



(43) **Pub. Date:** **Apr. 1, 2010**

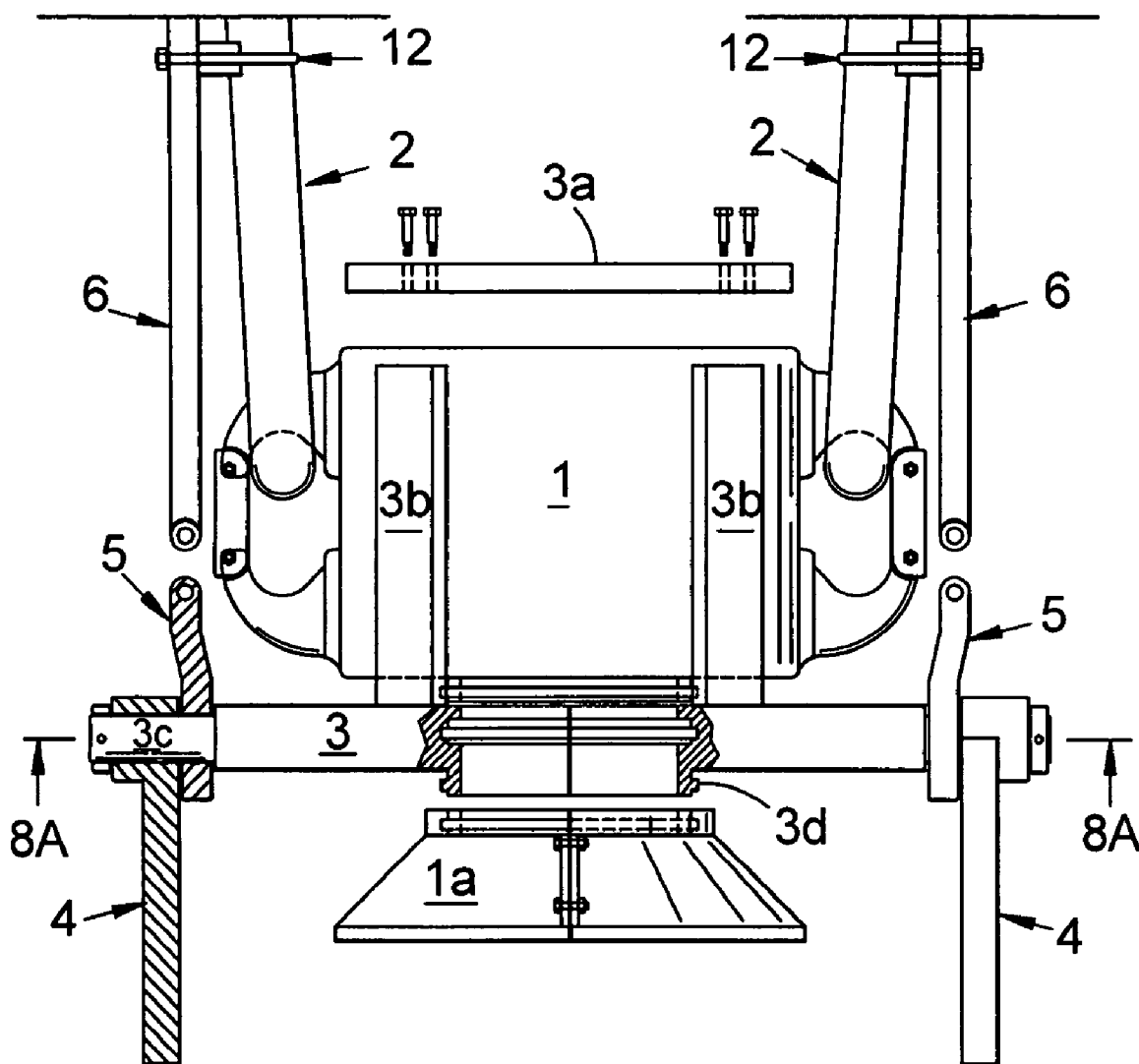


FIG. 2

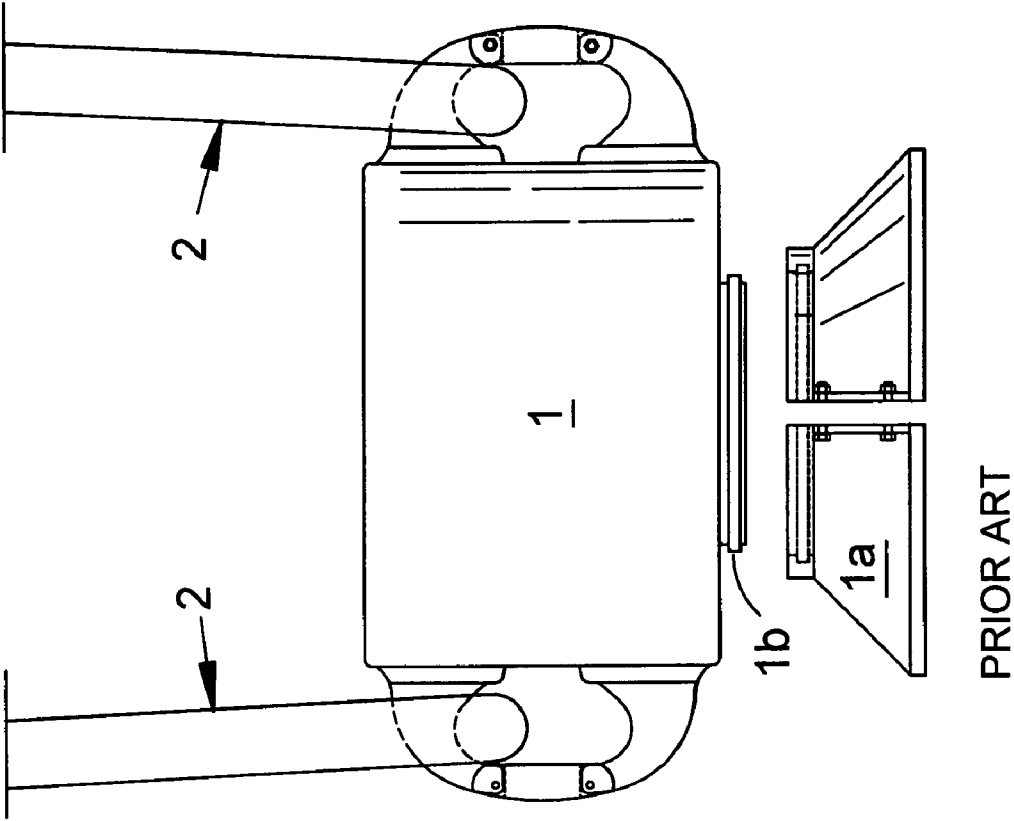


FIG. 1

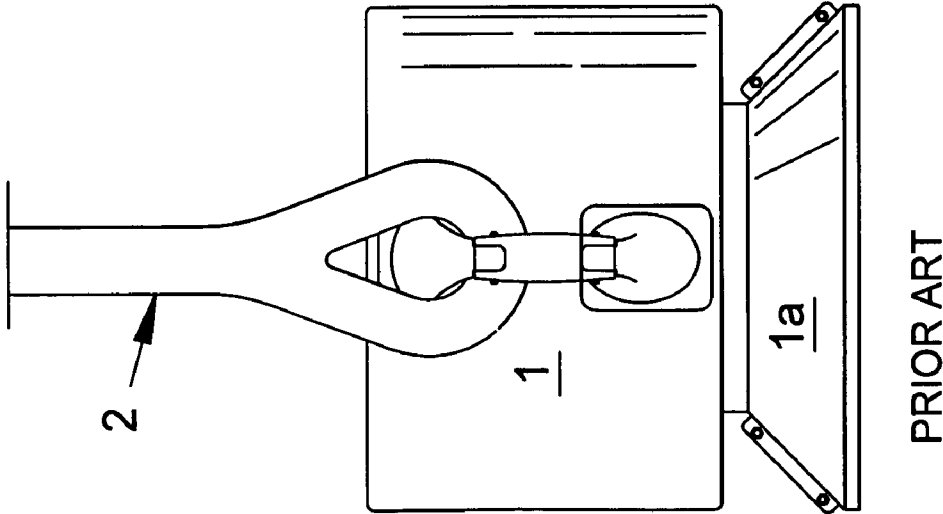


FIG. 4

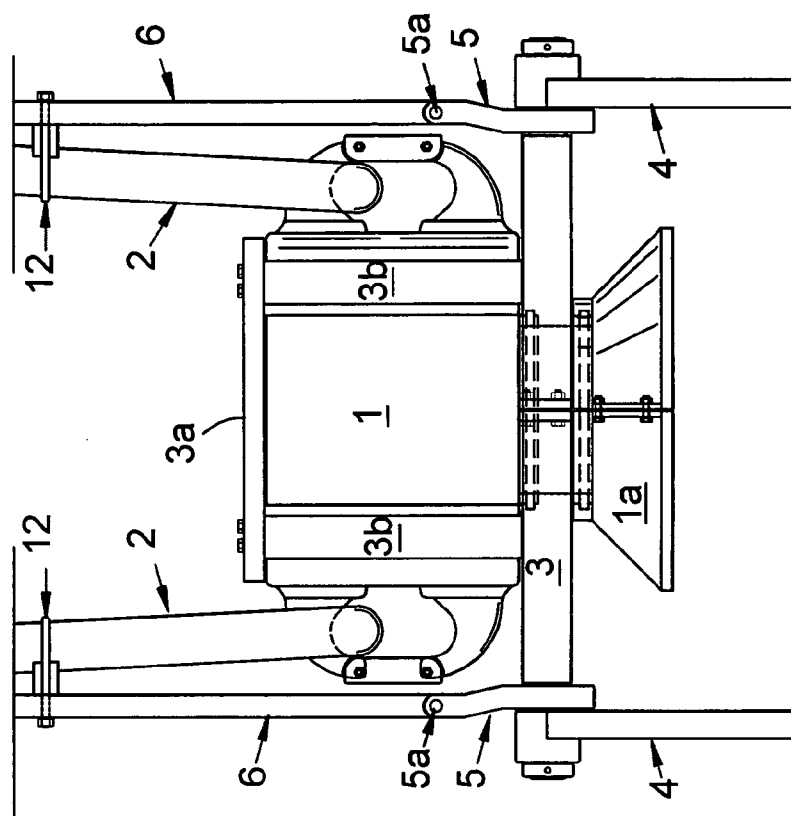
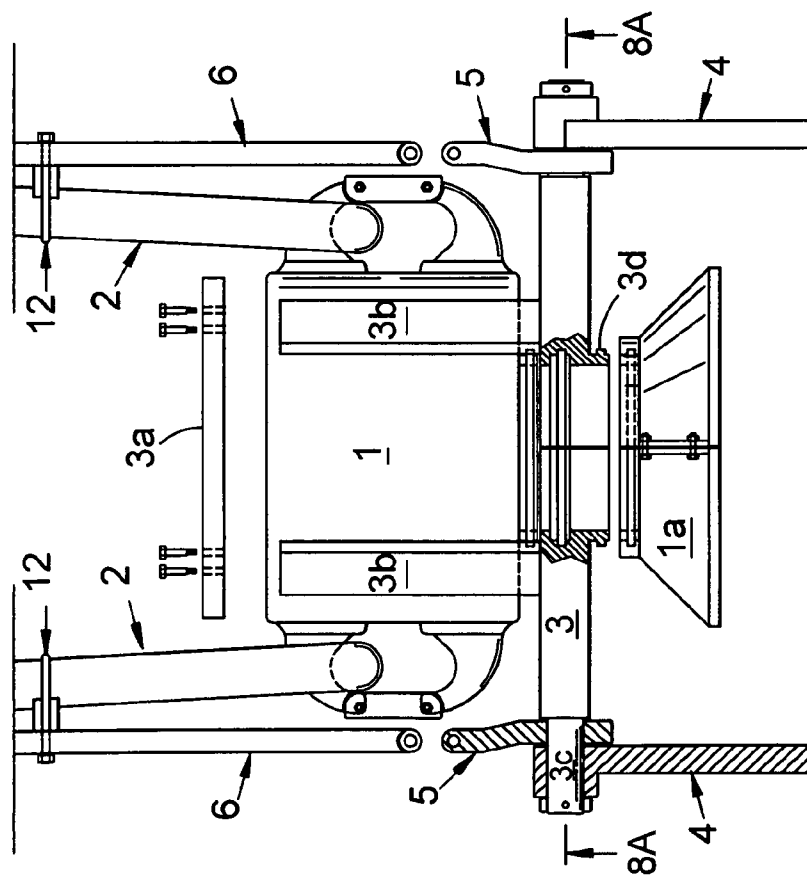


FIG. 3



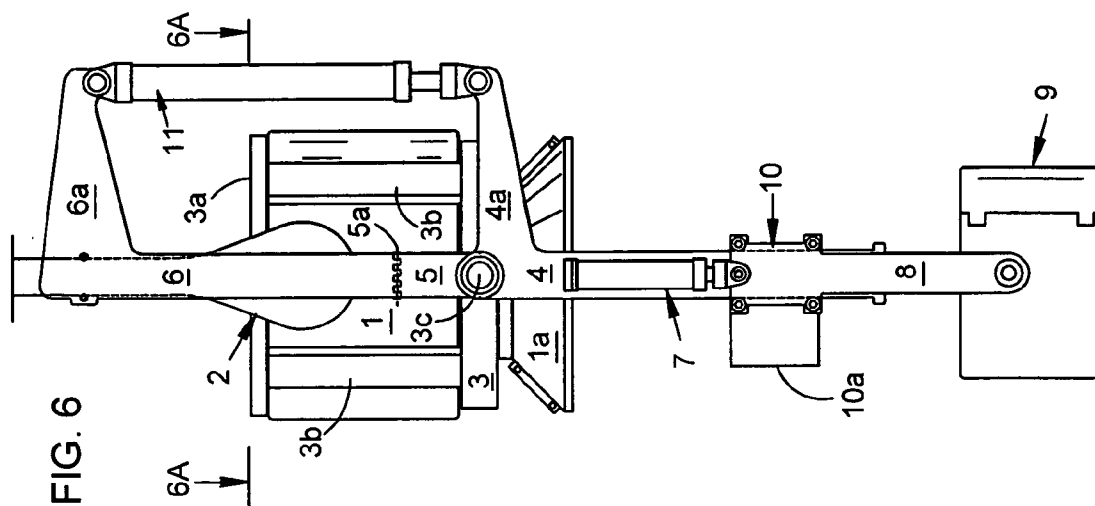


FIG. 6

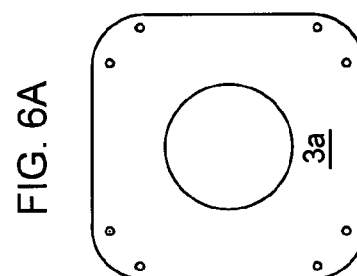


FIG. 6A

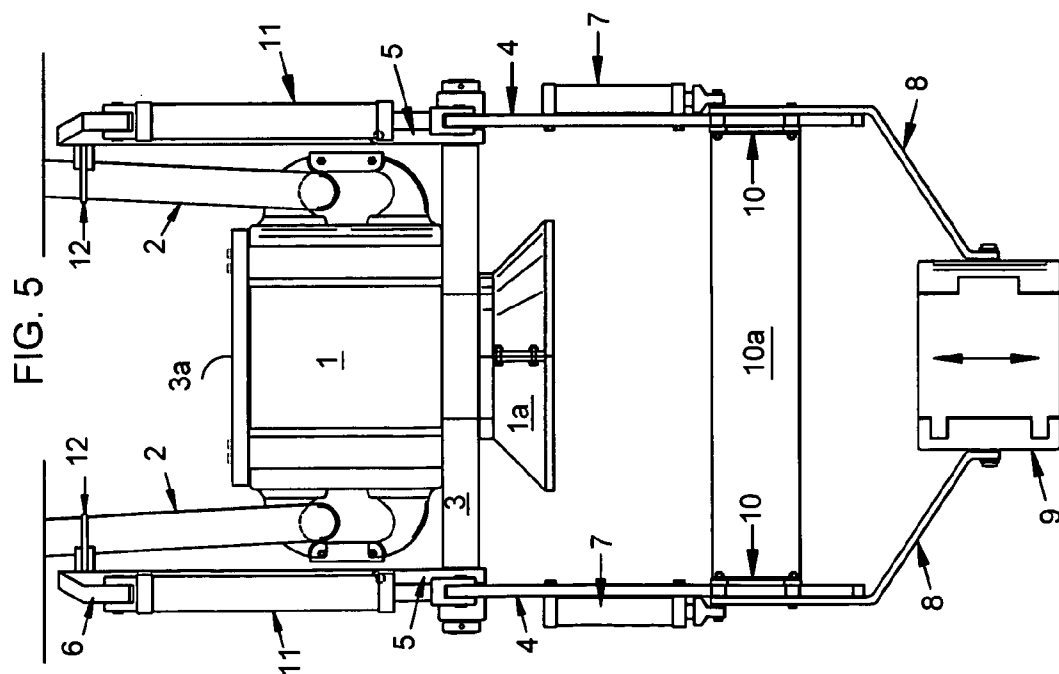
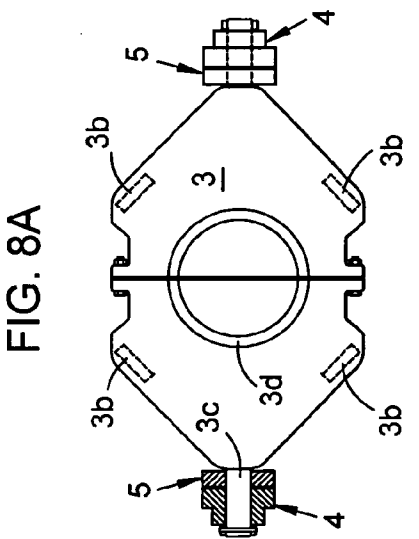
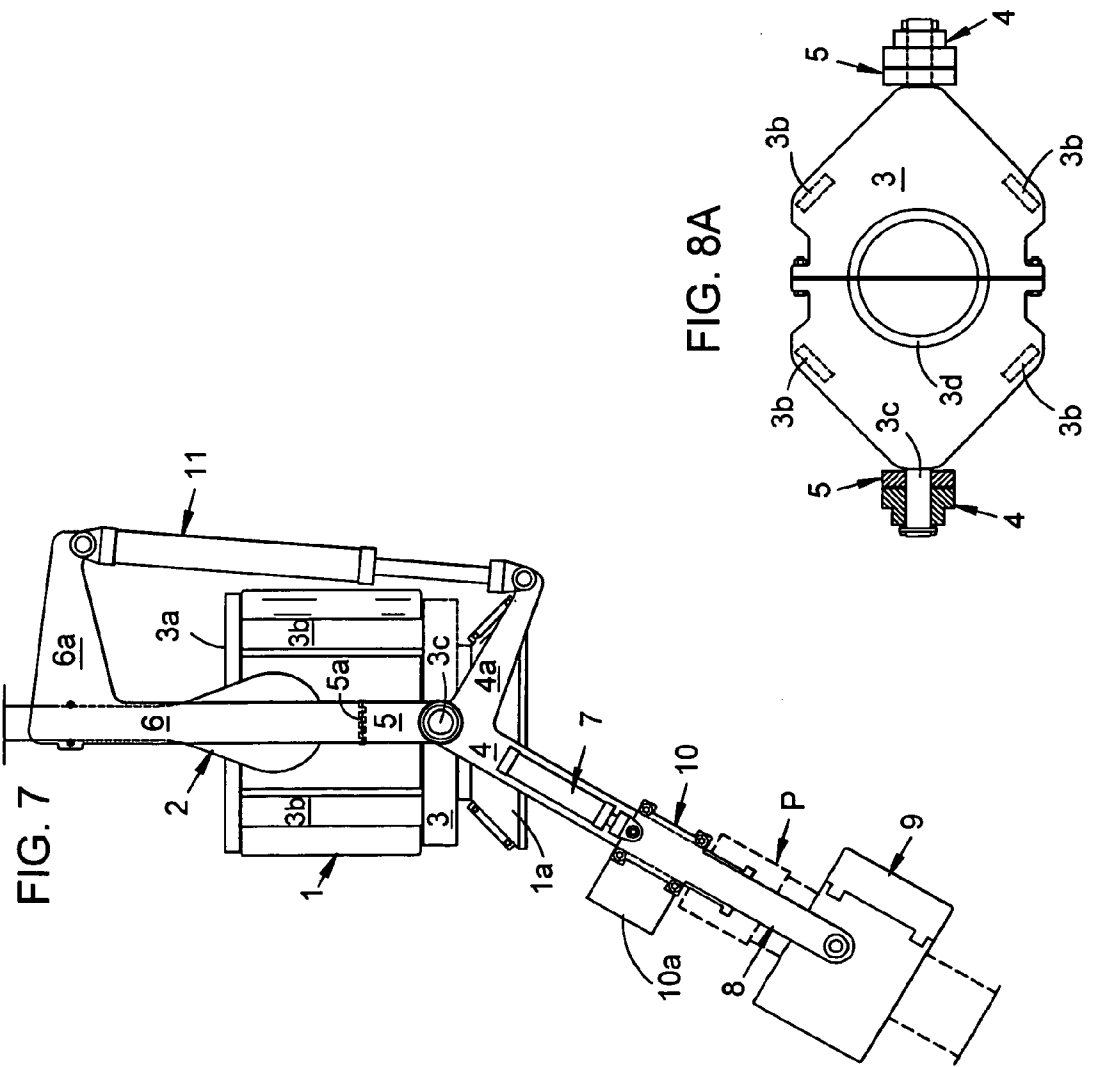
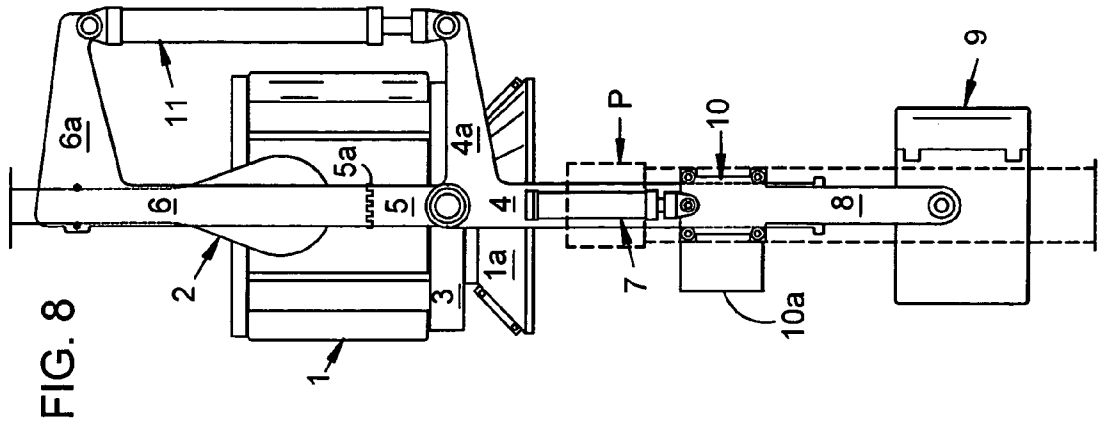
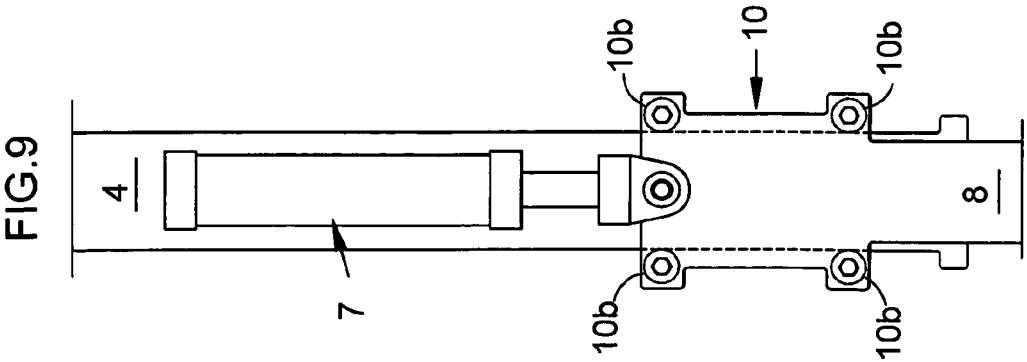
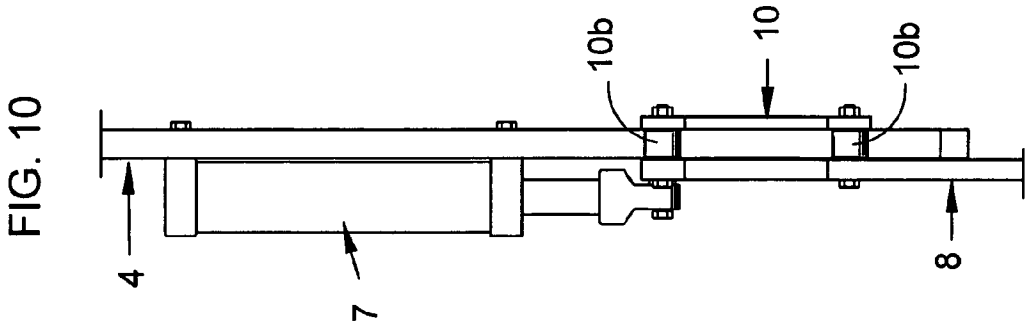
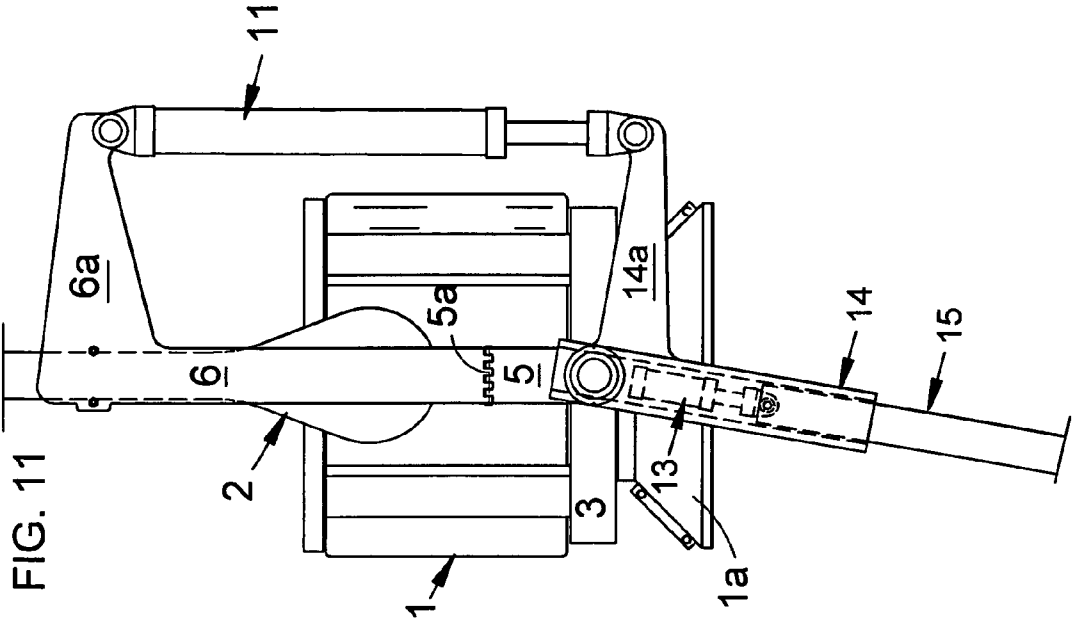


FIG. 5





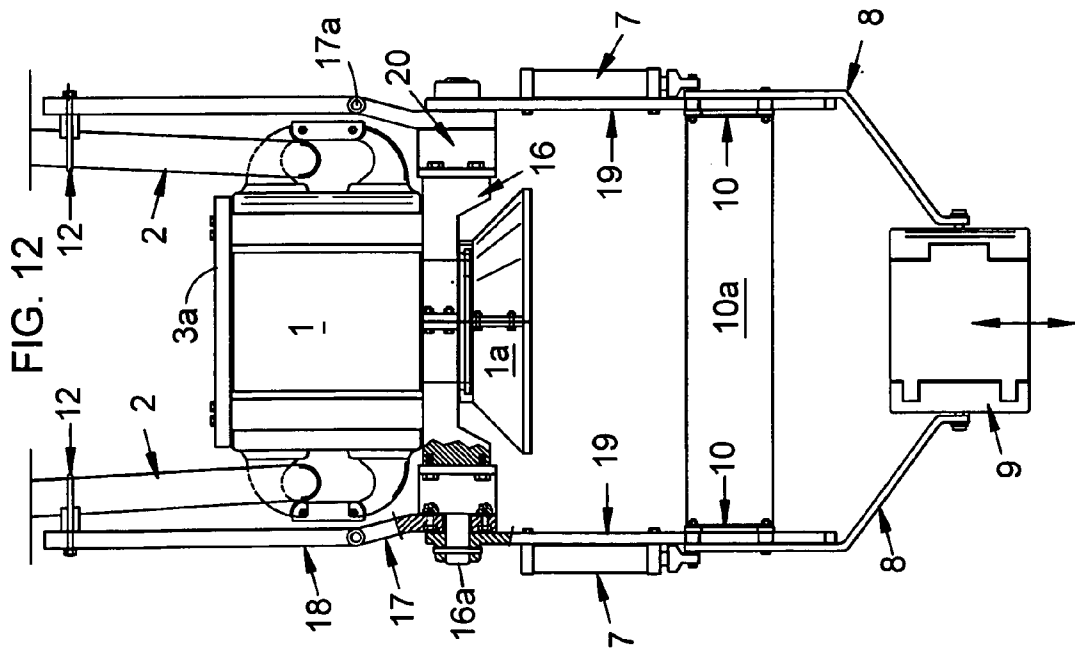
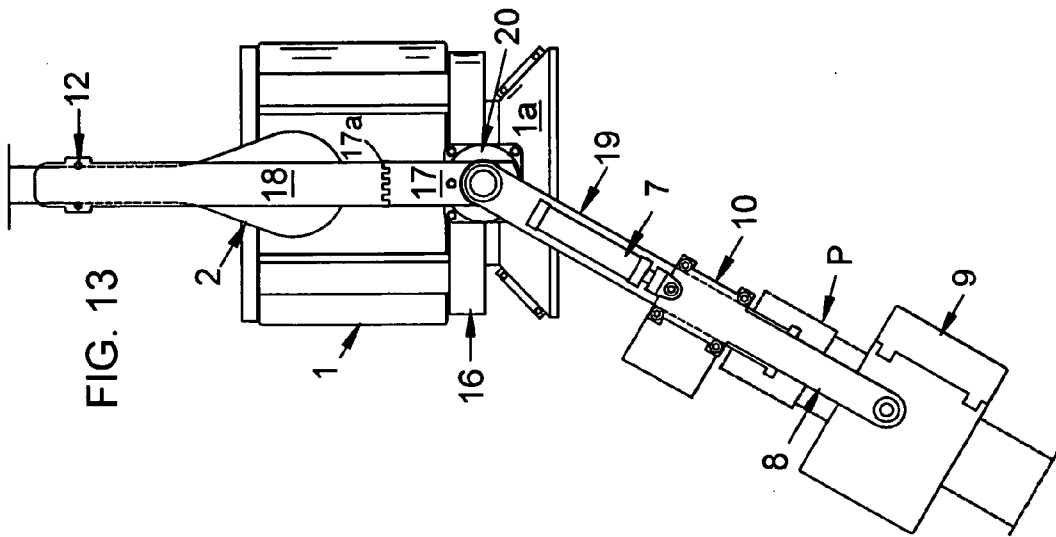


FIG. 15

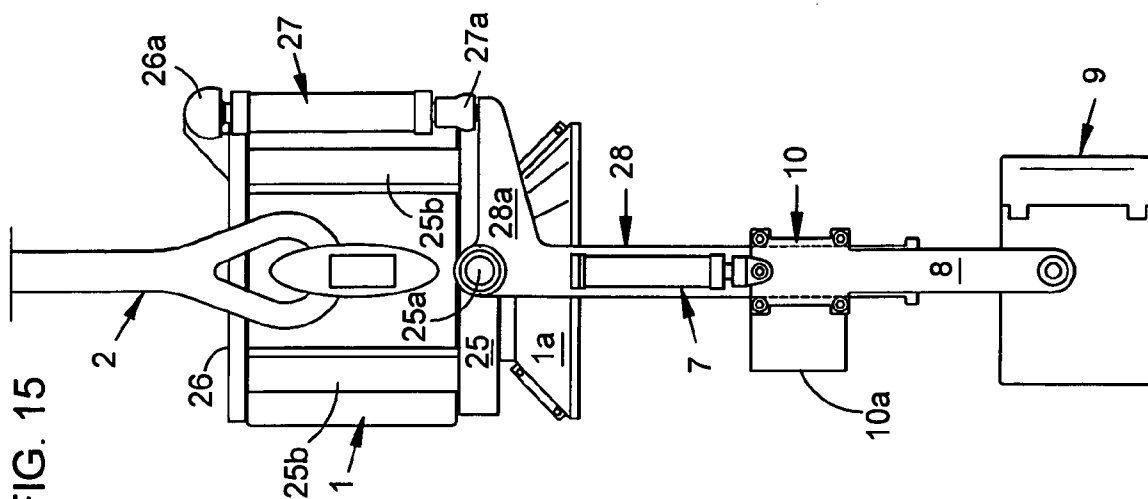
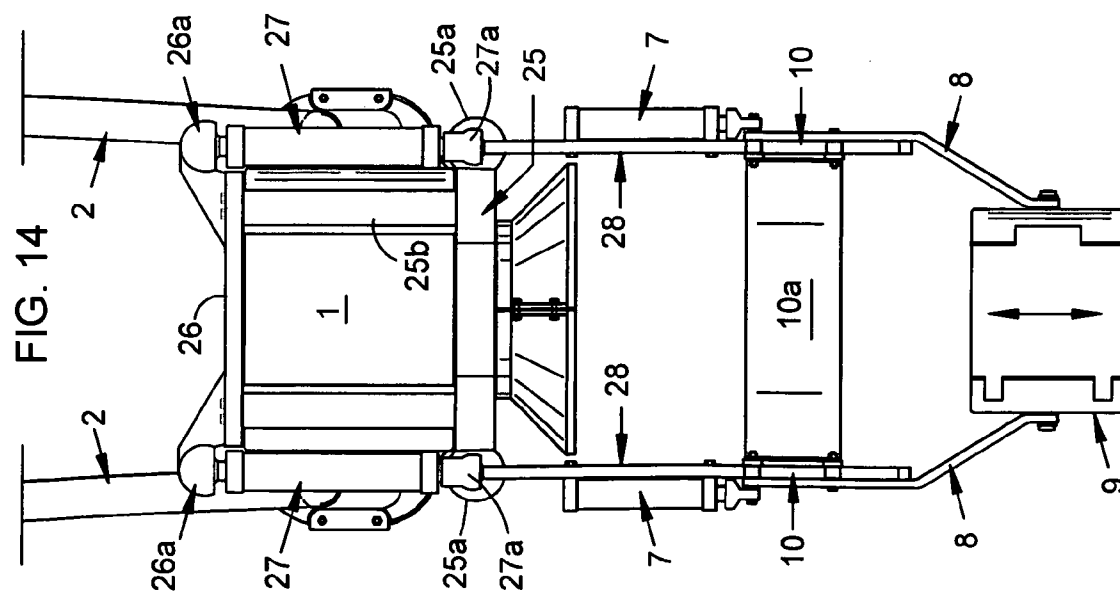


FIG. 14



PIPE HANDLING APPARATUS

[0001] This invention pertains to apparatus for handling pipe and pipe strings in well drilling and servicing processes, including connection of pipe sections to pipe strings suspended in wells.

BACKGROUND

[0002] During drilling and casing of wells, a pipe string is assembled by adding stands of pipe, consisting of one or a plurality of pipe sections, to pipe strings. The pipe strings extend through the drilling floor rotary opening and continue downward into existing well bores. The pipe string being assembled may be drill strings or casing strings, and occasionally other tubular strings.

[0003] The rate of the pipe string assembly is part of the well drilling time involvement and can amount to many hours of total well producing time involved. Cost reduction, involves time reduction in pipe string assembly.

[0004] Well production time, in terms of drilling rate, has been addressed with great earnest for many years. Pipe string assembly rate has about the same cost effectiveness as drilling rate. This invention addresses the reduction of costs, and does so within the safety concerns common to well bore production and production expected of completed wells.

[0005] For safety reasons, the use of personnel in contact with tubulars during pipe string assembly on the derrick floor is being minimized. Full mechanization of such activities on the derrick floor is not always possible but every effort to limit the contact between the more dangerous activities and people is worthwhile.

[0006] Offshore drilling rigs are usually massively complex and costly and the addition of machinery approaching automatic functions is not an expense that is a large percentage of the overall costs. On smaller on-shore rigs, the complex machinery is not readily adaptable and the reduction of contact between men and machinery is approached with simpler apparatus such as the present invention.

SUMMARY OF THE INVENTION

[0007] An elevator is modified to accept swing arms and related manipulating gear. The preferred elevator has a mounting ring on the lower face to accept a pipe guide. The pipe guide is replaced by a mounting base which is secured to the mounting ring. The mounting base has a lower mounting ring to which the pipe guide can be attached.

[0008] To prevent destructive loads on the elevator mounting ring, the mounting base is provided with security structure that engages the elevator elsewhere on its structure.

[0009] In the preferred configuration, the mounting base has a pivot axle extending horizontally from opposite sides of the elevator to support a swing arm assembly to support a single section elevator. Optionally, the pivot axle may comprise the rotor of a motor.

[0010] In one configuration, an actuator mounting bracket is attached to each pivot axle and extends upward to support tilt cylinders. An upper swing arm is attached to the pivot axle to pivot about a horizontal axis and is situated to be tilted by the tilt cylinders. The upper swing arm carries a lower swing arm which is arranged to carry a single section elevator. The lower swing arm is attached to the upper swing arm by extension riders which allow limited swing arm extension and may

compensate for thread make-up. Extension of the swing arm is controlled by a linear motor, or cylinder, that is, preferably, fluid powered.

[0011] The swing arm arrangement allows the single section elevator to be swung from the well axis to pick up a pipe section that extends toward the well axis. When the single section is lifted, it can swing to be aligned with the well axis to position it for make-up on the pipe string standing in a spider.

[0012] These and other objects, advantages, and features of this invention will be apparent to those skilled in the art from a consideration of this specification, including the attached claims and appended drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0013] In the formal drawings, wherein like features have like captions,

[0014] FIGS. 1-2 show a typical prior art elevator with features that enable use of the apparatus of the invention.

[0015] FIGS. 3-4 show the elevator of FIGS. 1-2 with attachments that enable the use of the elements making up the apparatus of this invention.

[0016] FIGS. 5-6 show the conversion assembly that generally comprises the apparatus of this invention.

[0017] FIG. 6A is a top view of a single component of the assembly of FIG. 6, and is taken along line 6A of FIG. 6.

[0018] FIGS. 7-8 show the apparatus of the invention in the two principal positions that enable the assembly of a pipe string.

[0019] FIG. 8A is a plan view of mounting base 3, taken along line 8A of FIG. 3.

[0020] FIGS. 9-10 show details of the preferred construction of the swing arm extension enabling elements.

[0021] FIG. 11 shows the side view of part of the overall apparatus having alternate structural shapes making up a swing arm.

[0022] FIG. 12 shows a front view of an alternate construction of the apparatus.

[0023] FIG. 13 shows a side view of the apparatus of FIG. 12.

[0024] FIG. 14 is a front view of an alternate form of the apparatus.

[0025] FIG. 15 is a side view of the apparatus of FIG. 14.

DETAILED DESCRIPTION OF DRAWINGS

[0026] In the presented formal drawings, some features having no bearing upon points of novelty and are well known to those skilled in the art of machine construction are omitted in the interest of descriptive clarity. Some omitted features may be such as weld lines, threads, fasteners, and the like.

[0027] The overall drilling rig assembly, being well established in the art, is not shown. A traveling block and spider is considered to be generally essential to pipe handling, is in the art, and is not shown.

[0028] No fluid power circuitry for management of the cylinders 7, 11, and 27 is shown. Such features are well established in the art, and may vary in accordance with available gear normally on rigs, or are devised to suit the intended rig requirements.

[0029] Fluid powered cylinders are described for convenience but may be replaced by any suitable form of motors, linear or rotary. Such arrangements are anticipated by and are

within the scope of the claims. Fluid power may be liquid or gas, and may include gas for power and liquid for damping and control functions.

[0030] FIGS. 1-2 relate to prior art and show elevator 1 supported by elevator bails 2. Pipe guide 1a is commonly in place and is secured to pipe guide mounting ring 1b.

[0031] FIGS. 3-4 show the typical elevator 1 adapted by mounting base 3 to support mount bracket 5 and upper swing arm 4 for pivoting about the mounting base shaft extension 3c. Mounting bracket extensions 6 are stabilized by alignment clamps 12 which engage the bails 2. The bails are engaged to modify tilt characteristics of the elevator when off-axis loads are carried by the swing arm assembly. The elevator can sway on the bails 2 and hinge 5a is provided to keep related stresses from challenging the extensions 3c. To prevent the possible over-stressing of the ring 1b of FIG. 2, stabilizing plate 3a engages the top of the elevator and is secured to the mounting base by standards 3b.

[0032] FIGS. 5-6 show the overall assembly. Mounting bracket extension 6 has crank projection 6a which carries tilt cylinder 11. Upper swing arm 4 has crank projection 4a which is engaged by the tilt cylinder 11 to enable tilting of the swing arm assembly. The lower swing arm 8 is secured to the upper swing arm 4 by extension rider 10 for limited vertical movement, controlled by compensator cylinder 7. The lower swing arm 8 carries the single section elevator 9. The extension riders are stabilized by the connecting link 10a.

[0033] FIG. 6A is a top view of the stabilizing plate 3a and is taken along line 6A of FIG. 6.

[0034] FIGS. 7-8 show side views of the apparatus in the two primary functional positions used in pipe string assembly. In FIG. 7 the swing arm is tilted from vertical to engage pipe section P when the assembly is moving downward. Section P is stationary and the single section elevator, having been opened to accept the pipe section, is closed to lift the pipe section when upward motion takes place. FIG. 8 shows the pipe section P vertical on the well centerline and having been torqued up on a pipe string (not shown). The elevator is lowered to a position to engage the now assembled pipe string for lifting the string to release the spider, not shown, to enable lowering of the pipe string into the well.

[0035] During the make-up of the pipe threads, the compensator cylinders 7 allow the single string elevator 9 to move downward to accept the changing vertical position of the upper pipe section during the run of the threads.

[0036] FIG. 8A is a bottom view of the mounting base 3. Ring 3d is a duplicate of the ring 1b of FIG. 2 and is for re-mounting of pipe guide 1a. Bore 3e is contoured (not shown) to provide a mating surface to fit ring 1b of FIG. 2.

[0037] FIGS. 9-10 show details of the extension rider 10 which enables lengthening of the swing arm. The extension rider 10, carried by the lower swing arm, encases the upper swing arm 4 and has wheels 10b to reduce friction as the compensator cylinder 7 extends or retracts. Ideally, the compensator cylinders apply just enough force to support the single section being added to the pipe string. The cylinder fluid pressure is normally ballasted to allow fluid movement to limit force on the pipe threads in the make-up process.

[0038] FIG. 11 is identical to part of the apparatus of FIG. 6 but with an alternate form of the swing arms elements 4 and 8. The elements 14 and 15 are telescoping tubes, preferably, of non-circular cross section. Extension riders are not needed

and the compensator cylinder 13 is enclosed in the tube 14. Crank arm 14a allows tilt cylinder 11 to tilt the swing arm assembly. Tube 15 carries the single section elevator 9, not shown, in the manner described for FIG. 4.

[0039] FIGS. 12-13 employ rotary motors to tilt the swing arms. otherwise, the assembly is much the same as FIGS. 3-6. Mounting base 16 replaces the mounting base 3 and motors 20 are directly connected thereto. Risers 17 and 18 are connected to the motor frame and extend upward to be stabilized by bails 2. The upper swing arm extension 19 is connected rotationally to the motor output shaft 16a. The lower swing arm extension 8 is unchanged and carries the single section elevator 9.

[0040] FIGS. 14-15 show an alternate for of the apparatus. The major difference from the apparatus of FIGS. 5-6 is the attachment of the swing arm tilt cylinders. Plate 26 has connectors 26a to secure the top end of the linear motors, or cylinders, 27. Mounting base 25, secured to plate 26 by struts 25b has trunnions, or sockets, 25a supporting the swing arm. The upper swing arm 28 carries the previously described lower swing arm 8. Linear motor, or cylinder, 27 has connector 27a to engage crank arm 28a. The overall function is much as described for FIGS. 5-6.

[0041] An elevator normally has slips and dies situated for actuation to grip pipe that extends through the central opening of the elevator. Elevator 1, or an equivalent, may be used without slips, dies, or actuating gear to serve a purpose that requires no such features. The elevator 1 should be construed in that light.

[0042] A single section elevator is a common definition of an elevator usually used to manipulate single sections. A plurality of sections comprising a stand may be manipulated by that elevator.

[0043] Features of the apparatus of this invention are powered. The type of power, and its control, will be governed by the equipment already on the users rig. Hydraulic power is usually present and preferred. The control of the power used by the present invention will likely be combined with controls to related apparatus such as spiders. Such controls are usually off-the-shelf but their arrangement is usually unique on any particular rig. Such control rigging is well within the capability of those skilled in the related art. To avoid complicating the descriptive matter, the circuitry is not shown.

[0044] Linear motors shown in the drawings are not limiting factors. Linear motors may be rotary motors with associated screws, electric or fluid powered, for instance, and are well known in the art of machine design and construction. The tilt and extension needs, likewise, can be met with common spur gears and mating gears or racks. Such arrangements, and other equivalents, are well known in the art and, herein, are considered equivalent to linear motors.

[0045] From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

[0046] It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims.

[0047] As many possible embodiments may be made of the apparatus of this invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, we claim:

1. A pipe handling apparatus for use on drilling rigs to assemble drill strings suspended in wells, the apparatus comprising:

- a) an elevator suspendable from elevator bails of a traveling block, and having accessory mounting provision;
- b) a mounting base secured to said accessory mounting provision, the mounting base having shaft extensions with horizontal axes;
- c) a swing arm arranged to pivot about the axes and to extend downward to support a single section elevator, the swing arm being variable in length, controlled in length by a first motor;
- d) a mounting bracket arranged for mounting on the axes;
- e) a mounting bracket extension to attach to the mounting bracket and to extend upward to be secured to the bails for stabilization;
- f) a second motor arranged to force and control rotation of the swing arm relative to the mounting bracket extension; and
- g) said single section elevator.

2. The pipe handling apparatus according to claim 1 wherein said second motor is a fluid powered motor connected to a crank arm extending from said swing arm and connected to a second crank arm extending from said mounting bracket extension.

3. The pipe handling apparatus according to claim 1 wherein said swing arm comprises an upper part and a lower part arranged for telescoping action, said variable in length controlled by said first motor.

4. The pipe handling apparatus according to claim 3 wherein said swing arm comprises telescoping lengths of tubing, one length enclosing said first motor.

5. The pipe handling apparatus according to claim 1 wherein said second motor is a fluid powered linear motor.

6. The pipe handling apparatus according to claim 1 wherein said mounting base is supported by structure that extends to brace the mounting base by additional contact on the elevator structure.

7. A pipe handling apparatus for use on drilling rigs to assemble drill strings suspended in wells, the apparatus comprising:

- a) an elevator suspendable from elevator bails, with a pipe guide mounting ring, attached to a traveling block;
- b) a mounting base secured to said pipe guide mounting ring, the mounting base having shaft extensions with horizontal axes;
- c) a swing arm arranged to pivot about the axes and to extend downward to support a single section elevator, the swing arm being variable in length controlled in length by a first motor;
- d) a mounting bracket arranged for mounting on the axes;
- e) a mounting bracket extension to attach to the mounting bracket and to extend upward to be secured to the bails for stabilization;

- f) a second motor arranged to force and control rotation of the swing arm relative to the mounting bracket extension; and

- g) said single section elevator.

8. The pipe handling apparatus according to claim 7 wherein said second motor is a fluid powered motor connected to a crank arm extending from said swing arm and connected to a second crank arm extending from said mounting bracket extension.

9. The pipe handling apparatus according to claim 7 wherein said swing arm comprises an upper part and a lower part arranged for telescoping action, said variable in length controlled by said first motor.

10. The pipe handling apparatus according to claim 7 wherein said swing arm comprises telescoping lengths of tubing, one length enclosing said first motor.

11. The pipe handling apparatus according to claim 7 wherein said second motor is a fluid powered linear motor.

12. The pipe handling apparatus according to claim 7 wherein said mounting base is supported by structure that extends to brace the mounting base by additional contact on the elevator structure.

13. A pipe handling apparatus for use on drilling rigs to assemble drill strings suspended in wells, the apparatus comprising:

- a) an elevator suspendable from elevator bails of a traveling block, and having accessory mounting provision;
- b) a mounting base secured to said accessory mounting provision;
- c) a fluid powered rotary motor attached to each side of said mounting base, and having an output shaft extending to rotate about a horizontal axis;
- d) a swing arm attached to each said output shaft and to extend downward to support a single section elevator, said swing arm being variable in length controlled in length by a linear motor; and
- e) said single section elevator.

14. The apparatus of claim 13 wherein said rotary motor is a partial-turn hydraulic motor.

15. The pipe handling apparatus according to claim 13 wherein said swing arm comprises telescoping lengths of tubing, one length enclosing said linear motor.

16. The pipe handling apparatus according to claim 13 wherein said accessory mounting provision is a flange arranged to support a pipe guide on a lower side of said elevator.

17. The pipe handling apparatus according to claim 13 wherein said mounting base has a flange arranged to receive a pipe guide.

18. The pipe handling apparatus according to claim 13 wherein said mounting base is supported by structure that extends to brace the mounting base by additional contact on the elevator structure.

* * * * *