

[54] **RACK AND PINION HOIST**

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[51] **Int. Cl.²** **B66B 11/04**

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Primary Examiner—James B. Marbert

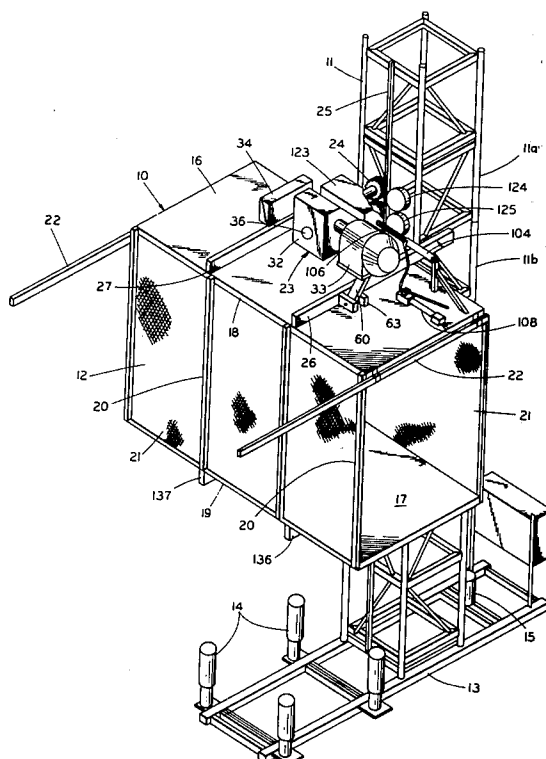
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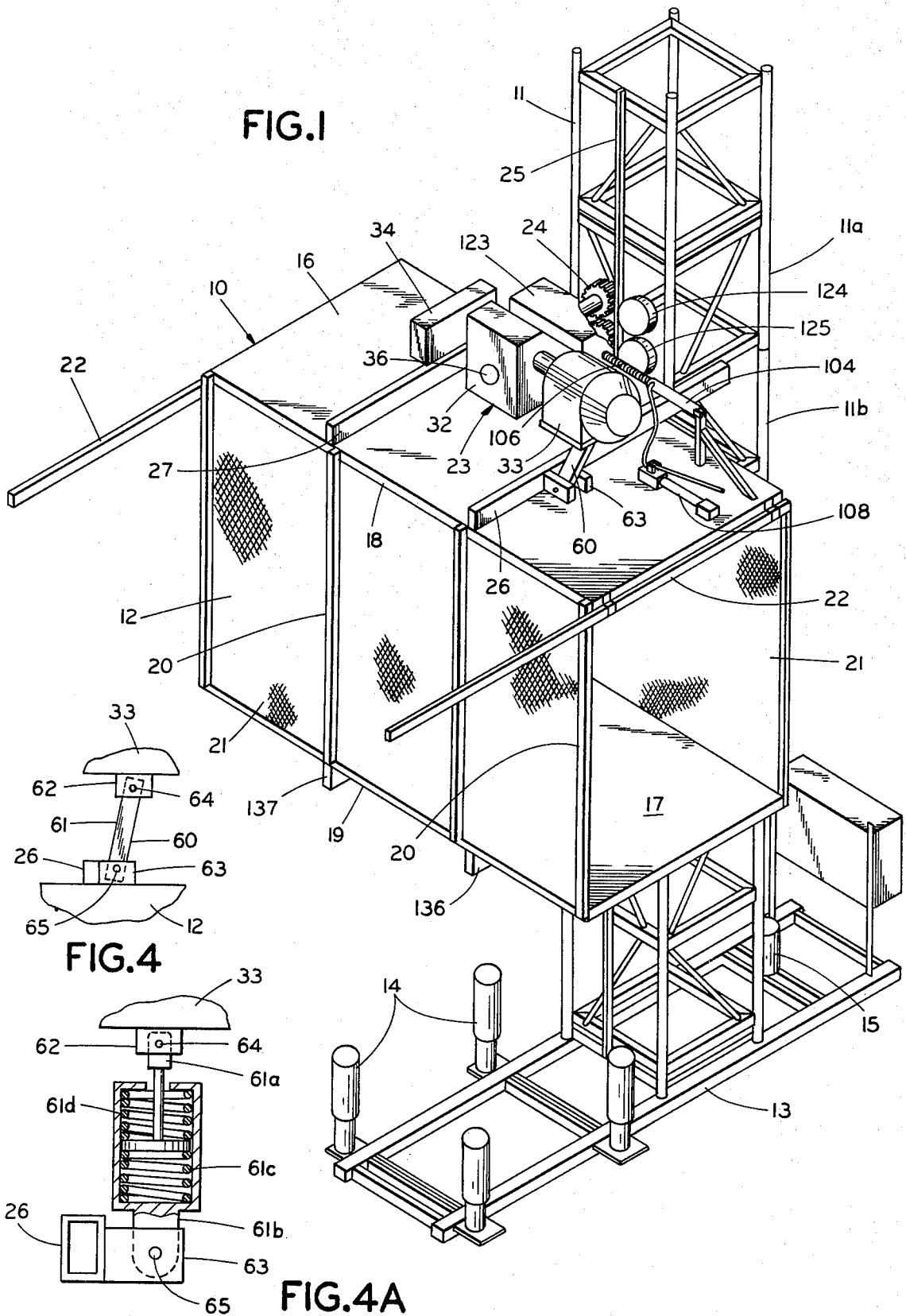
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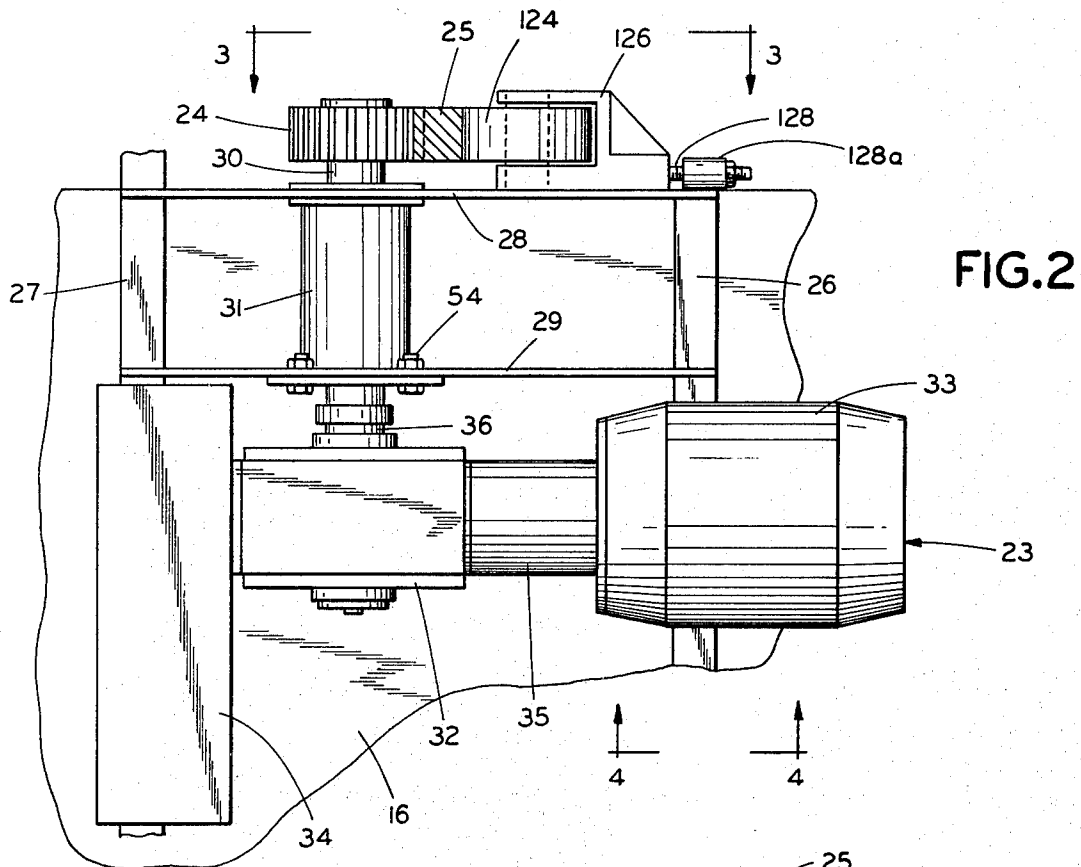
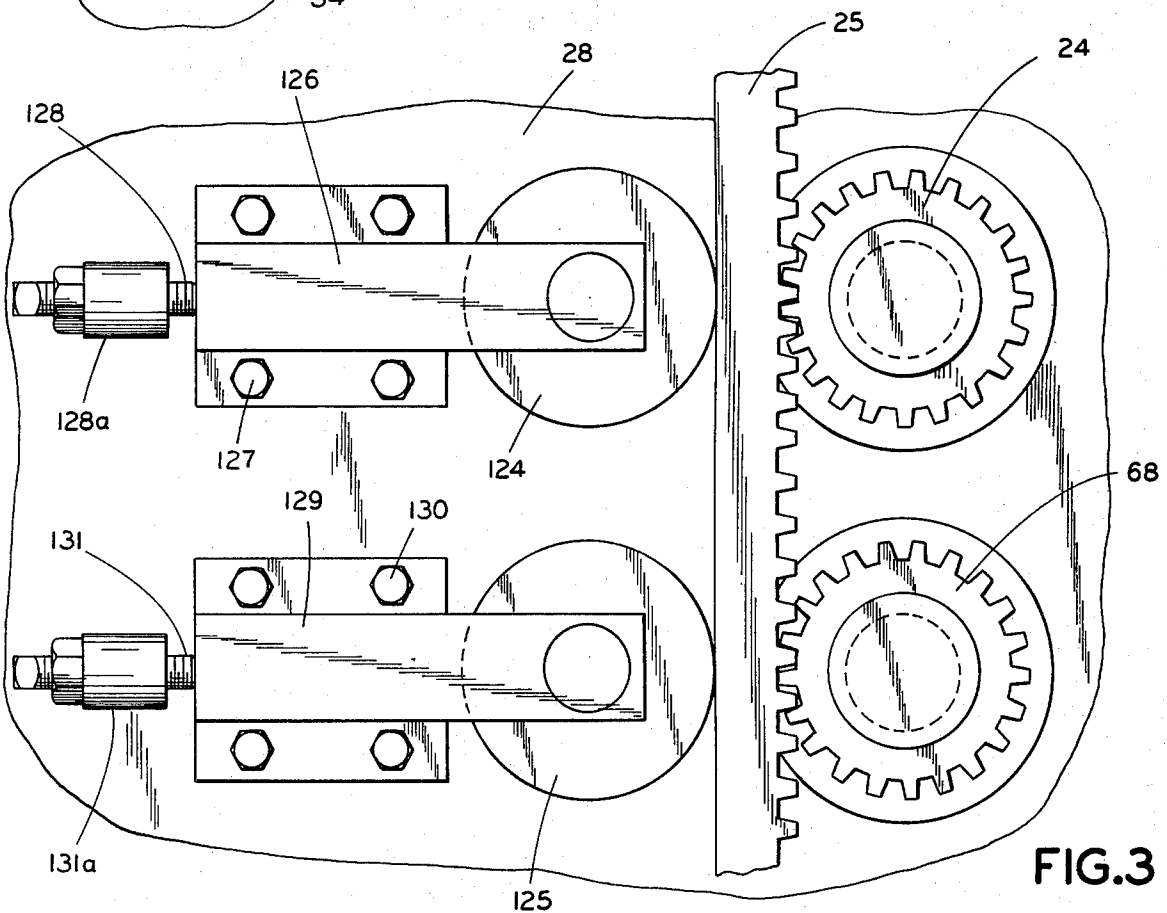
ABSTRACT

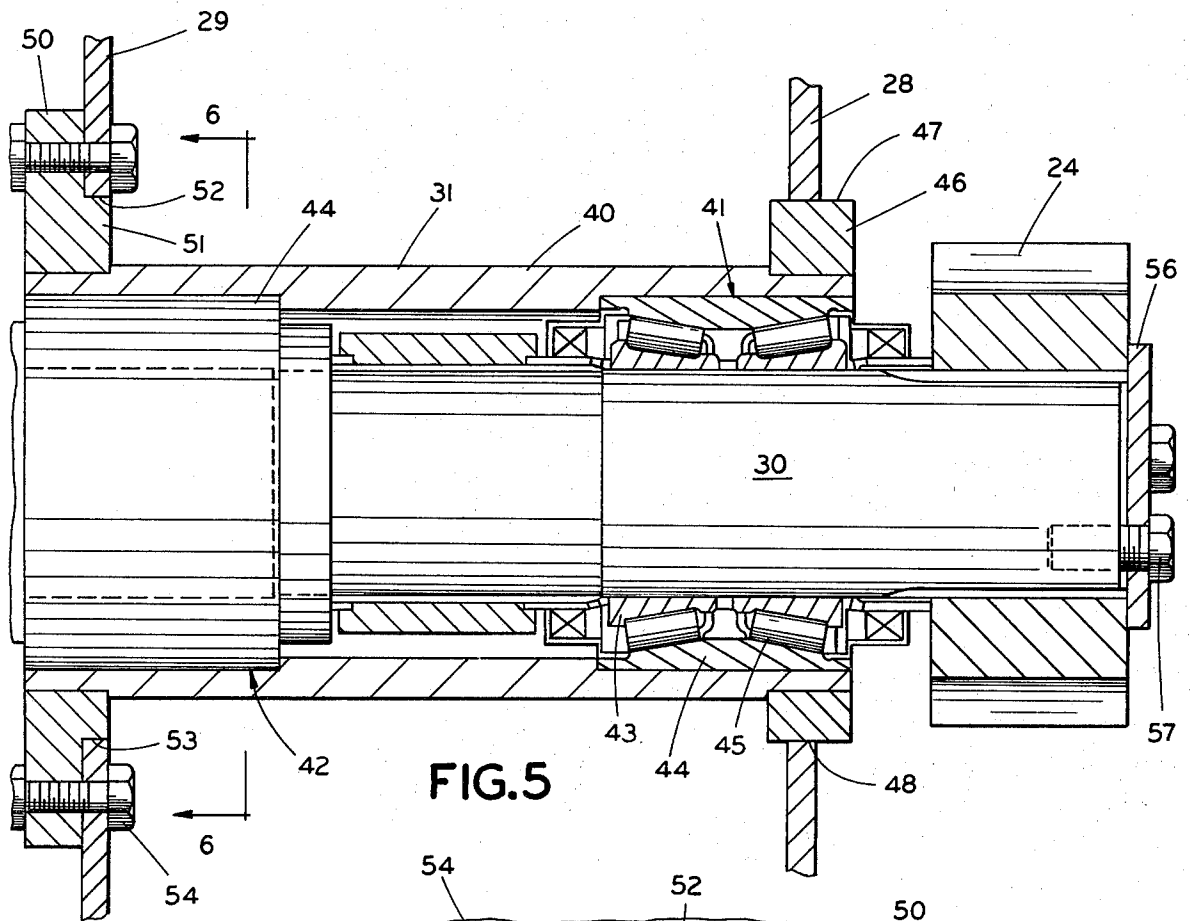
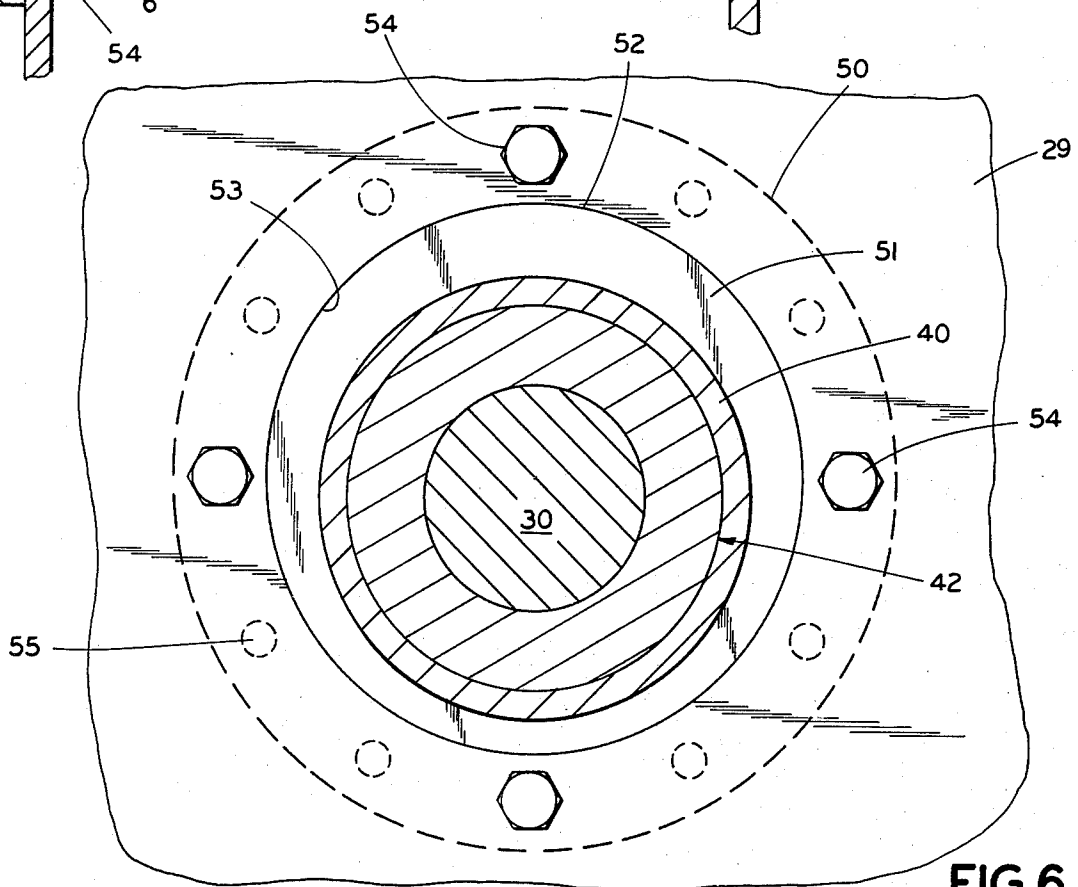
A hoist is provided with a rack and pinion drive assembly for raising and lowering the lift frame of the hoist and a rack and pinion overspeed mechanism for braking the lift frame when the hoist exceeds a predetermined speed. The drive assembly includes a pinion shaft rotatably supported by a bearing assembly which is rigidly secured to the frame. A drive pinion is secured to one end of the shaft, and a reducer gear box is mounted on the other end of the shaft. A motor is connected to the gear box for rotating the shaft and the drive pinion, and the motor and gear box are prevented from rotating with the shaft by a torque mount which connects the motor to the frame but which permits limited movement of the motor relative to the frame to reduce shocks. An overspeed pinion is mounted on a second shaft which is also rotatably mounted on bearings on the frame. The overspeed pinion shaft carries a brake drum, and a brake band extends around the drum. One end of the brake band is secured to the frame, and the other end is secured to an extendable plunger which carries a spring for urging the plunger to tighten the band around the drum. Releasable lock means holds the plunger in a retracted position against the bias of the spring, and the lock means is engageable by centrifugal weights on the drum when the overspeed pinion shaft rotates too fast to permit the plunger to extend to tighten the brake band about the drum. The bearings for both the drive shaft and the overspeed pinion shaft are secured to the frame by eccentric mounting means so that the positions of the shafts can be adjusted relative to the frame and to the rack.

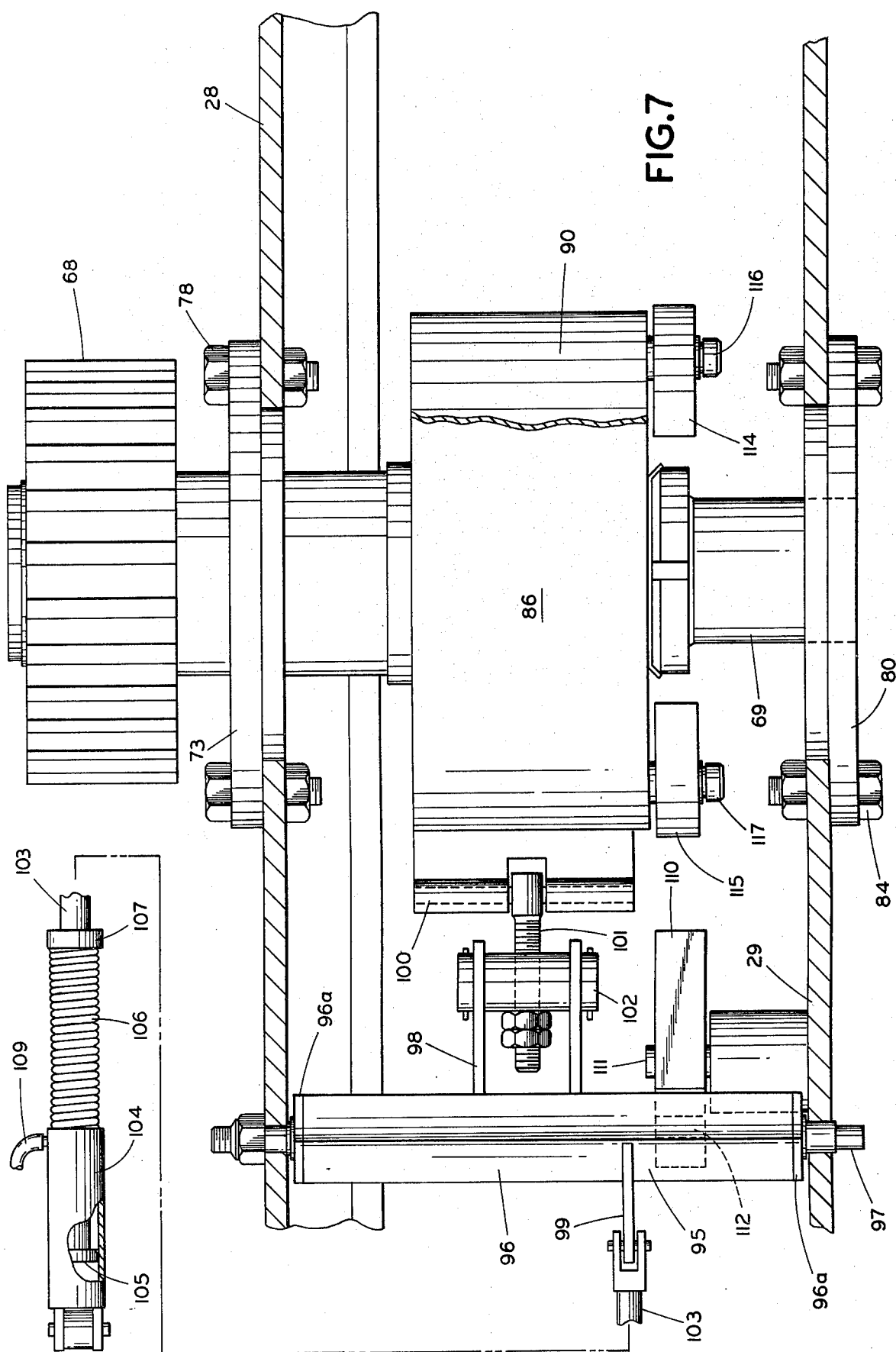
3 Claims, 15 Drawing Figures

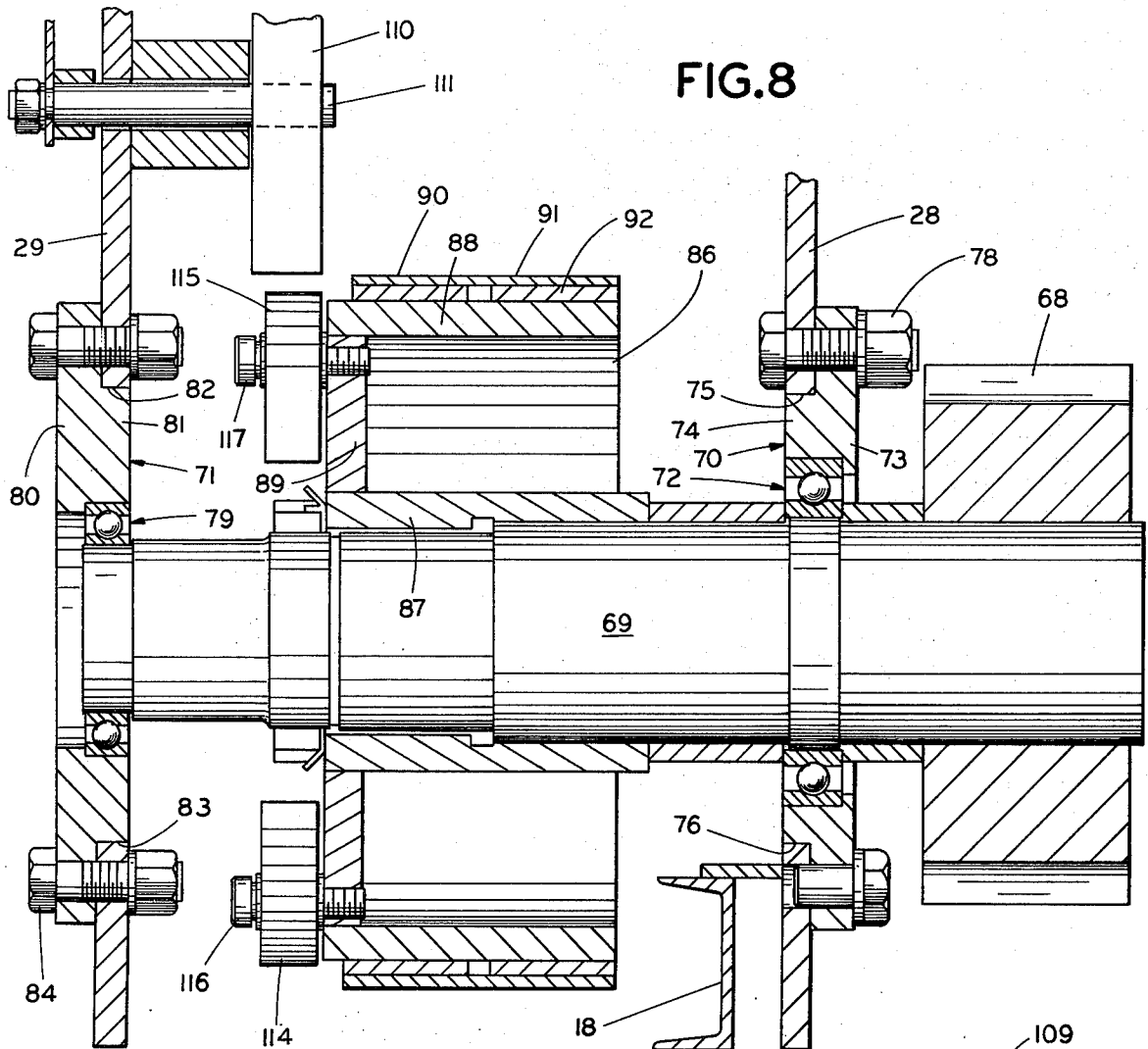
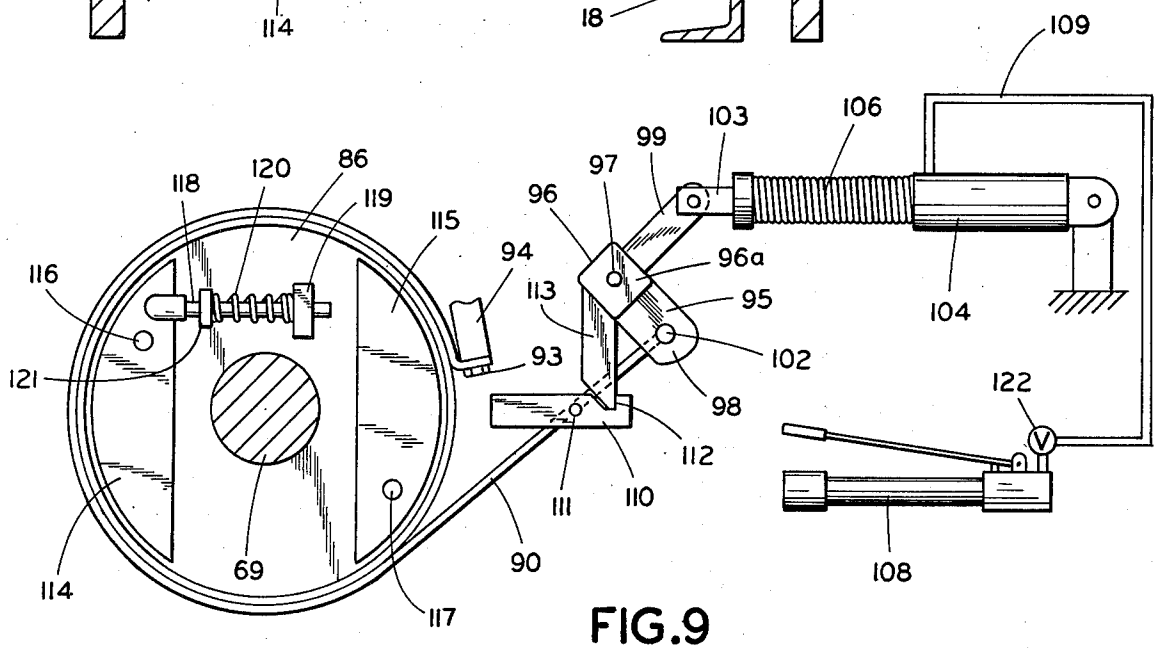












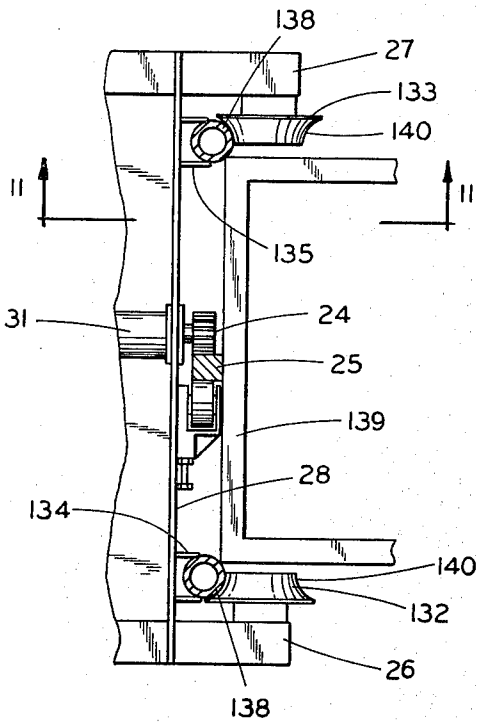


FIG. 10

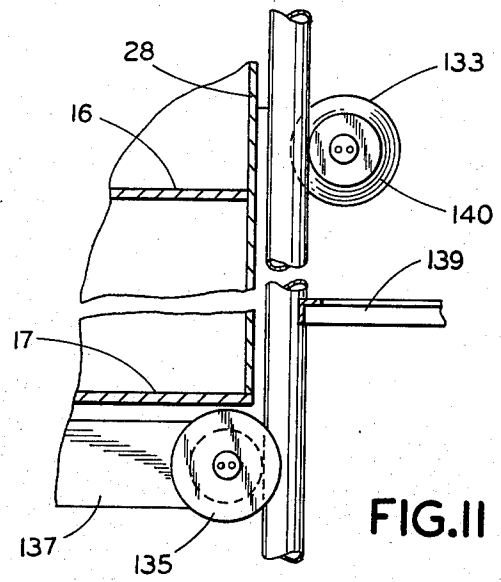


FIG. 11

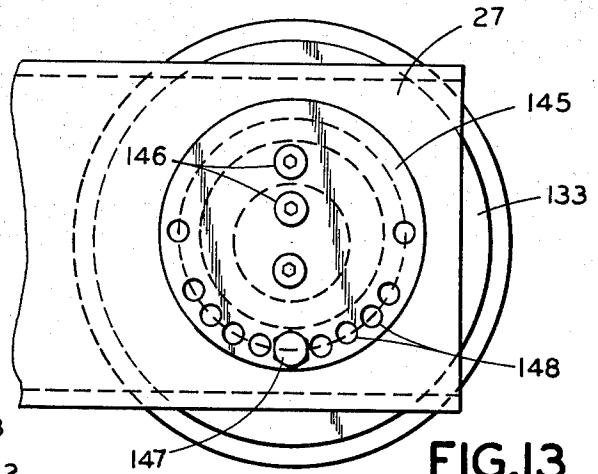


FIG. 13

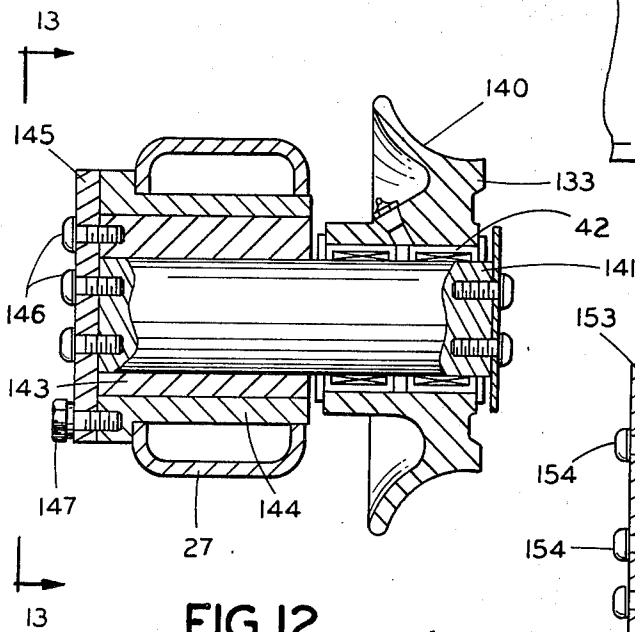


FIG. 12

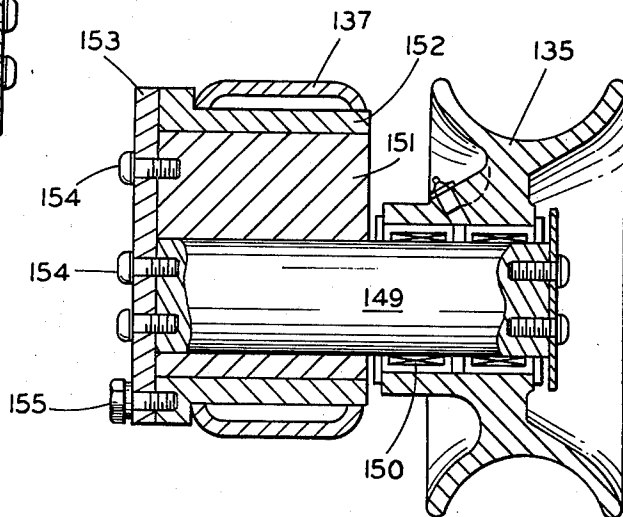


FIG. 14

RACK AND PINION HOIST

BACKGROUND

This invention relates to hoists, and, more particularly, to a hoist which is provided with rack and pinion drive and overspeed mechanisms.

The invention finds particular utility in so-called personnel hoists — hoists which are used to lift men and material to the various floors of a building which is being constructed. Personnel hoists typically include a tower structure which extends upwardly alongside the building and which is secured thereto, and a cage or lift frame which travels upwardly along the tower. In the past the drive means for lifting and lowering the cage along the tower has been provided by cables which are wound about drums. However, certain disadvantages are present in cable driven hoists, and in recent years hoists have been provided with rack and pinion drive systems.

A rack and pinion drive assembly conventionally includes a vertically extending rack which is secured to the tower and a plurality of drive pinions which are rotatably mounted on the cage. Suitable power means for rotating the drive pinions are carried by the cage, and as the drive pinions are rotated, the cage is raised or lowered.

Personnel hoists are usually required to be equipped with an overspeed mechanism for braking the cage if the cage travels too fast. Those hoists which are provided with rack and pinion drive assemblies may also be equipped with an overspeed mechanism which includes a pinion which also engages the rack.

Certain problems have arisen with rack and pinion personnel hoists heretofore available. The rack and pinion drive mechanism is generally located within the cage, and this reduces the available space within the cage and presents a possible hazard to the occupants of the cage. Further, the drive mechanism usually includes a reducer gear box between the drive shaft and the motor. In most prior hoists the gear box and the motor have been rigidly secured to the cage, and the pinion shaft has been supported by the gear box. Stresses which are imposed on the drive pinion from side loading and other causes is transmitted to the gear box, and excessive stresses could cause failure of the bearings or other components within the gear box, backlash in the gearing, and other problems. Any adjustment of the pinion relative to the rack is fairly difficult, requiring movement of the gear box and motor relative to the cage.

To my knowledge all rack and pinion personnel hoists presently available have multiple drive pinions, and the use of two or more drive pinions might cause backlash problems between the drive pinions, e.g., the lower drive pinion might not contribute substantially to the driving of the cage along the rack and the higher pinion might be required to perform at a greater capacity than intended.

Problems have also arisen with the rack and pinion overspeed mechanisms, particularly in the resetting operation. The overspeed mechanism actuates a braking device each time the cage exceeds a predetermined excessive rate of travel, and the braking device must be reset after each operation. Rack and pinion overspeed mechanisms have generally been confined within a closed structure, and the resetting operation may be difficult and time-consuming.

SUMMARY

The invention provides an improved rack and pinion drive assembly and an improved rack and pinion overspeed mechanism which overcome the foregoing problems. The drive assembly includes a single drive pinion, and the shaft for the single drive pinion is rotatably mounted in a bearing which is rigidly secured to the frame. The reducer gear box and the motor are supported on the drive shaft and are allowed to float relative to the cage. Since the pinion shaft is rigidly supported by the bearing, the gear box is not required to withstand any side loading on the pinion, and the bearings within the gear box need only support the weight of the gear box itself. A torque mount extends between the motor and the frame and prevents the motor and gear box from rotating with the drive shaft but permits limited movement of the motor relative to the cage to absorb and reduce shocks when the motor starts and stops. The overspeed mechanism includes a pinion which engages the rack and which is mounted on a shaft rotatably supported by a pair of axially spaced bearings secured to the cage. A brake drum is secured to the shaft between the bearings, and a brake band extends around the drum and may be tightened about the drum by an extendable plunger. The plunger is reciprocally mounted within a hydraulic cylinder, and when the overspeed mechanism is actuated to brake the cage, the plunger can be retracted quickly and easily by forcing hydraulic fluid into the cylinder by means of a hydraulic pump. The bearings for both the drive pinion shaft and the overspeed pinion shaft are secured to the frame with eccentric mounting means so that the positions of the shaft and the pinions can be adjusted relative to the rack. Both the drive mechanism and the overspeed mechanism are supported on top of the cage to provide a clean cage, permitting maximum utilization of the space within the cage and eliminating any potential hazard from the mechanisms.

DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawing, in which—

FIG. 1 is a perspective view of a personnel hoist formed in accordance with the invention;

FIG. 2 is a fragmentary top plan view of the drive mechanism for the hoist;

FIG. 3 is a fragmentary elevational view taken along the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary elevational view taken along the line 4—4 of FIG. 2;

FIG. 4A is a view similar to FIG. 4 of a modified torque mount;

FIG. 5 is a fragmentary longitudinal sectional view taken through the drive pinion, the shaft, and the bearing therefor;

FIG. 6 is a fragmentary sectional view taken along the line 6—6 of FIG. 5;

FIG. 7 is a fragmentary top plan view of the overspeed mechanism;

FIG. 8 is a longitudinal sectional view taken through the shaft of the overspeed mechanism;

FIG. 9 is a schematic illustration of the overspeed mechanism;

FIG. 10 is a fragmentary top plan view of the cage and the tower showing the guide rollers;

FIG. 11 is a fragmentary sectional view taken along the line 11—11 of FIG. 10;

FIG. 12 is a sectional view through the support shaft of one of the upper guide rollers;

FIG. 13 is a fragmentary side elevational view taken along the line 13—13 of FIG. 12; and

FIG. 14 is a view similar to FIG. 12 of one of the bottom guide rollers.

DESCRIPTION OF SPECIFIC EMBODIMENT

Referring now to FIG. 1, the numeral 10 designates generally a hoist for lifting men and/or material, commonly referred to as a personnel hoist. The hoist includes a tower 11 which extends upwardly alongside the structure which is being constructed and which is secured thereto and a cage or lifting frame 12 which rides up and down the tower. The particular tower illustrated is formed from a plurality of interlocking tower sections 11a, 11b, etc. and is supported by a base 13. The base includes four buffer springs 14 to absorb shocks when the cage reaches its lowermost position, and a buffer spring 15 for the counterweight (not shown). When the tower is completed, a conventional cathead may be supported by the top tower section for carrying the sheaves for the counterweight cable.

The cage 12 includes a roof 16 and floor 17, which may be of heavy construction grade plywood, wire mesh, or the like and which are supported by upper and lower tubular frames 18 and 19, respectively. Upright tubular members 20 extend between the upper and lower frames, and wire mesh side panels 21 are secured to the uprights. The cage will also generally include front and rear doors (not shown) which may be slidably supported by horizontally extending door supports 22. The cage carries rollers which will be described more fully hereinafter and which are engageable with the vertical tubular members on the tower for holding the cage on the tower and for permitting sliding movement of the cage relative to the tower.

A drive assembly designated by the numeral 23 is mounted above the roof of the cage. The drive assembly includes a drive pinion 24 which meshes with a vertically extending rack 25 secured to the tower. If the tower is provided in sections, each tower section will include a rack section so that a substantially continuous rack is provided when the tower sections are interconnected. A pair of tubular box channels 26 and 27 are secured to the top frame 18 above the roof, and a pair of vertically extending plates 28 and 29 (FIG. 2) extend between the beams 26 and 27 and are secured thereto, as by welding. Still referring to FIG. 2, the drive pinion 24 is secured to a shaft 30 which is rotatably supported by a bearing 31 extending between the vertical plates 28 and 29. The other end of the shaft extends beyond the bearing and supports a reducer gear box 32. A motor 33 extends laterally or transversely from the reducer gear box relative to the pinion shaft 30, and a brake 34 is positioned on the opposite side of the gear box.

The motor 33 can be a conventional electric motor which includes a drive shaft which extends within shaft housing 35. The reducer gear box is also conventional and includes a worm and worm gear. The worm is connected to the drive shaft of the motor for rotation therewith, and the worm gear is connected to a hollow shaft 36 which is mounted on the pinion shaft 30. The worm meshes with the worm gear and drives the pinion shaft at a reduced rotational speed.

The brake 34 may also be a conventional braking device and includes a shaft connected to the other end of the worm and means for braking the rotation of the shaft. The brake may be connected to suitable controls located within the cage so that rotation of the worm and therefore the drive pinion can be braked when desired. The motor, gear box, and brake 34 may all be conventional and are well known in the art.

Referring now to FIG. 5, the bearing 31 includes a generally cylindrical bearing housing 40 and a conventional railroad-type roller bearing assemblies 41 and 42 mounted within the housing adjacent each end thereof. The right hand bearing is shown in section, and each bearing includes generally cylindrical inner and outer races 43 and 44 and roller bearings 45.

A radially outwardly extending support flange 46 is secured to the right hand end of the bearing housing as viewed in FIG. 5 and is provided with a circular outer periphery 47 which is rotatably received within a circular opening 48 in the vertical plate 28. As will be explained more fully hereinafter, the flange 46 is eccentrically mounted on the bearing housing relative to the axis of the shaft 30. This can be seen from the sectional showing of FIG. 5, the flange 46 being thicker at the top of this figure than at the bottom.

A support flange 50 is secured to the left hand end of the bearing housing and extends radially outwardly therefrom. This support flange includes a generally annularly shaped shoulder 51 having a circular outer periphery 52 which is rotatably received within a circular opening 53 in the vertical plate 29. The radius of the outer surface 52 is the same as the radius of the outer surface 47 of the support flange 46, and the outer surface 52 is also eccentrically related with respect to the axis of the shaft 30. The eccentricity of the outer surface 52 relative to the axis of the shaft 30 can be seen in FIG. 6, this surface being spaced farther away from the axis of the shaft at the upper portion of FIG. 6 than at the bottom. The support flange 50 is secured to the plate 29 by a plurality of bolts 54. The centers of the openings 48 and 53 are aligned, and an axis extending between these openings extends parallel to but offset from the axis of the shaft 30.

If the drive pinion 24 is to be adjusted relative to the rack 25, the bolts 54 may be removed, and the support flange 50 can be rotated by means of a spanner wrench or similar tool. Both of the support flanges 50 and 46 are secured to the bearing housing, and rotation of the flange 50 will also cause rotation of the flange 46. As the circular outer surfaces 47 and 52 rotate within the circular openings in the plates 28 and 29 the eccentricity of these surfaces relative to the axis of the shaft will cause the axis of the shaft to rotate about the axis of the circular openings in the plates and the shaft will move toward or away from the rack. The support flange 50 is provided with a plurality of bolt openings 55, and after the flanges are rotated to adjust the shaft as desired, the bolts can be reinserted through the bolt openings in the plate 29 and through the nearest openings 55 in the flange.

The pinion 24 can be non-rotatably secured to the shaft 30 by a splined connection and is releasably mounted on the end of the shaft by an end cap 56 and bolts 57 which secure the cap to the shaft.

A rigid torque mount 60 (FIGS. 1 and 4) extends between the motor 33 and the cage to hold the motor and the gear box as the drive pinion rotates so that the drive means does not rotate with the pinion. Referring to

FIG. 4, the torque mount includes an elongated link 61 having one end pivotally secured between a pair of brackets 62 which are secured to the motor 33 and the other end pivotally secured between a pair of brackets 63 which are secured to the box channel 26. Pins 64 and 65 pivotally secure the link to the brackets.

A shock absorbing torque mount 60a shown in FIG. 4A can be substituted for the rigid torque mount 60. The torque mount 60a includes a link 61a having one end pivotally secured between the brackets 62 and the other end retained between compression springs 61c and 61d. Spring 61c and 61d are retained in tubular housing 61b. The lower end of the housing 61b is pivotally secured between the brackets 63 which are secured to the box channel 26. The springs 61c and 61d absorb the starting and stopping torque of the drive means.

Other means can be used for connecting the drive means to the cage which will permit some relative movement between the drive means and the cage but which will hold the drive means so that it can rotate the pinion shaft.

The overspeed mechanism is illustrated in FIGS. 7-9. An overspeed pinion 68 is positioned below the drive pinion 24 (FIG. 3) and also meshes with the rack 25. The overspeed pinion is secured for rotation with a shaft 69 which is supported by a pair of axially spaced bearing assemblies 70 and 71. The bearing assembly 70 includes a ball bearing assembly 72 and a radially outwardly extending support flange 73. The support flange includes a generally annularly shaped shoulder 74 having a circular outer periphery 75 which is rotatably received in a circular opening 76 in the vertical plate 28. As discussed previously with respect to the support flanges for the bearing 31, the circular surface 75 is eccentrically related relative to the axis of the shaft 69. The support flange is secured to the plate 28 by bolts 78.

The other bearing assembly 71 similarly includes a ball bearing assembly 79 and a radially outwardly extending support flange 80. The support flange 80 also includes an annularly shaped shoulder 81 having a circular outer periphery 82 which is rotatably received within a circular opening 83 in the plate 29. The circular outer periphery 82 is eccentrically related to the axis of the shaft 69 in the same way as the surface 75, and the flange plate 80 is secured to the plate 29 by bolts 84.

The pinion 68 can be adjusted relative to the rack by removing the bolts 78 and 84 and rotating the support flanges 73 and 80 relative to the plates 28 and 29. The two support flanges are not connected, and each flange must be rotated independently while maintaining the proper relationship to each other so that the axis of the shaft remains perpendicular to the plates 28 and 29. The support flanges are provided with a plurality of bolt openings, and after the desired adjustment has been made, the bolts can be reinserted through the appropriate bolt openings in the support flanges and through the openings in the plates 28 and 29 to secure the bearing assemblies.

A brake drum 86 is mounted on the shaft 69 between the bearing assemblies for rotation with the shaft. The drum includes an inner cylinder 87 secured to the shaft and an outer cylinder 88 connected to the inner cylinder by an end wall 89. A brake band 90 extends around the outer periphery of the brake drum and includes an outer metal backing strip 91 and a friction pad 92 secured to the backing strip.

One end of the brake band is anchored to the cage by means of a bolt 93 and bracket 94 (FIG. 9) which is secured to one or both of the plates 28 and 29, and the other end of the brake band is rotatably secured to a bell crank 95. The bell crank includes an elongated square tubular body 96 which extends between the plates 28 and 29 and which includes end plates 96a. The tube 96 is rotatably mounted on a shaft 97 which extends between the vertical plates 28 and 29, and through openings in the end plates 96a. The bell crank also includes a pair of crank arms 98 and 99 which are welded or otherwise suitably secured to the tube 96. The end of the brake band which is secured to the bell crank is looped about a cross rod 100 (FIG. 7) which extends transversely to an attaching bolt 101, and the bolt 101 is secured to a cross member 102 which extends between the bifurcated crank arm 98. The crank 99 is rotatably connected to the bifurcated end of a plunger 103. The plunger 103 is reciprocally mounted within a hydraulic cylinder 104 which is mounted on top of the cage, and the inner end of the plunger terminates in a piston 105. A compression spring 106 is carried on the plunger between the cylinder and a radially enlarged flange 107 on the plunger and urges the plunger to extend from the cylinder. The plunger can be hydraulically retracted to compress the spring by a hydraulic pump 108 (see also FIG. 1) which is mounted on the roof of the cage. The pump is connected to the cylinder forwardly of the piston 105 by a fluid conduit 109.

After the plunger has been retracted to compress the spring, the plunger can be releasably locked in the retracted position by a trigger or latch 110 which is rotatably mounted on a shaft 111 extending through the vertical plate 29 and which is provided with a notch 112 for engaging a lever arm 113 secured to the central body 96 of the bell crank. As can be seen in FIG. 9, when the lever arm 113 engages the notch in the trigger, the bell crank is held against counterclockwise movement even though the spring 106 is urging the plunger to extend to the left.

A pair of centrifugal weights 114 and 115 are rotatably secured to the brake drum 86 by bolts 116 and 117. Each of the bolts passes through the associated centrifugal weight adjacent one end thereof so that the weights can be rotated outwardly under the influence of centrifugal force when the brake drum rotates fast enough. The speed at which the centrifugal weights will rotate outwardly can be adjusted by means of a rod 118 secured to the centrifugal weight 114 which extends through a mounting bracket 119 on the brake drum. A compression spring 120 is carried by the rod and abuts a nut 121 which is threadably engaged with the rod. The preload on the compression spring 120 can be varied by changing the position of the nut 121, and the greater the preload, the faster the speed at which the brake drum must rotate before the centrifugal weight moves outwardly. Similar adjusting means can be provided for the weight 115, or the two weights can be interconnected by link means so that movement of the one weight will cause movement of the other weight.

If the overspeed pinion 68 is caused to rotate too fast, either because the cage is descending or ascending too rapidly, the centrifugal weights will rotate outwardly, and one or the other of the weights will strike the trigger 110, thereby releasing the lever arm 113 and allowing the spring 106 to extend the plunger. As the plunger extends, the bell crank rotates and tightens the brake

band about the brake drum to stop the rotation of the pinion shaft 69 and the overspeed pinion 68. Braking of the overspeed pinion will also brake the cage.

After the overspeed mechanism has been actuated to brake the cage, it can be easily reset by pumping hydraulic fluid into the cylinder 104 to retract the plunger. When the plunger has been retracted sufficiently to permit the lever arm 113 to be latched by the trigger 110, the hydraulic pressure in the cylinder can be relieved by gradually opening the valve 122 on the pump until the lever arm 113 is firmly seated in the notch of the trigger. Thereafter, the valve 122 is fully opened to relieve the hydraulic pressure so that extension of the plunger is not impeded by residual hydraulic fluid in the cylinder.

The overspeed mechanism can be enclosed within a housing 123 (FIG. 1) to protect the components from the elements. However, the housing can be provided with a removable cover which permits access to the overspeed mechanism for resetting the mechanism or for inspecting or replacing the parts thereof.

Referring to FIGS. 2 and 3, back-up rollers 124 and 125 engage the back of the rack 25 opposite the drive pinion 24 and the overspeed pinion 68, respectively. Each of the back-up rollers is adjustably mounted on the vertical plate 28 for movement toward or away from the rack so that backlash between the pinions and the rack can be adjusted as desired. The roller 124 is rotatably mounted on a bifurcated support 126 which is secured to the plate 28 by bolts 127. The bolts extend through elongated slots in the plate 28, and an adjusting screw 128 can move the support 126 relative to the plate when the bolts are loosened. Similarly, the back-up roller 125 is supported by a bifurcated support 129 which is secured by bolts 130 and which is adjustable by a screw 131. The screws 128 and 131 are threadedly engaged with tubular supports 128a and 131a which are welded to the plate 28.

The cage is slidably secured to the tower by upper and lower pairs of guide rollers which are mounted on the cage and which engage the vertical tubular supports of the tower. As shown in FIGS. 10 and 11, a pair of upper rollers 132 and 133 are rotatably supported by the box channels 26 and 27 which extend rearwardly from the vertical plate 28 of the cage, and a pair of lower rollers 134 and 135 are rotatably supported by a pair of box channels 136 and 137 which extend below the floor of the cage. The upper rollers 132 and 133 engage the rear portions of tubular supports 138 of the tower and prevent the top of the cage from moving away from the tower, and the lower rollers engage the forward portions of the tubular supports so that the cage is supported in cantilever fashion on the tower. The four tubular supports of the tower are joined by braces 139, and the upper rollers have an arcuate surface 140 which extends for only about 90° so that the rollers can move along the supports without interference from the braces.

The cage is also equipped with upper and lower pairs of side rollers which engage the sides of the tubular supports and prevent the cage from moving laterally relative to the tower. The side rollers are conventional and are not shown.

Each of the upper and lower rollers are eccentrically mounted so that the position of each roller can be adjusted relative to the cage and the tower. Referring to FIG. 12, the upper roller 133 is rotatably supported on a cylindrical shaft 141 by a bearing 142. The cylindrical

shaft 141 is eccentrically mounted within an eccentrically bored cylinder 143 so that the axis of the shaft 141 extends parallel to but offset from the axis of the cylinder 143. The cylinder 143 is rotatably received in an outer cylinder 144 which extends through the box channel 27 and is secured thereto, as by welding. An end cap 145 is secured to both the shaft 141 and the cylinder 143 by bolts 146 so that these parts rotate together, and the end cap is removably secured to the outer cylinder 144 by a bolt 147. The end cap is provided with a plurality of arcuately disposed bolt openings 148 (FIG. 13) so that the shaft 141 and eccentric cylinder 143 can be rotated and secured in the desired position by the bolt 147.

The other top roller 132 is similarly eccentrically mounted, and as the eccentrically mounted support shafts 141 are rotated about the axes of the outer cylinders 144, the rollers move toward or away from the cage and therefore draw the top of the cage toward the tower or allow the top of the cage to move away from the tower. The rollers can therefore be adjusted until the drive pinion 24 is centered on the rack 25, and this adjustment can compensate for manufacturing tolerances.

The eccentric mounting for the bottom roller 135 is shown in FIG. 14. The roller is rotatably mounted on a cylindrical shaft 149 by bearing 150, and the shaft 149 is received in an eccentrically bored cylinder 151. The cylinder 151 is rotatably received in an outer cylinder 152 which extends through the channel 137 and is secured thereto. An end cap 153 is secured to both the shaft 149 and cylinder 151 by bolts 154 and is removably secured to the outer cylinder 152 by bolt 155. The end cap is provided with a plurality of openings for the bolt 155 as described with respect to the end cap 145.

The other bottom roller is similarly eccentrically mounted, and rotation of the support shafts 149 moves the bottom rollers toward or away from the cage and therefore allows the bottom of the cage to move toward the tower or push the bottom of the cage away from the tower. This movement of the bottom rollers permits adjustment to compensate for manufacturing tolerances and for wear of the rack and drive pinion. The top and bottom rollers therefore provide for adjustment of the pinion in a direction transverse to the adjustment permitted by the eccentrically mounted bearing for the pinion.

When the hoist is to be used, the tower sections are interconnected in place over the foundation 13 in the conventional manner. The cage is installed on the tower by first loosening the back-up rollers 124 and 125 and moving them slightly away from the pinions. The cage is slid into place on the tower so that the pinions engage the rack, and the adjustable guide rollers on the cage which engage the vertical tubular members of the tower are positioned so that the cage is slidably connected to the tower. The drive pinion 24 and the overspeed pinion 68 can then be adjusted to center the cage on the tower and to compensate for manufacturing tolerances. As previously described, the drive pinion 24 is adjusted by removing the bolts 54 from the support flange 50 and turning the support flanges relative to the vertical plates 29. Rotation of the support flanges moves the cage relative to the rack when the drive pinion engages the rack since the axis of the pinion shaft is eccentrically related to the circular openings in the vertical plates 28 and 29. After the desired adjustment has been made, the bolts 54 can be re-

placed. The overspeed pinion 68 is similarly adjusted by removing the bolts 78 and 84 and rotating the two support flanges 73 and 80 relative to the vertical plates 28 and 29. Thereafter, the back-up rollers 124 and 125 can be adjusted to give the desired backlash.

The motor 33 and brake 34 are controlled by a suitable control panel positioned within the cage. The motor can be a conventional reversible electric motor, and rotation of the motor in one direction rotates the drive pinion 24 to raise the cage along the rack and the tower, and rotation of the motor in the other direction lowers the cage. The brake 34 is used to stop the cage during normal operation.

The drive pinion is rigidly supported against side loading, i.e., loading in a direction transverse to the pinion shaft, by the bearing 31, and, since the bearing 31 is a separate component from the reducer gear box 32, a bearing can be selected which is strong enough to withstand any stresses which conceivably could be encountered. The drive mechanism comprising the reducer gear box 32 and the motor 33 is mounted on the other end of the pinion shaft, and the torque mount 60 allows the drive mechanism to float somewhat with respect to the rigid bearing and pinion shaft. The torque mount permits some relative movement between the drive mechanism and the cage, and this absorbs or reduces shocks and provides a very smooth drive. Since the bearings within the reducer gear box need not withstand side loading on the pinion and need be strong enough only to support the weight of the drive mechanism on the pinion shaft, a special heavy duty gear box is not required. The smoothness of the drive can also be attributed to the few parts between the motor and the pinion. The only gears between the motor and the pinion shaft is the worm and the worm gear within the reducer gear box, and this reduces backlash and the possibility of wear.

Since only a single drive pinion is used, fewer components are required than for hoists which use multiple drive pinions, and the fewer components increase the reliability of the drive system and make maintenance and repair easier. In the event that wear occurs between the drive pinion and the rack, this wear can be compensated for very easily by adjusting the pinion relative to the rack by means of the eccentrically mounted support flanges.

The overspeed pinion acts essentially as an idler pinion while the cage is raised and lowered during normal operation. However, when the cage exceeds a predetermined safe speed, the centrifugal weights will release the spring-biased plunger to stop the rotation of the overspeed pinion shaft and the overspeed pinion, thereby stopping the cage.

The entire drive system and overspeed mechanism is mounted above the cage, and the only equipment needed within the cage is the control panel for the motor and the brake 34. This provides a "clean" cage which permits maximum utilization of the space within the cage, eliminates the dirt or mess which might be associated with the drive system, such as dripping oil and the like, and eliminates any possible hazard to the occupants of the cage.

While in the foregoing specification a detailed description of a specific embodiment of the invention was set forth for the purpose of illustration, it is to be understood that many of the details hereingiven may be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In a hoist apparatus having a generally upwardly extending tower, a rack secured to the tower, and a lifting frame operatively connected to the tower for generally vertical movement along the tower, drive means on the frame for moving the frame along the tower, bearing means mounted on the frame, a shaft rotatably supported by the bearing means at at least a pair of axially spaced locations, a brake pinion mounted on the shaft for rotation therewith and engaging the rack, the bearing means including a pair of axially spaced support flanges extending generally transversely to the shaft, each flange having a substantially cylindrical surface which is eccentrically related to the longitudinal axis of the shaft, the frame being provided with a pair of generally circular openings which rotatably receive the cylindrical surfaces of the support flanges, and means for releasably securing the bearing means to the frame whereby the position of the axis of the shaft relative to the frame can be changed by releasing the securing means and rotating the cylindrical surfaces of the support flanges within the frame openings, a brake drum mounted on the shaft for rotation therewith, a brake band extending around a portion of the brake drum and having a pair of ends, one end of the brake band being secured to the frame, a plunger reciprocally mounted on the frame and connected to the other end of the brake band, a spring acting on the plunger for biasing the plunger to tighten the brake band about the brake drum, a latch pivotally mounted on the frame for holding the plunger against the bias of the spring, and centrifugal weight means pivotally mounted on the brake drum and movable outwardly under the influence of centrifugal force as the brake drum rotates, the brake pinion being rotated by the rack as the frame moves along the tower whereby the shaft and the brake drum are rotated, the centrifugal weight means being engageable with the latch when the centrifugal weight means pivot outwardly whereby the latch is pivoted to release the plunger when the rotational speed of the brake drum exceeds a predetermined value whereby the brake band will be tightened about the brake drum to stop the shaft and the brake pinion and thereby stop movement of the frame along the tower.

2. The structure of claim 1 in which the plunger is connected to the other end of the brake band by a bell crank rotatably mounted on the frame, the latch being releasably engageable with the bell crank to prevent rotation of the bell crank under the bias of the spring.

3. The structure of claim 1 in which the plunger is reciprocally mounted within a cylinder and includes a piston within the cylinder, a fluid pump mounted on the frame, a fluid conduit communicating the pump and the cylinder whereby the piston and the plunger can be retracted against the bias of the spring by pumping fluid into the cylinder.

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