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[54] **RESTRAINT APPARATUS FOR A MOBILE STRUCTURE**

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[52] **U.S. Cl.** **188/38**; 188/60

[51] **Int. Cl.** **B61h 7/12**

[58] **Field of Search** 188/38, 38.5, 40–44, 188/60, 31, 69

[56] **References Cited**

UNITED STATES PATENTS

450,532	4/1891	Runser	188/38.5 UX
703,818	7/1902	Plattenburg	188/40
834,961	11/1906	Balch	188/38
1,613,965	1/1927	Sheal	188/41 X
2,817,418	12/1957	Vial	188/69
2,970,445	2/1961	Suderow	188/44 X
2,996,154	8/1961	Vial	188/31 X
3,741,349	6/1973	Banks	188/42

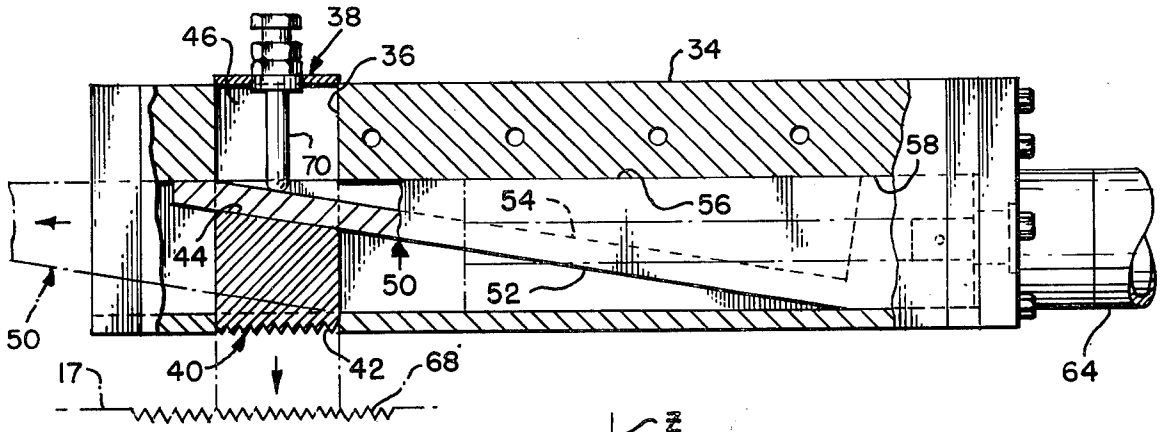
Primary Examiner—Duane A. Reger

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[57] **ABSTRACT**

A mobile crane rides on rails in a trench. The trench is provided with a pluality of vertical serrations. Pads having mating serrations are provided on the crane. A wedge is movable behind each pad to force the serrations of the pad into engagement with the serrations on the trench. The wedge locks the crane against movement transversely of the rail while the serrations lock the crane against longitudinal movement. Modifications are shown using pins rather than serrations and multiple wedges rather than single wedge and pad.

10 Claims, 10 Drawing Figures



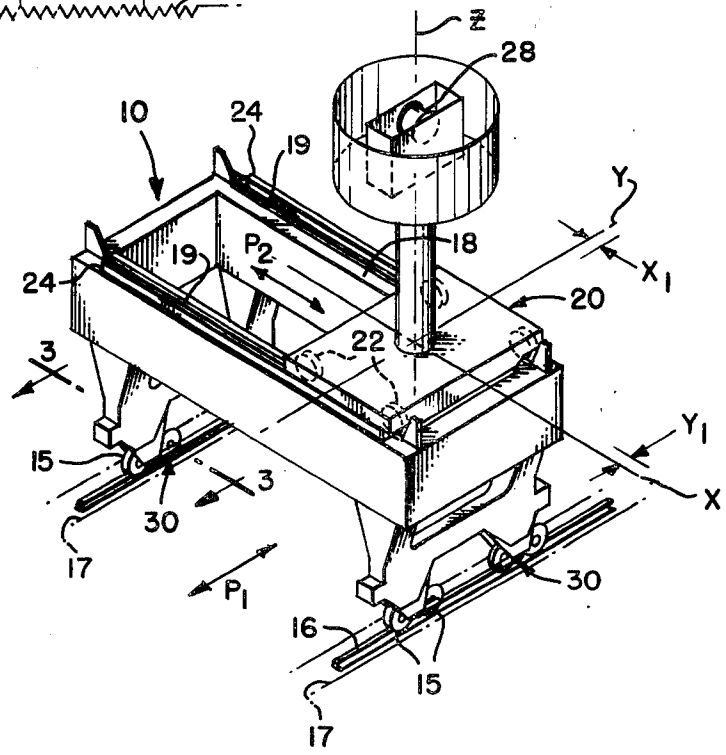


FIG. 1

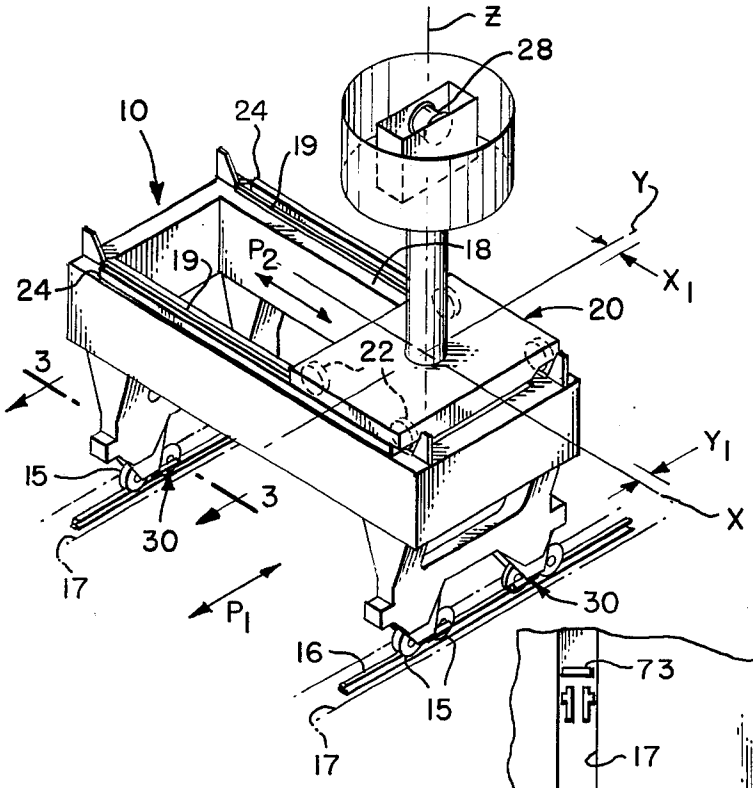


FIG. 2

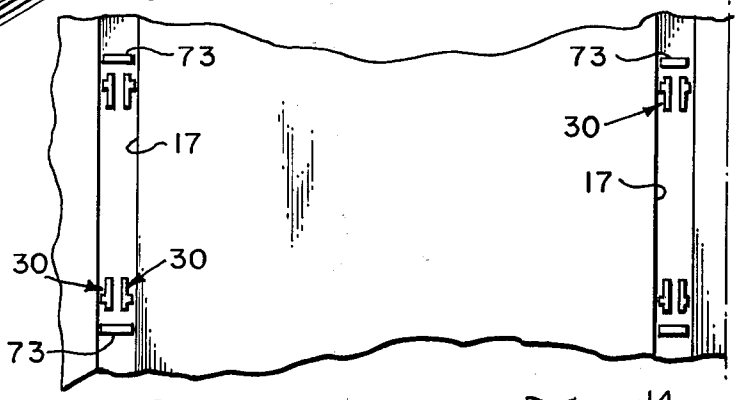
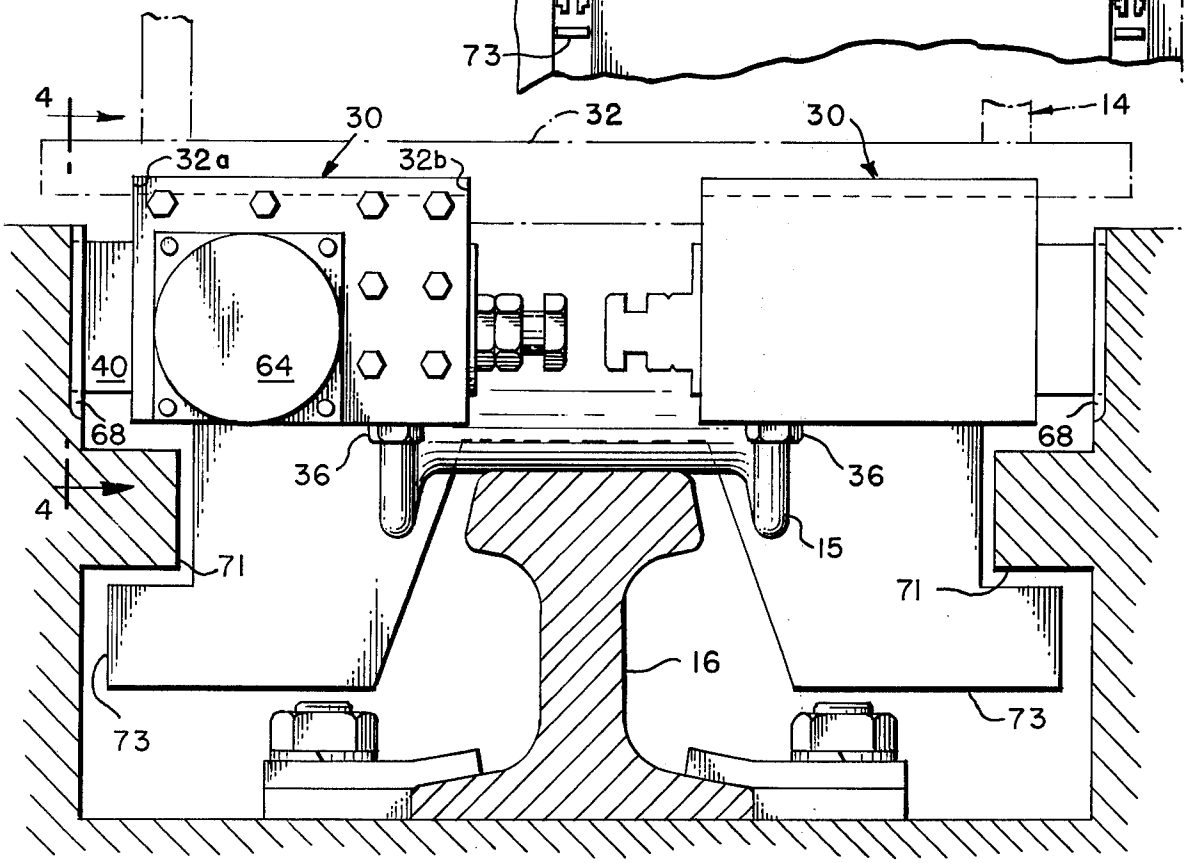


FIG. 3



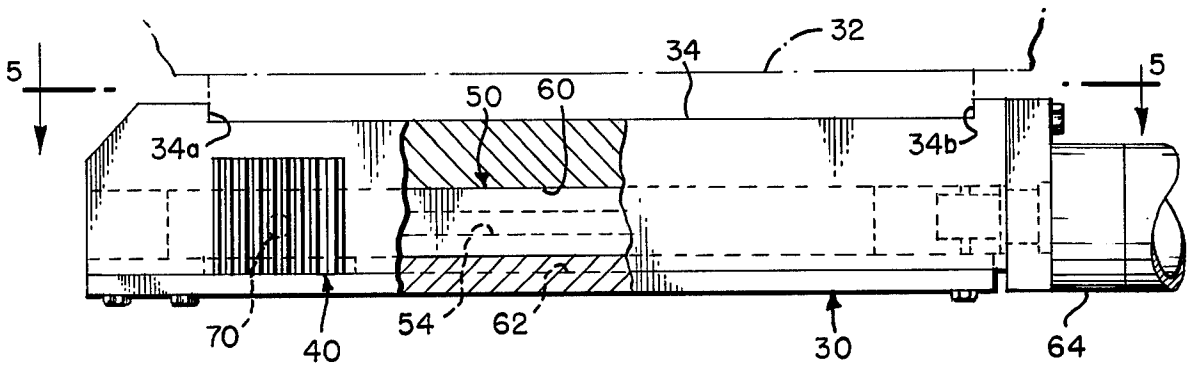


FIG. 4

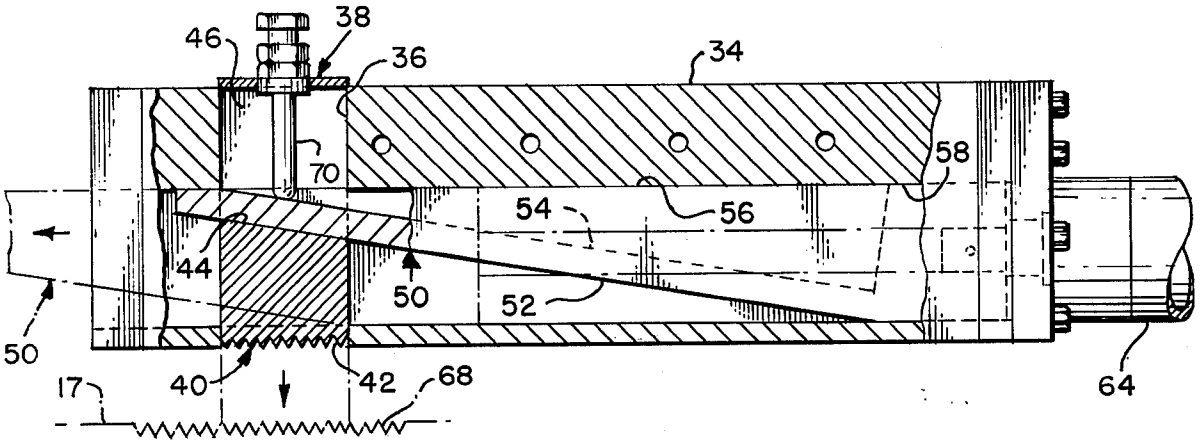


FIG. 5

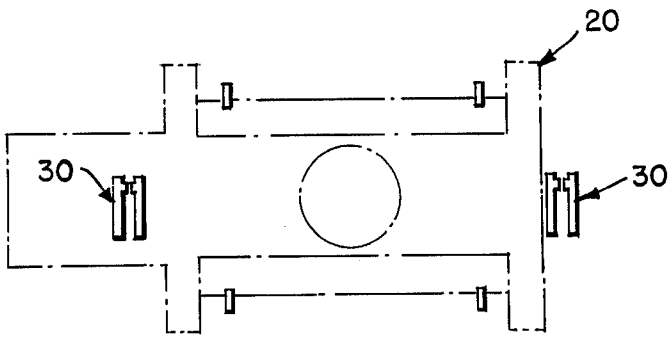
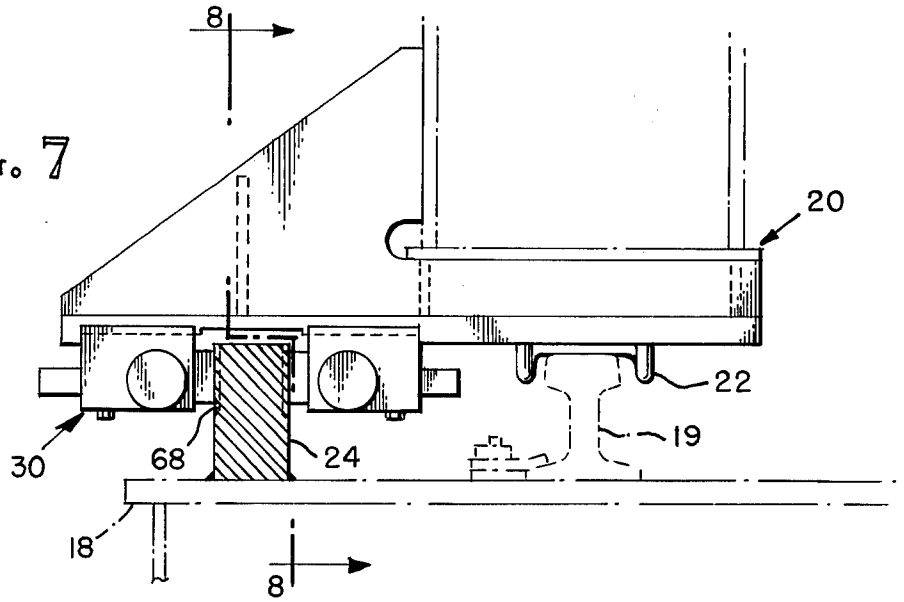


FIG. 6

FIG. 7



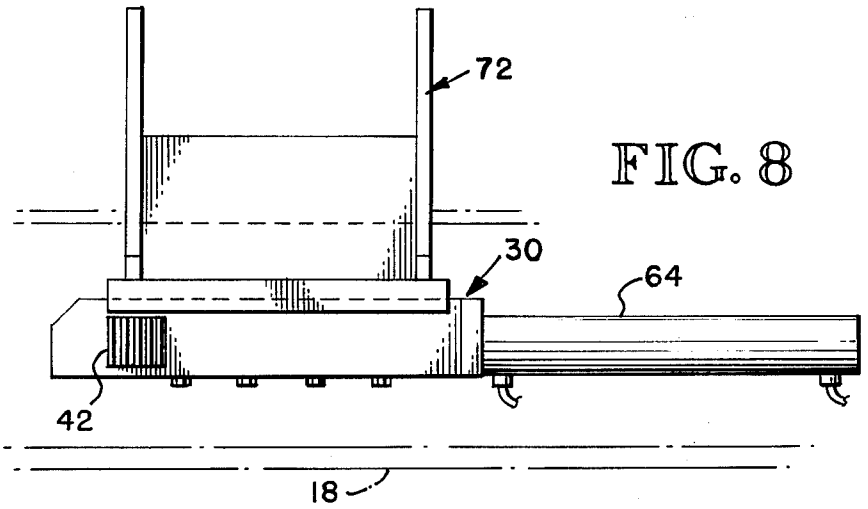


FIG. 8

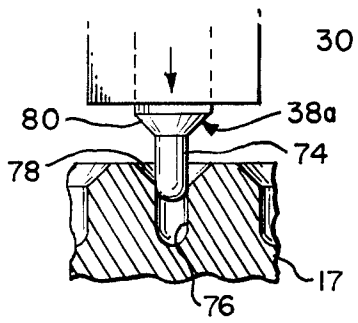


FIG. 9

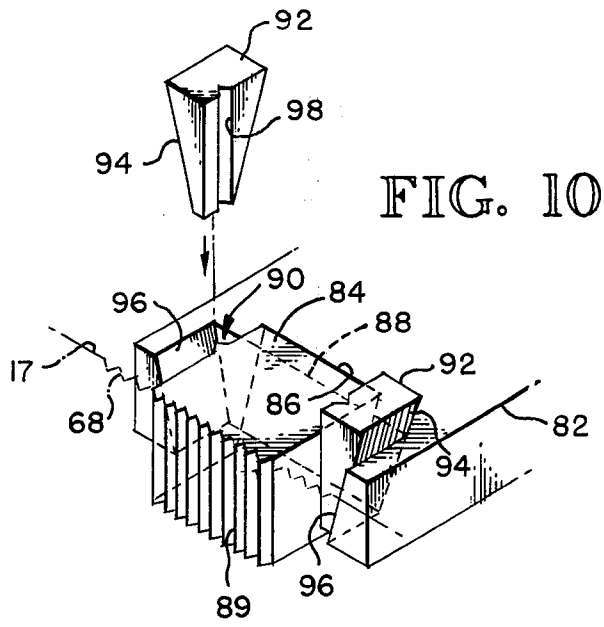


FIG. 10

RESTRAINT APPARATUS FOR A MOBILE STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to restraint devices for mobile structures which are generally guided along a predetermined path.

2. Description of the Prior Art

Mobile structures, such as gantry cranes, bridge cranes, trolleys mounted on cranes, etc., have frequently required a restraining apparatus to hold the mobile structure rigid relative to some reference or base. Conventional techniques have utilized brakes on the wheels of the mobile structure or various types of clamps which clamp the rail upon which the mobile structure is supported. While these braking and clamping devices are suitable for relatively light weight structures, they are not adequate for restraining relatively heavy mobile structures under dynamic loading conditions.

One particulary acute problem with large heavy mobile structures is that the wheels are generally free to float on the rails, that is, move laterally a restricted amount on the rails, thus precluding the use of the rails or the surface along the rails as a reference medium for locking the crane. As a result the crane must be restrainable regardless of its position in the X and Y axes of movement at any particular instant.

SUMMARY OF THE INVENTION

Basically this invention provides a means for restraining to extremely close tolerances under dynamic loading large heavy mobile structures. One application, for example, is to restrain a **250** ton gantry crane against movement under dynamic loading caused by an earthquake. It is also an object of this invention to provide a restraint device for mobile structures which can be confined in a small area and is inexpensive to manufacture and maintain. Another object is to provide a restraint device which can be actuated with a minimal amount of power or by hand. Another object is to provide a restraint device that locks the cranes in any desired position without relying on a predetermined reference datum.

These objects are best obtained by uniquely utilizing a simple wedge between the mobile structure and some fixed anchoring means adjacent to the mobile structure. In the preferred embodiment, the wedge urges a serrated pad into engagement with serrations on the anchoring member with the wedge providing restraint in the transverse direction and the serrations providing restraint in the longitudinal direction. The wedge concept allows the crane to be locked in place regardless of its position along the X and Y axes of movement. Furthermore little power is required to insert the wedge. Other modifications are available, such as providing multiple wedges for both the transverse and longitudinal restraint and/or providing pins passing into openings rather than serrations.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWING

FIG. **1** is a schematic isometric of a mobile structure embodying the principles of the invention.

FIG. **2** is a schematic illustration locating the restraint devices on the apparatus of FIG. **1.**

FIG. **3** is a framentary vertical section taken along the line **3—3** of FIG. **1.**

FIG. **4** is a framentary vertical view taken along the line **4—4** of FIG. **3.**

FIG. **5** is a plan view of the apparatus taken along the line **5—5** of FIG. **4.**

FIG. **6** is a schematic illustration locating second restraint devices for a trolley on the crane.

FIG. **7** is a fragmentary vertical section of a restraint device shown in FIG. **6.**

FIG. **8** is a fragmentary vertical of the restraint device taken along the line **7—7** in FIG. **7.**

FIG. **9** is a schematic illustration of a modified form of restraint device.

FIG. **10** is a further modified form of restraint device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As is best shown in FIG. **1,** a mobile structure, such as a gantry crane **10,** is provided with side frames **12** supported on trucks **14.** The trucks **14** have wheels or rollers **15** that ride on a rail **16** in a trench **17.** While it is important that the wheels be generally guided in some form of path, it is not necessary that the path be located in a trench but rather only that some fixed structure be provided along side of the path which provides an anchoring means to which the crane can be locked. The side frames **12** support beams **18,** each of which is provided with a rail **19.** Mounted on the rails **19** is a second mobile structure, such as a trolley **20,** having its own set of wheels **22.** Anchoring means in the form of a restraint bar **24** is positioned along side the rails **19.** As is well understood, the gantry can move along path P–1 whereas the trolley can move along the path P–2 at right angles to the path P–1.

The trolley is provided with a hoist **28** for lifting objects. Conventional power means, not shown, are utilized to move the gantry and trolley in their respective paths to position the hoist over the object to be lifted. An axis Z indicates a line coincident with the center of the object being raised. Axis Y illustrates a line through the object parallel to the path P–1, whereas axis X indicates a line through the object perpendicular to the path P–1. It is the primary purpose of this invention to restrain movement of the mobile structures through a distance not to exceed some tolerance X–1 along the Y axis and Y–1 along the X axis. Utilizing the apparatus of this invention, it has been found that once the trolley and gantry are locked into place, the only movement off the axis Z will be by as a result of deflection internally of the gantry and trolley.

As best shown in FIG. **2,** restraint devices **30,** four in number in the preferred embodiment, are provided on each side frame **12.** Each of the restraint devices **30** are identical therefore only one will be described. The restraint device is rigidly secured to a plate **32** that is an integral part of a box frame which makes up the truck **14.** The restraining device comprises a housing **34** that fits within notch surfaces **32***a* and **32***b* of the bottom plate **32** to lock the housing against transverse movement. Bolts **36** locate the housing on the bottom plate but the shear loads are born primarily by the notch surfaces in the bottom plate. Likewise, as best shown in FIG. **4,** the housing **34** is provided with notch surfaces **34***a* and **34***b* which receive the bottom plate **32.** The notch surfaces **34***a* and **34***b* again pass the shear force in the longitudinal direction directly to the plate **32.**

As best shown in FIGS. 4 and 5, the housing 34 is provided with a transverse opening 36 which receives a slidable bracket 38. The outer end of the bracket is provided with a serrated pad 40 having vertical serrations 42. The bracket 38 can move in a transverse direction but is restrained by the side walls of the opening 36 from movement in the longitudinal direction. The inner end of the pad 40 is provided with a sloped shoulder 44. Between the sloped shoulder 44 and the end of the bracket 38 is a space 46 which allows movement of the bracket in a manner to be described. The restraint device is also provided with a wedge 50 having a sloped forward surface 52 in engagement with the sloped shoulder 44 and a rearward slot 54 parallel to the sloped forward surface 52. The rearward wall 56 of the wedge rides on a guide surface 58 and the sidewalls ride between two guide plates 60 and 62. A pneumatic ram 64 is coupled to an end of the wedge for reciprocating the wedge. As is best shown in FIG. 5 extension of the piston rod of the ram 64 moves the wedge to the left. The sloped surface 44 is pushed laterally outwardly of the housing 30, moving serations 42 into engagement with a vertically serrated surface 68 of the trench 17. In the event the teeth of the serrations do not mesh the dynamic loading of the crane while the cylinder remains pressurized will provide sufficient deflection of the crane to shift the serration 42 and move into engagement with the serrations 68 thus firmly locking the crane against the trench. Retraction of the piston rod moves the slotted surface 54 against an abutment screw 70 which is fastened to the rear of the bracket 38. The abutment screw slides along the slot retracting the pad 40 from the serrations of the trench thus freeing the crane for movement. As is readily apparent, movement of the wedge requires little power.

It is important to note that the wheels 15 are free to slide transversely on the rail 19. Due to the enormous loading and weight of the crane it has been found that deflection in the structural members of the crane require that the wheels be free to move laterally on the rail to a limited extent. Because of this movement there is no absolute reference with which to establish the position of the Z axis relative to the X and Y axes. The operator aligns the crane over the object T to be lifted (Z axis) and once so positioned the crane is then locked by the restraint device on the Z axis regardless of its position relative to the rails.

As best shown in FIGS. 6, 7 and 8 the restraint device is also usable outside of a trench, as for example, on the trolley 20. In this embodiment identical restraint apparatus 30 are secured to a cantilevered platform 72. A total of four restraint devices are used on the entire trolley 20, as is best shown in FIG. 6. The restraint devices will be positioned approximately midway between the wheels 22 on the trolley. The details of the restraint device 30 used with the trolley are identical with that employed with the gantry in FIGS. 1–5. The serrations 68, however, rather than being in a trench, would be on the restraint bar 24.

Uplift restraints 73 are also provided on the trucks 14 for engagement with a lateral projection 71 in the trench 17. Suitable uplift restraints are also provided on the trolley 20.

A modified form of restraint device 30 is illustrated in FIG. 9. Basically, the structure is identical with the restraint device for the preferred embodiments with the exception that a bracket 38*a* has a pin 74 engagable in one of a plurality of spaced openings 76 in the trench 17. The pin is extended into engagement with the sloped surface 78 of the opening 76 with the crane being moved slightly to allow the pin to index into the opening to lock the crane against movement along the trench 17. A sloped surface 80 on the pin 74 will be abutted aganist the sloped surface 78 to lock the crane against lateral movement relative to the trench 17.

In FIG. 10, still a further embodiment is shown. In this embodiment a framework 82 is securely fastened to the truck 14. A central wedge 84 having a rearwardly sloped surface 86 is dropped into the framework 82 and against an outwardly and downwardly sloped surface 88 on the framework. In this manner, the wedge 84 moves laterally outward of the crane into engagement with the serrations on the trench 17. For this purpose the wedge 84 has serrations 89 which mesh with the serrations 68 of the trench. At this time, the crane is locked against movement laterally. The wedge also fits in an opening 90 which is larger than the length of the wedge in a direction parallel to the trench 17. In this manner, the serrations 89 and 68 will match up since the wedge is free to move longitudinally of the trench. Next two side wedges 92, each having rearwardly sloped surfaces 94 are slid into place at the sides of the opening 90 on sloped surfaces 96. The two side wedges then wedge the central wedge 84 between the sides of the frame work 82 thus locking the central wedge longitudinally of the trench. Keyways 98 may be provided in the side wedges to prevent the side wedges from slipping laterally out of the opening 90, if desired.

While the preferred forms of the invention have been illustrated and described, it should be understood that variations will be apparent to one skilled in the art without departing from the principles of the invention. For example, the wedge could easily be pointed in the vertical direction and thus reciprocated vertically rather than horizontally where space provides. Other wedge actuating systems couls also be employed. Accordingly, the invention is not to be limited to the specific forms described.

I claim:

1. Restraint apparatus for large mobile structures movable along a path and having to be temporarily locked in both the longitudinal and transverse directions in the path, comprising:

a mobile structure having rotatable support members, means for supporting the rotatable support members along said path, fixed anchoring means along said path and spaced from a rotatable support member supporting means, and means for wedging and clamping the mobile structure to the fixed anchoring means for positively locking the mobile structure in both the transverse and longitudinal directions, regardless of the position of the mobile structure relative to said supporting means, said wedging and clamping means including a movable main wedge, said anchoring means including a first set of surfaces extending generally transversely of said path, said wedging and clamping means including a second set of generally transversely extending surfaces coupled to said mobile structure and movable into and held in overlapping engagement with said first set of surfaces by movement of said movable main wedge, with the wedge precluding movement of said second set of surfaces laterally of the path and locking means precluding

movement of said second set of surfaces longitudinally along said path.

2. The restraint apparatus of claim 1, said first set of surfaces including vertical serrations spaced along said path, said second set of surfaces including mating vertical serrations engageable, when extended, with said first set of serrations.

3. The restraint apparatus of claim 1, said first set of surfaces including a transverse opening in said anchoring means, said second set of surfaces including a pin insertable into said opening.

4. The restraint apparatus of claim 1, said wedging and clamping means including a laterally movable pad, said locking means including guide surfaces fixed against movement relative to said mobile structure in a direction longitudinally of said path, said second set of surfaces being provided on said movable pad, said main wedge being movable between said pad and said mobile structure for extending said pad laterally toward said anchoring means, and means for retracting the main wedge and pad.

5. The restraint apparatus of claim 1, said mobile structure having a transverse opening formed by longitudinally spaced end walls and a sloped rear wall, said movable main wedge including a slope rear wall engageable with said opening rear wall for laterally extending the main wedge when moved along said opening rear wall and an opposite front wall, said second set of generally transversely extending surfaces being provided on the main wedge front wall in confronting relation with said first set of surfaces, movement of said main wedge to extend said second surfaces into locking engagement with said first surfaces causing free longitudinal movement of said main wedge between said opening end walls to allow unrestricted overlapping engagement of said first and second sets of surfaces, said locking means including a set of side wedges insertable between said movable main wedge and said respective end walls of said opening to lock the movable main wedge against longitudinal movement in said opening whereby the movable main wedge prevents lateral movement of said mobile structure and the side wedges prevent longitudinal movement.

6. The restraint apparatus of claim 1 wherein said anchoring means includes an additional set of opposite, generally transverse surfaces, said wedging and clamping means including an opposite movable main wedge and an additional set of opposite, generally transverse surfaces movable by said opposite movable wedge into overlapping engagement with said additional set of opposite, generally transverse surfaces of said anchoring means to attach to said anchoring means along opposite sides of said rotatable support members to preclude longitudinal and lateral movement of said mobile structure.

7. The restraint apparatus of claim 6, said anchoring means including an elongated bar between said wedging and clamping means.

8. The restraint apparatus of claim 6, said anchoring means including a trench having sidewalls on either side of said clamping and wedging means.

9. The restraint apparatus of claim 5, said first and second sets of generally transverse surfaces including vertical serrations, said movable main wedge also including opposite end walls, each having a vertical keying member, said side wedges each having a mating keying member to slidably position the side wedges aganist the movable main wedge.

10. The restraint apparatus of claim 9, said main and side wedges being manually positionable.

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