4. The control gondola is again identified with reference numeral 5 and has the seat 6, being provided with the drive 51 for a hydraulic pump 52 and the central control means 7.

A hydraulic cylinder 22 is accommodated in the telescopic sections 2,2' of a traverse and has a piston rod 221 which is connected with one section and a cylinder 222 which is connected with the other section of the traverse. The unit 22 can be activated from the gondola 5 as shown in FIG. 4. After its piston rod 221 is extended from the cylinder, fluid flow is blocked and the fluid-filled cylinder chamber makes it unnecessary to provide mechanical arresting means for arresting the sections 2,2' against other telescopic movement. When the sections 2,2' are to be telescoped together or apart, the crane is advanced on its wheels over a short distance, and during this time the necessary telescoping action is carried out.

The uprights composed of the sections 1,1' are telescoped by means of the hydraulic cylinder and piston units 8' which replace the units 8 of the preceding figures. The units 8' are of the double-acting type and their cylinders can be arrested at the upper end portions of the sections 1 by means of arresting means 13. Extending sections 83 are releasably secured to the connecting portions 82 on the piston rods 81 and, when fluid is now supplied to the cylinders, the piston rods 81 move downwardly until the extending sections abut against the ground, thereby raising the traverse 2,2' with the upper sections 1 with reference to the lower sections 1', that is telescoping the upper sections out of the lower sections 1'. In the selected telescoped position, the sections 1,1' are mechanically connected with one another in suitable manner which does not in itself form a part of the present invention, and the device is now ready for use.

The provision of the separate control valves 78 for the individual cylinder and piston units 8' near the uprights 1,1' is particularly important, because it makes it possible to connect each of the individual extending sections 83 with a piston rod, putting it in place by posi-

tioning it on the ground and exerting —by suitably controlling the extension of the piston rod of the respective cylinder and piston unit 8'— light downward pressure to hold it in place until all of the units 8' are similarly provided with the extending sections 83 and can then be controlled in unison for raising to their desired height.

In FIG. 2 the crane according to the embodiment of FIGS. 2-4, is shown supported on its uprights and holding the lifted load 10. In FIG. 3 the crane is shown in telescoped —collapsed— condition rolling onto a flat-bed 101 up a ramp 100 with its wheels 9 and under the action of its own drive.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a crane, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A crane, comprising a pair of longitudinally spaced portals each having at least two uprights provided with upper end portions connected by a traverse, and with lower end portions; longitudinally extending structural members connecting said portals to form therewith a self-supporting structure; displacing means at said lower end portions for displacing said structure along the ground; at least a pair of load-engaging elements pivotably connected to and depending from each traverse, said elements each comprising a hydraulic cylinder connected to the respective traverse, a piston displaceable in said cylinder and having an outwardly projecting piston rod provided with a free end, and an engaging portion on said free end for engaging a load; and a hydraulic system for said elements, comprising a plurality of hydraulic circuits each associated with one of said elements, central control means associated with all of said circuits for operating all of said elements in unison, and individual control means comprising individual valves each located on one of said uprights and interposed in said circuits for operating said elements individually.

2. A crane as defined in claim 1, said hydraulic system further comprising a pump, and a drive for said pump; and a control platform suspended from at least one of said structural members intermediate said portals and located proximal to the ground, said control

platform supporting thereon said pump, drive and central control means of said hydraulic system.

3. A crane as defined in claim 1, said displacing means comprising a plurality of wheel units.

4. A crane as defined in claim 3, each of said wheel units comprising a bifurcated wheel support, pivot means mounting the respective wheel support to one of said lower end portions for vertical movement about a pivot axis, and at least one wheel mounted in the respective bifurcated wheel support.

5. A crane as defined in claim 4; and further comprising a plurality of cylinder and piston units each carried by one of said uprights and cooperating with one of said wheel units in a sense effecting, when operated, pivotal displacement of the respective unit in a substantially vertical plane from a raised position to a lowered ground-engaging position.

6. A crane, comprising a pair of longitudinally spaced portals each having at least two uprights provided with upper end portions connected by a traverse, and with lower end portions; longitudinally extending structural members connecting said portals to form therewith a self-supporting structure; displacing means at said lower end portions for displacing said structure along the ground; at least a pair of load-engaging elements pivotably connected to and depending from each traverse, said elements each comprising a double-acting hydraulic cylinder connected to the respective traverse, a piston displaceable in said cylinder and having an outwardly projecting piston rod provided with a free end, and an engaging portion on said free end for engaging a load; a hydraulic system for said elements, comprising a plurality of hydraulic circuits each associated with one of said elements, central control means associated with all of said circuits for operating all of said elements in unison, and individual control means each associated with one of said circuits for operating said elements individually; arresting means for arresting said cylinders in upright orientation; and extension sections connectable with said piston rods for extending the length thereof so that, at the will of an operator, said elements may be used without said extension sections for engaging a load, or be arrested in upright orientation and connected with one of said sections.

7. A crane as defined in claim 6, wherein each traverse is composed of at least two telescopable tubular sections.

8. A crane as defined in claim 7; and further comprising hydraulic cylinder and piston units in each traverse and operable for telescoping said tubular sections thereof.

9. A crane as defined in claim 1, said displacing means comprising a plurality of wheel units each having a bifurcated wheel support pivotably mounted to one of said lower end portions for vertical movement about a pivot axis, at least one wheel mounted in said wheel support, and a hydraulic cylinder and piston unit mounted in the respective upright and having a piston rod acting upon the associated wheel support for pivoting the same about said pivot axis.

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