Sept. 6, 1966 B. G. ELLIOTT ET AL 3,270,894

MATERIAL HANDLING APPARATUS

Filed April 5, 1965 3 Sheets-Sheet 1

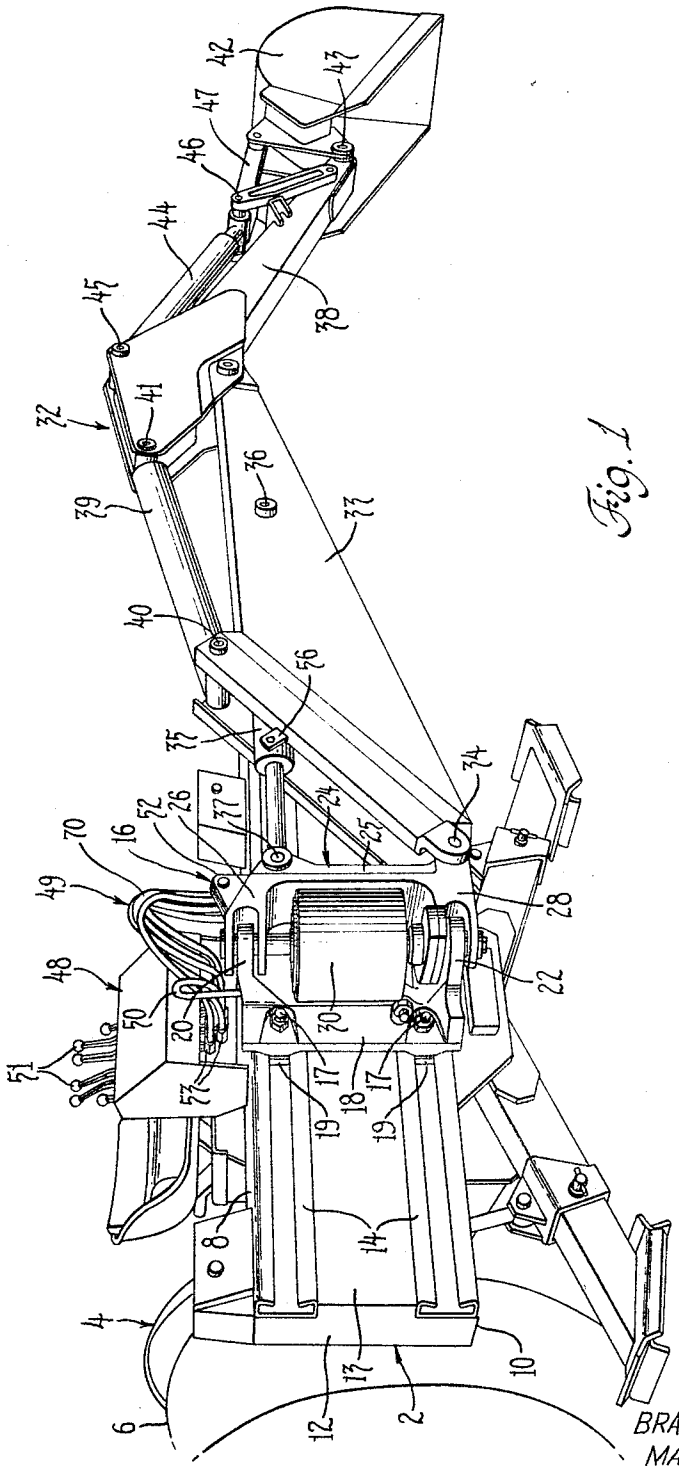


Fig. 1

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MATERIAL HANDLING APPARATUS

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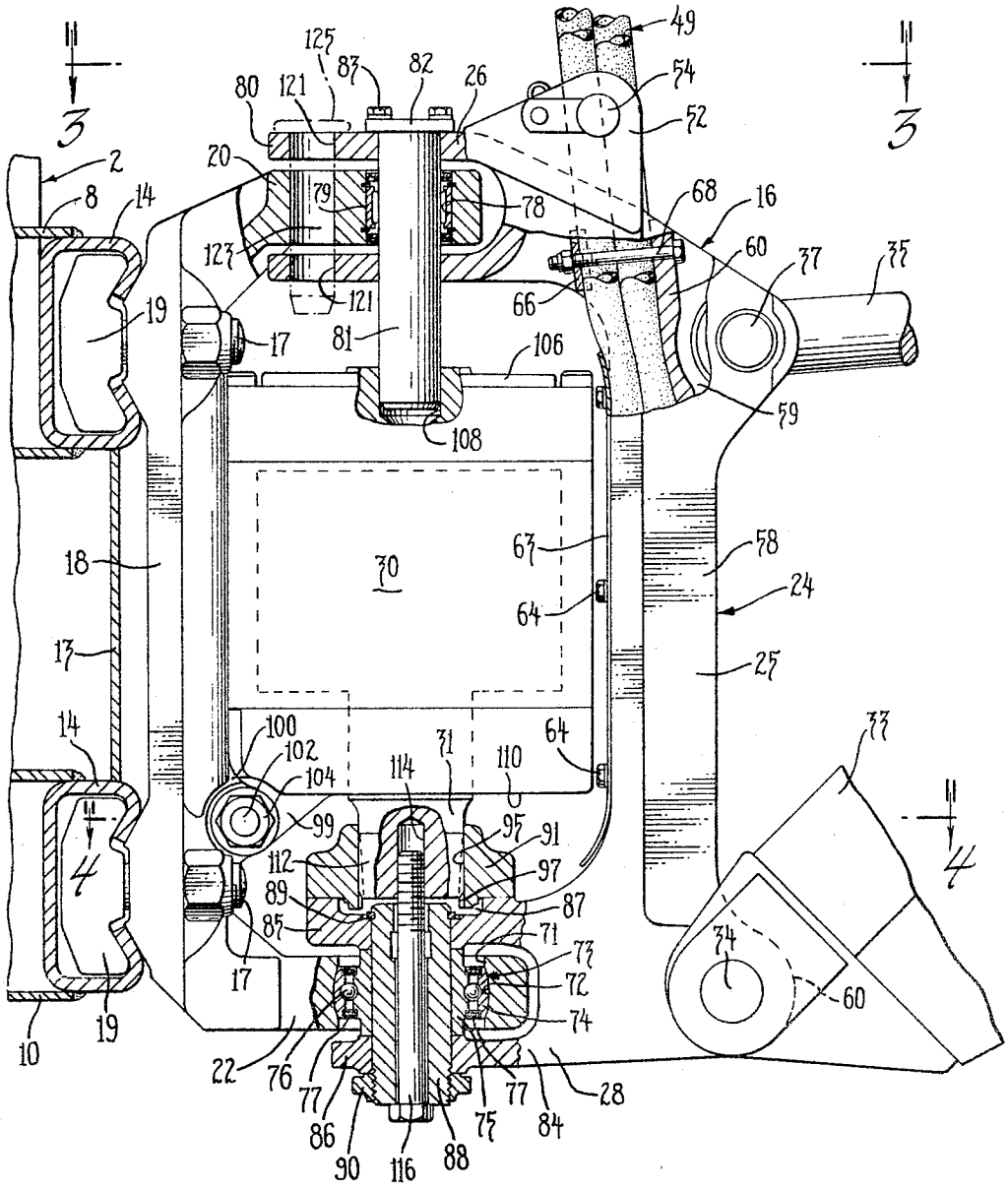


Fig. 2

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Filed April 5, 1965 3 Sheets-Sheet 3

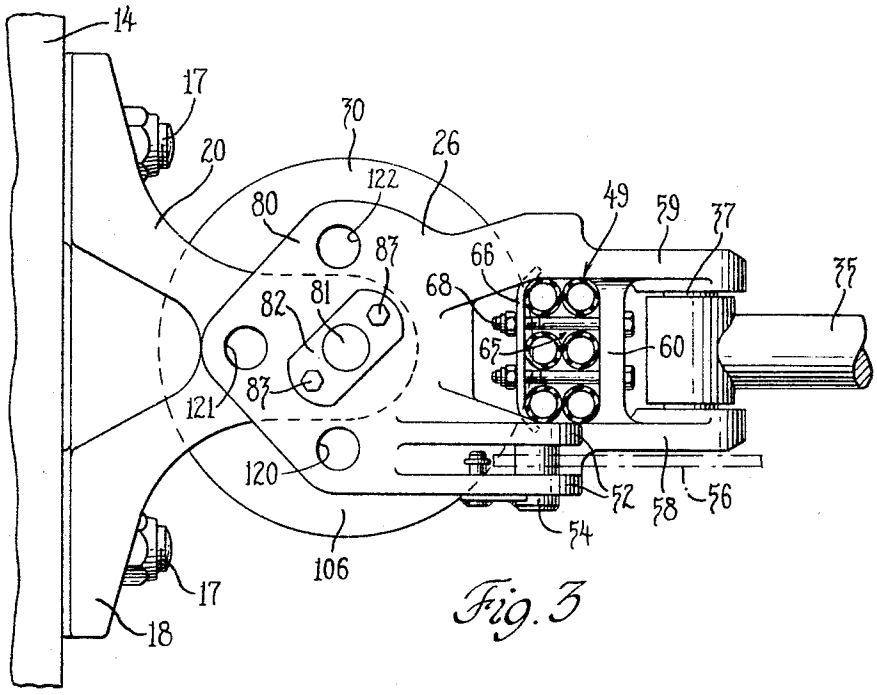


Fig. 3

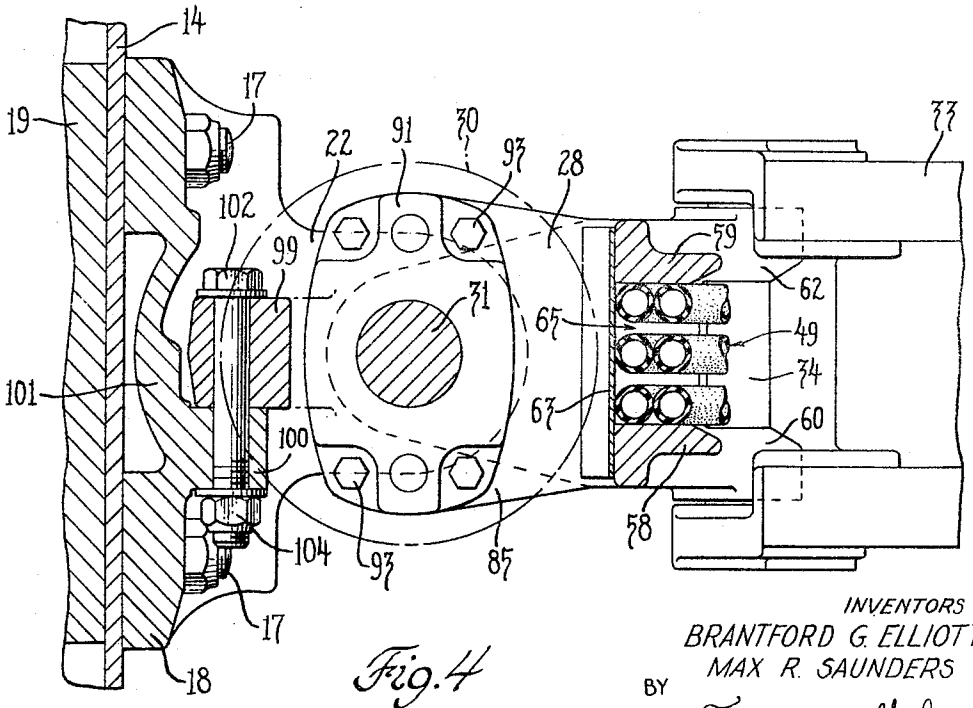


Fig. 4

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3,270,894

MATERIAL HANDLING APPARATUS

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This invention relates generally to material handling equipment and is particularly, but not exclusively, concerned with material handling apparatus of the type commonly referred to as "backhoes."

Presently available backhoes include the type mounted on a transverse supporting frame attached to the rear end of a tractor or similar vehicle, the backhoe boom or mast assembly being mounted for side to side swinging movement on a swing unit carried by the transverse supporting frame. The swing unit includes generally a support bracket mounted on the transverse frame with a mast frame connected to the bracket for pivotal movement about a vertical axis, and a rotary motor or actuator for causing the mast frame to swing from side to side about the vertical axis.

Presently available swing units of this type are of expensive, complex construction, and are difficult to service and repair. In some cases, the entire backhoe or boom assembly must be removed from the supporting frame in order to install or remove the rotary actuator.

It is therefore an object of this invention to provide material handling apparatus having a swingable boom or mast in which the rotary actuator can be removed and installed with a minimum number of manual operations and without the necessity of disconnecting the boom from the supporting structure.

Another object is to provide a swing type boom mounting for backhoes and similar material handling apparatus in which a rotary motor for swinging the backhoe boom or mast can be installed and removed from the mounting structure with a minimum amount of effort and without the necessity of disconnecting the boom from the mounting.

Still another object is to provide a swing type boom or mast support for material handling apparatus including a pivotally connected support bracket and mast supporting frame assembly with a rotary motor or actuator for pivotally actuating the mast frame with respect to the support bracket in which the motor is mounted on the bracket with a single fastener and is releasably coupled to the mast frame.

A further object lies in the provision of a swing type boom support for material handling apparatus including a pivotally connected support bracket and mast supporting frame assembly with a rotary motor for pivotally actuating the mast frame with respect to the support bracket in which the motor is pivotally mounted on the supporting bracket and has a shaft releasably coupled to one arm of the mast frame which is pivotally connected with one arm of the supporting bracket by a self-aligning bearing.

In achievement of the foregoing, and other objects, apparatus incorporating the present invention includes a support bracket having vertically spaced, parallel arms and a mast or boom supporting frame having vertically spaced parallel arms pivotally connected with the bracket arms. Received between the bracket and mast frame arms is a rotary motor or actuator which is pivotally connected by a single pin or bolt to the bracket. The shaft of the actuator is non-rotatably coupled to the lower mast frame arm for actuating the mast frame with respect to the bracket. By removing the single pivot bolt and moving the motor upwardly along the pivotal axis, the shaft may

be withdrawn from the lower mast frame arm and the motor removed from the assembly.

The lower bracket arm is formed with a vertical opening having a spherical, concave wall for receiving an annular bearing support member having an outer complementary convex wall. Rotatably supported in the annular bearing support is a sleeve member, the ends of which are received between the bifurcated end of the lower mast frame arm and secured thereto by a hollow bushing. An adapter plate having an internally tapered splined opening is mounted on the lower mast frame arm for receiving the tapered splined end of the motor shaft. To reduce vibrating and slippage between the coacting splines of the shaft and adapter, a threaded rod extends through the hollow bushing into threaded axial engagement with the motor shaft to draw the motor shaft axially into the adapter opening.

Other objects, advantages and features of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a rear perspective view of a tractor mounted backhoe embodying the invention;

FIG. 2 is an elevational view of the boom support and rotary actuator with certain parts being broken away; and

FIGS. 3 and 4 are views taken on lines 3—3 and 4—4 of FIG. 2, respectively.

While a single embodiment of the invention is described and illustrated in the foregoing specification and accompanying drawings, the invention is not limited to the exact construction shown, but includes numerous alterations in the construction and arrangement of parts as will be apparent to those skilled in the art, and all of which fall within the scope and spirit of the invention.

Referring to FIG. 1, a transverse supporting frame 2 is mounted on the rear end of a tractor 4 having rear wheels 6, only one of which is visible in the drawing. The supporting frame 2 includes top, bottom, and side walls 8, 10 and 12, respectively, and a rear wall 13. Mounted on frame 2 in vertically spaced, parallel relationship is a pair of tracks or rails 14 on which is slidably mounted a swing unit designated generally by reference numeral 16.

The swing unit 16 includes a support bracket 18 on which is pivotally mounted a mast frame 24. Bracket 18 is secured to the supporting frame 2 by bolts 17 which extend through slots in track members 14 into engagement with slide members 19. Projecting rearwardly from bracket 18 are vertically spaced, parallel upper and lower arms 20 and 22, respectively. Mast frame 24 includes a vertical body portion 25 having upper and lower bifurcated arms 26 and 28, respectively, projecting therefrom. The bifurcated arms 26 and 28 receive the upper and lower arms 20 and 22, respectively, of bracket 18. Arms 20 and 22 of bracket 18 are pivotally connected respectively with arms 26 and 28 of mast frame 24 such that mast frame 24 is swingable from side to side with respect to bracket 18 about a vertical axis. Mounted on bracket 18 between arms 20, 26 and 22, 28 is a rotary actuator or motor 30 having a shaft 31 non-rotatably coupled to the lower mast frame arm 28. Upon actuation of the rotary motor 30, the shaft 31 thereof causes mast frame 24 to pivot with respect to bracket 18 about the vertical axis of the motor shaft.

Carried by the mast frame 24 is a backhoe assembly 32 including a main boom or mast 33 pivotally connected by a pin 34 with the lower end of mast frame 24. Boom 33 is actuated in a vertical plane about pivot pin 34 by a hydraulic piston and cylinder actuator 35 having one end pivotally connected with boom 33 at 36, and its other end pivotally connected at 37 with mast frame 24 near the upper end of body portion 25. Pivotally mounted on the end of mast 33 is a dipper stick 38 provided

with a hydraulic actuator 39 which is pivotally connected at 40 with boom 33 and at 41 with the dipper stick. A bucket 42 is pivotally mounted on dipper stick 38 at 43 and is actuated about pivot point 43 by a hydraulic actuator 44. Actuator 44 has one end pivotally connected with the dipper stick at 45 and its other end pivotally connected at 46 with a linkage 47 connected with the bucket.

Mounted on the top wall 8 of support frame 2 is a hydraulic control unit indicated generally be reference numeral 48. The control unit 48 is connected hydraulically with the hydraulic actuators 35, 39 and 44 of the backhoe by flexible hoses 49 and with the rotary motor 30 by hoses 50. Hydraulic medium is conducted to and from the backhoe and rotary motor through hoses 49 and 50 by manipulation of a plurality of control handles 51 on control unit 48. By extending and retracting the hydraulic actuator 35, mast 33 pivots upwardly or downwardly about pin 34; extension and retraction of actuator 39 similarly causes the dipper stick 38 to pivot about mast 33; the bucket 42 is similarly actuated about dipper stick 38 by actuator 44 in a well-known manner. Motor 30 is hydraulically actuated to cause mast frame 24 to swing about a vertical axis to swing the backhoe from side to side. By loosening bolts 17, the entire swing unit 16 can be shifted transversely along tracks 14 from one end to the other of support frame 2 for excavating alongside buildings, foundations, and the like in a manner similarly disclosed in U.S. Patent 3,117,685.

Projecting upwardly from the upper mast frame arm 26 is a pair of spaced, apertured lugs 52 (FIGS. 2 and 3) having a pin 54 mounted therein. For transport, mast 33 is pivoted upwardly to position an apertured ear 56 (FIG. 1) between lugs 52, and pin 54 locks mast 33 in the transport position.

Referring to FIGS. 2, 3 and 4, the vertical body portion 25 of mast frame 24 comprises a pair of laterally spaced plates 58 and 59 extending vertically between arms 26 and 28. Extending between the upper ends of plates 58 and 59 is a support plate 60. Pin 34 extends between plates 58 and 59 through apertured lug members 60 and 62 formed at their lower ends, respectively. Mounted between the edges of plates 58 and 59 adjacent the rotary motor 30 is a guard plate 63 which is secured to plates 58 and 59 by screws 64. Plates 58 and 59 cooperate with guard plate 63 to define a channel 65 extending vertically between arms 26 and 28.

Hoses 49 extend from terminals 53 at control unit 48 up and over the top of swing unit 16 into the upper end of channel 65. As shown in FIGS. 3 and 4, hoses 49 are securely clamped to the upper end of channel 65 by a clamp plate 66 which is connected with the support plate 60 by bolts 68 which extend between adjacent pairs of hoses 49. Guard plate 63 further cooperates with plate 60 to clamp hoses 49 against movement. The length of hoses 49 between the upper end of channel 65 and control unit 48 form a looped slack portion 70 to take up transverse movement of the swing unit 16 along tracks 14.

Formed in the lower bracket arm 22 is a vertical opening 71 having a concave spherical wall 72 defining a seat for a self-aligning bearing assembly 73. Bearing assembly 73 includes an annular bearing support member 74 having an outer convex spherical wall complementary with wall 72 which seats in the spherical wall 72 of opening 71. Rotatably supported on the inner wall of the annular support member 74 is a bearing member in the form of a hollow, cylindrical sleeve 75 which rotates about its vertical axis on ball bearings 76 mounted in opposed grooves in the outer wall of sleeve 75 and the inner wall of member 74. Bearing seals 77 are mounted between the opposed inner and outer walls of bearing support member 74 and sleeve 75, respectively, above and below balls 76.

The upper bracket arm 20 is provided with an opening 78 coaxial with opening 72, in which is mounted a bearing assembly 79. The upper mast frame arm 26 has a bifurcated end portion 80 which receives the upper arm 20 of support bracket 18. Arm 26 of mast frame 24 is pivotally connected with arm 20 by a pin 81 extending through opening 78 and secured to the upper portion of the bifurcated end portion 80 by a plate 82 and a pair of screws 83 as shown in FIGS. 2 and 3.

The lower mast frame arm 28 is formed with a bifurcated end portion 84 including upper and lower portions 85 and 86, respectively. The lower bracket arm 22 is received between the bifurcated portions 85 and 86 with the upper portion 85 overlying the upper end of sleeve 75 and the upper surface of portion 86 seated against the lower end of sleeve 75. A recessed cavity 87 is formed in the upper face of portion 85 concentric with aligned openings in portions 85 and 86 coaxial with the cylindrical opening through sleeve 75. A hollow, cylindrical bushing 88 is mounted in the aligned openings in portions 85 and 86 and extends through sleeve 75. The upper end of bushing 88 is grooved to receive an annular retaining ring 89 to prevent downward axial movement of bushing 88 with respect to portion 85. Upward movement of bushing 88 is prevented by a nut 90 threaded onto the lower end of the bushing and bearing against the lower side of portion 86. Thus, mast frame 24 is supported on the bearing assembly 73 and is free to rotate about the common vertical axes of bushing 88 and pin 81.

Mounted on the upper face of portion 85 of arm 28 is a coupling plate or adapter 91 which is secured to arm 28 by fasteners 93 (FIG. 4). An axial opening 95 is formed in coupling plate 91 coaxial with bushing 88. Downwardly and inwardly tapered internal splines 97 are provided in opening 95 as shown in FIG. 2.

The housing of the rotary actuator 30 is formed with a mounting lug 99 projecting from its lower end wall which is pivotally secured to a support lug 100 on body member 101 of the support bracket by a bolt 102 and nut 104 as shown in FIGS. 2 and 4. Formed in the upper end wall 106 of the motor housing is a cylindrical recess 108 for receiving the lower end of pin 81.

Shaft 31 of motor 30 depends from the lower end wall 110 of the motor housing and has an externally splined end portion 112. End portion 112 is formed with an axial, internally threaded hole 114 for receiving the threaded end of a bolt 116. Bolt 116 is received in the axial cylindrical opening of bushing 88 and acts to pull the coacting splines together to prevent relative movement between shaft 31 and coupling plate 91 to reduce vibration. Upon rotation of shaft 31 caused by hydraulic actuation of motor 30, the splines of shaft 31 act on coupling plate 91 to rotate the mast frame 24 about the vertical axis of bushing 88 to swing the boom to the left or right as desired by the operator.

The bifurcated end portion 80 of arm 26 is provided with three holes 120, 121 and 122 (FIG. 3) each of which can be brought into registry with a transport locking hole 123 (FIG. 2) in the bracket arm 20. For transport, one of holes 120, 121 or 122 is aligned with hole 123 and the swing unit is locked by a pin 125 as shown in FIG. 2.

To remove motor 30, bolts 102 and 116 are removed and upward movement of the motor withdraws shaft 31 from coupling plate 91 permitting the motor to be lifted from between the bracket and mast frame arms. Pin 81 may be raised axially a distance sufficient to permit the shaft to clear plate 91. The engagement between pin 81 and motor 30 provides additional lateral support for the motor. Bolt 116 insures a tight fit between the coacting splines.

While a specific embodiment of the invention has been illustrated and described herein, it will be apparent to those skilled in the art that other forms may be adopted without departing from the scope and spirit of the invention as defined in the appended claims.

We claim.

1. Material handling apparatus comprising: a support bracket having a pair of upper and lower, vertically spaced, parallel arms; a mast frame having a pair of upper and lower, vertically spaced, parallel arms each of which has vertically spaced inner and outer portions at the ends thereof; means pivotally connecting the upper and lower mast frame arms with the upper and lower support bracket arms, respectively, with the upper support bracket arm received beneath the outer portion and above the inner portion of its associated mast frame arm, and the lower support bracket arm received beneath the inner portion and above the outer portion of its associated mast frame arm; a rotary motor having a housing and a rotatable shaft projecting therefrom, means detachably connecting the motor housing to the support bracket between the inner portions of the mast frame arms such that the motor shaft is movable into coaxial relationship with the pivotal axis between the mast frame and support bracket; and coupling means detachably mounted on the inner portion of one of the mast frame arms having an opening coaxial with the pivotal axis between the mast frame and support bracket for receiving the motor shaft; the motor shaft and the opening in said coupling means being secured against rotation relative to each other when the shaft is received in the opening to couple the motor shaft to the mast frame independently of the pivotal connection between the mast frame and support bracket to cause the mast frame to pivot relative to the support bracket when the shaft is caused to rotate by said motor, whereby said motor is selectively removable from the support bracket and detachable from the mast frame independently of the connection between the mast frame arms and support bracket arms.

2. Material handling apparatus comprising: a support bracket having a pair of spaced, parallel arms; a mast frame having a pair of spaced, parallel arms; means pivotally connecting one of said mast frame arms with one of said bracket arms and securing said one arms against relative axial and transverse movement; means pivotally connecting the other of said mast frame arms with the other of said bracket arms and restraining said other arms against relative transverse movement only; a material handling mast carried by said mast frame for swinging movement about the pivotal axis between said bracket and mast frame arms, said means pivotally connecting said one arms supporting said mast aaginst movement along said pivotal axis, a motor having a housing and a rotatable shaft projecting therefrom; a lug projecting from said motor housing; fastening means detachably connecting said lug to said bracket and pivotally securing said motor housing to said bracket between said arms; and means coupling said motor shaft with said one arm of said mast frame on the pivotal axis thereof for rotating said mast frame about said pivotal axis upon rotation of said motor shaft.

3. Material handling apparatus as defined in claim 2 in which said one arm of said mast frame includes a portion extending between said bracket arms and overlying said one bracket arm; coupling means comprising an adapter on said portion of said one mast frame arm having an internally splined, axial recess formed therein, and in which said motor shaft is externally splined for non-rotatable engagement with said adapter.

4. Material handling apparatus as defined in claim 3 further including an axial opening in the means pivotally connecting said one arms; an axial, internally threaded opening in said motor shaft; and a bolt extending through the axial opening in said connecting means into threaded engagement with the threaded opening in said motor shaft to secure said shaft against axial movement relative to said adapter.

5. Material handling apparatus as defined in claim 4 wherein the splines on said motor shaft and adapter recess are complementarily tapered inwardly toward said one bracket arm such that said bolt pulls the motor shaft into tight, axial engagement with the adapter to prevent angular vibration between the shaft and adapter during rotation.

6. Material handling apparatus comprising: a bracket having a pair of spaced, parallel arms; a mast frame having a pair of spaced, parallel arms; means pivotally connecting one of said bracket arms with one of said mast frame arms and the other of said bracket arms with the other of said mast frame arms; a rotary motor having a pair of members rotatable with respect to each other, one of which defines a shaft for the motor and the other of which defines a housing for the motor; means pivotally connecting one of said motor members to said bracket such that the motor can be moved with respect to the bracket between said pivotally connected arms to bring the rotary axis of said motor into axial alignment with the pivotal axis between the mast frame arms and bracket arms; an adapter carried by one of said mast frame arms having means for selectively securing the other of said motor members to the adapter in axially spaced relationship with the pivotal connections between the mast frame arms and bracket arms to rotatably couple said other motor member to the mast frame such that said connecting means and adapter respectively restrain said one and said other motor members against rotation relative to said bracket and mast frame whereby relative rotation between said motor members will cause the mast frame to pivot relative to the bracket, said motor thereby being selectively removable from the mast frame and bracket assembly without affecting the pivotal connections between the mast frame arms and bracket arms.

7. Material handling apparatus comprising: a supporting frame; a bracket mounted on said supporting frame having a pair of vertically spaced, upper and lower parallel arms; a mast frame having a pair of vertically spaced, upper and lower parallel arms respectively pivotally connected with the upper and lower bracket arms; a motor having a housing with upper and lower end walls and a rotatable shaft projecting from the lower end wall; a mounting lug projecting from said motor housing; a fastener connecting said mounting lug to said bracket to detachably secure the motor to the bracket between said arms with the upper end wall of the motor housing disposed beneath the upper pivotally connected bracket and mast frame arms, and the lower end wall of the motor housing disposed above the lower pivotally connected bracket and mast frame arms; an adapter mounted on the lower mast frame arm having an opening coaxial with the pivotal axis between the mast frame and bracket arms; said opening non-rotatably receiving the motor shaft to couple the motor shaft with the lower mast frame arm for actuating the mast frame about the pivotal axis between the bracket and mast frame arms upon rotation of the motor shaft; the upper end wall of said motor housing being spaced below the upper pivotally connected bracket and mast frame arms such that the motor is movable upwardly toward said upper arms upon removal of said fastener to withdraw the motor shaft from the adapter opening permitting the motor to be removed from between the bracket and mast frame arms without disassembly of the mast frame and bracket.

8. Material handling apparatus comprising: a supporting frame; a bracket mounted on said supporting frame having a pair of vertically spaced, parallel, upper and lower arms projecting horizontally from the supporting frame; a vertical opening in said lower arm having a concave wall; an annular bearing support mounted in said opening having an outer convex wall complementary with the concave wall of said opening; a bearing member received in said annular bearing support; antifriction means supporting said bearing on the inner wall of said annular bearing support for rotation about a vertical axis; a mast frame having a lower, bifurcated arm with spaced upper and lower portions receiving the

lower bracket arm; means securing the upper and lower portions of said lower mast frame arm to said bearing member; and said mast frame having an upper arm pivotally connected with the upper arm of said bracket.

9. Material handling apparatus as defined in claim **8** wherein said bearing member is in the form of a hollow, cylindrical sleeve and the upper and lower portions of the lower mast frame arm engages the upper and lower ends, respectively, of said sleeve; and further including aligned openings in said upper and lower portions coaxial with said sleeve.

10. Material handling apparatus as defined in claim **9** wherein said securing means comprises a hollow, cylindrical bushing received in said sleeve and the aligned openings in said upper and lower portions of the lower mast frame arm, and retaining means engaging opposite ends of said bushing to prevent axial displacement thereof with respect to the sleeve and lower mast frame arm.

11. Material handling apparatus as defined in claim **10** further including: an adapter plate mounted on the upper surface of the upper portion of the lower mast frame arm; an opening in said adapter plate coaxial with said bushing and sleeve; and a rotary actuator secured to said bracket having a shaft non-rotatably received in the opening of said adapter plate for causing the mast frame to pivot from side to side relative to the bracket.

12. Material handling apparatus as defined in claim **11** further including an axial, threaded opening in the actuator shaft; and a bolt extending through said hollow bushing into engagement with said axial, threaded opening to secure said actuator shaft against axial displacement relative to said adapter plate.

13. Material handling apparatus as defined in claim **12** wherein said rotary actuator includes: a housing received between said bracket and mast frame arms; and a mounting lug projecting from said housing pivotally connected with said bracket between said bracket arms.

14. Material handling apparatus as defined in claim **13** wherein said actuator housing has an upper end wall spaced vertically beneath the upper bracket and mast frame arms sufficiently to permit withdrawal of the actuator shaft from the adapter plate upon disconnection of said mounting lug from said bracket and withdrawal of said bolt from said hollow bushing.

15. Material handling apparatus as defined in claim **14** wherein the actuator shaft and adapter plate opening have coacting splines which are complementarily tapered downwardly and inwardly such that said bolt pulls the actuator shaft into tight engagement with the adapter plate opening.

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