

July 16, 1968

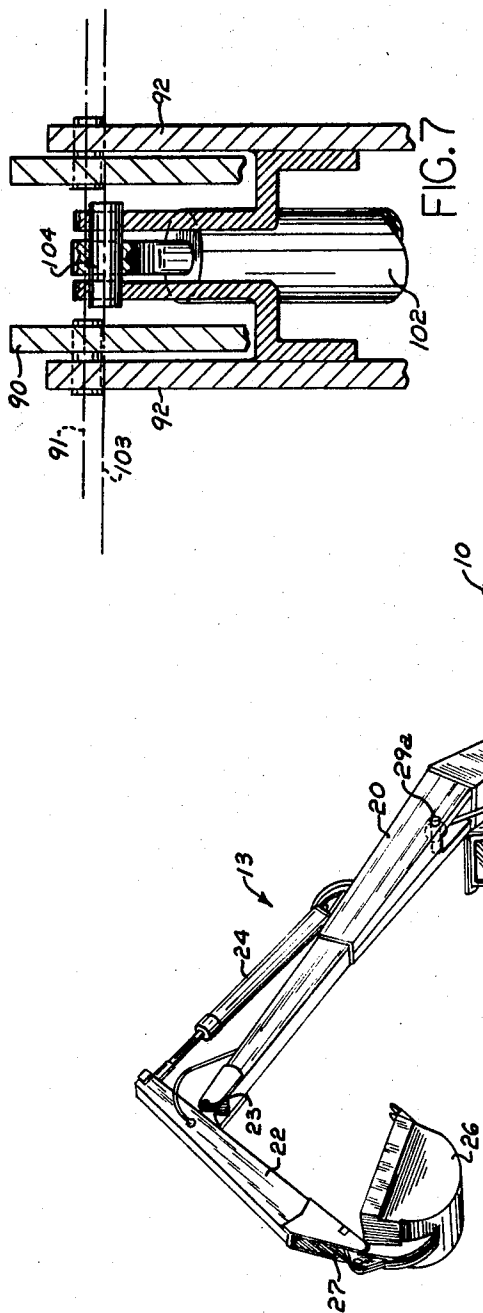
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3,392,855

MATERIAL HANDLING MACHINE

Filed April 4, 1966

3 Sheets-Sheet 1



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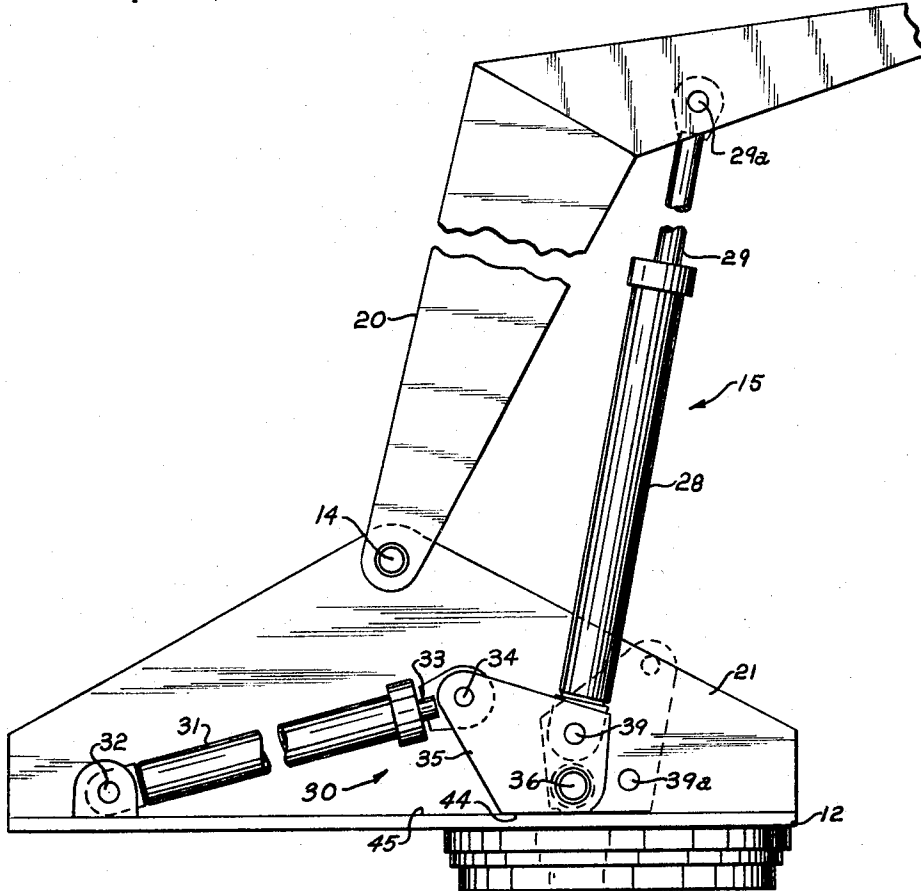


FIG. 2

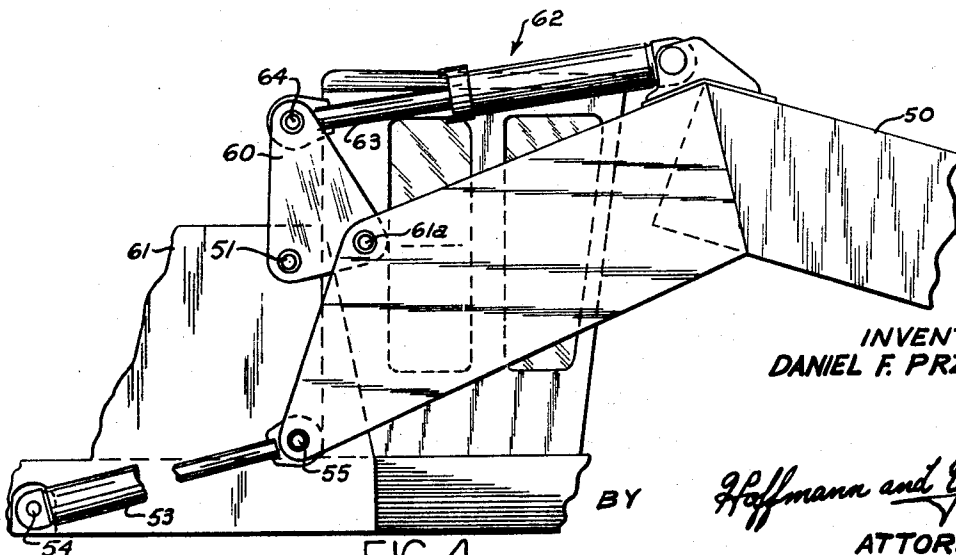


FIG. 4

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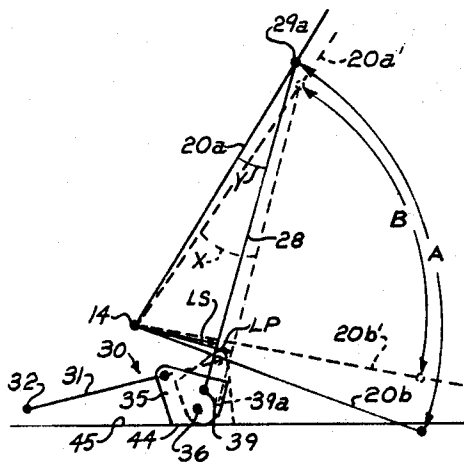


FIG. 3

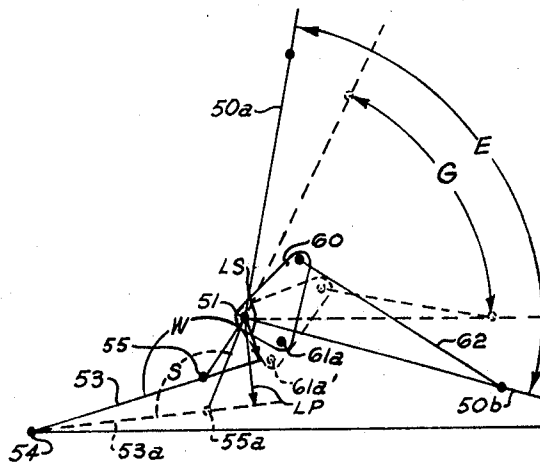


FIG. 5

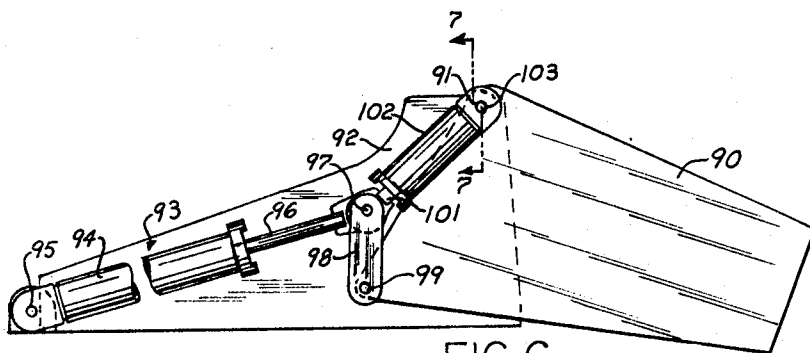


FIG. 6

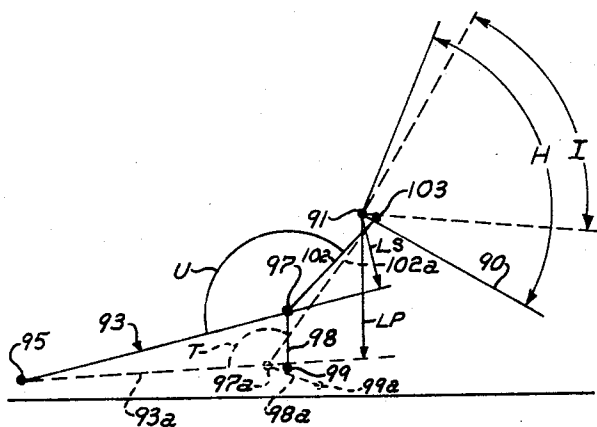


FIG. 8

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MATERIAL HANDLING MACHINE

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ABSTRACT OF THE DISCLOSURE

A material handling machine includes a boom member carried on a boom support and dipper stick is pivotally carried on one end of the boom member. A first part of a hydraulic lift power means is pivotally connected to the boom member and a second part of the hydraulic lift power means is pivotally connected to a link member which, in turn, is pivotally connected to the boom support. A power cylinder is provided for pivoting the link member relative to the boom support.

The present invention relates to a material handling machine, and particularly relates to a material handling machine, such as a backhoe, which includes a boom member having a dipper stick pivotally connected to the end of the boom member, and wherein the boom member is pivotally connected to a support for pivotal movement about a horizontal axis and power means which acts between the boom and the support for effecting vertical pivotal movement of the boom.

Known material handling machines, such as a backhoe, include a boom carried by a support for pivotal movement in a substantially vertical plane about a horizontal axis. The vertical movement or stroke of the boom about the horizontal pivot axis is effected by a power means. The power means moves the boom at a particular speed and power providing a boom stroke having a particular speed-power relationship. Preferably, in known material handling machines, the power means includes a hydraulic cylinder and piston rod. The hydraulic cylinder is generally connected for pivotal movement about a horizontal axis to the support and the outer end of the piston rod is generally pivotally connected to the boom so as to provide for the necessary relative movements between the piston rod and boom, on the one hand, and the hydraulic cylinder and support, on the other hand, as the boom moves vertically about the horizontal pivot axis.

The boom generally carries on its outermost end a suitable tool for performing some operation. Commonly, the tool is a bucket for effecting digging or movement of some material. These machines, however, are effective to perform numerous different operations, depending upon the nature of the tool supported on the end of the boom, and are also capable of lifting and/or carrying heavy loads. Due to the various uses for these machines, the lifting power requirements for the boom vary. Moreover, the desired speed of vertical movement of the boom also varies.

In accordance with the present invention, there is provided a new and improved material handling machine having a boom carrying a dipper stick and wherein the boom is movable in a vertical plane by a power means and wherein the speed-power relationship for boom movement may be controlled and varied within limits. This provides for rapid boom movement when handling light loads requiring little power, and also provides for handling heavy loads requiring greater power but at a low speed. The ability to vary the speed-power relationship does provide a material handling machine of greater versatility and efficiency.

Accordingly, the principal object of the present inven-

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tion is the provision of a new and improved material handling machine having a boom carrying a dipper stick and wherein the boom is pivotal about a horizontal axis by power means and which is constructed and arranged so that the speed-power relationship for boom movement may be controlled through a wide range whereby the boom may be readily moved either through a power stroke at a relatively low rate of speed or through a speed stroke at a relatively high rate of speed but at less power.

A further object of the present invention is the provision of a new and improved material handling machine having a boom pivotally carrying a dipper stick and with the boom pivotally supported for vertical movement about a horizontal axis relative to a support member and a hydraulic power means acting between the support member and the boom to effect the vertical pivoting movement thereof and constructed so as to provide selectively for movement of the boom through a speed stroke wherein the boom moves through a substantially wide range of movement at a relatively fast rate of speed and a power stroke wherein the boom moves through a substantially lesser range of movement but is capable of handling greater loads.

A further object of the present invention is the provision of a new and improved material handling machine having a boom pivotally carrying a dipper stick and with the boom pivotally connected to a support and power means for moving the boom relative to the support including a hydraulic cylinder pivotally connected to the support and a piston rod pivotally connected to the boom, and wherein the machine includes a mechanism for shifting one of the aforementioned pivot connections so as to cause the power means to apply a substantially greater effective force for moving the boom in one position of the pivot connection than in another position thereof to thereby vary the speed-power relationship for boom movement.

A still further object of the present invention is the provision of a new and improved material handling machine having a boom supported for pivotal movement and a hydraulic power means supported to effect the pivotal movement of the boom and wherein the hydraulic power means includes a piston rod pivotally connected to the boom at a point above the boom pivot and a cylinder connected to a support member and incorporating power means for moving the support member for the cylinder pivot relative to the boom pivot so as to vary the distance between the pivot point of the boom and the pivot point of the cylinder and also vary the direction in which the piston rod applies force to the boom.

A still further object of the present invention is the provision of a new and improved material handling machine having a boom supported for pivotal movement about a horizontal axis by a support and wherein the boom pivot is carried on a member which may be moved relative to the support upon actuation of a hydraulic cylinder acting between the support and member and including a lift cylinder pivotally connected to the boom at a point spaced from the boom pivot point so as to effect vertical movement of the boom through speed and power strokes depending upon the position of the member carrying the boom pivot.

A still further object of the present invention is the provision of a new and improved material handling machine incorporating a boom supported for pivotal movement about a horizontal axis relative to a support frame and a hydraulic lift mechanism operatively connected to effect the vertical movement of the boom and wherein the lift cylinder is connected to a link member which, in turn, is pivotally connected to the boom and wherein a hydraulic cylinder acts between the link and support frame and when energized moves the link member so as to vary the

relative position of the boom pivot and the connection of the piston rod relative to the boom thereby varying the effective force applied by the hydraulic mechanism to effect movement of the boom.

Further objects and advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description of the preferred embodiment thereof made with reference to the accompanying drawings forming a part of this specification and in which:

FIG. 1 is a schematic perspective view of a material handling machine embodying the present invention;

FIG. 2 is a detailed view of a portion of the material handling machine shown in FIG. 1;

FIG. 3 is a view illustrating schematically the mechanism shown in FIG. 2;

FIG. 4 is a view of a portion of a modified machine incorporating the present invention;

FIG. 5 is a view illustrating schematically the mechanism shown in FIG. 4;

FIG. 6 is a view of a portion of a still further modified machine embodying the present invention;

FIG. 7 is a fragmentary sectional view of the machine shown in FIG. 6, taken approximately along the section line 7—7 of FIG. 6; and

FIG. 8 is a view illustrating schematically the mechanism shown in FIG. 6.

The present invention provides an improved material handling machine having a boom movable in a vertical plane about a substantially horizontal axis and wherein the movement of the boom is effected by a power means. The present invention is adapted for use in any type of material handling machine which incorporates such a boom and is particularly adapted for use in material handling machines which have varying demands with regard to speed of boom movement and power capability of the boom.

As representing the preferred embodiment of the present invention, FIG. 1 illustrates a material handling machine 10. The material handling machine 10 includes a support carrier 11 which carries a support platform 12. The support platform 12 is rotatable about a substantially vertical axis and carries a boom structure 13. The boom structure 13 is supported for pivotal movement about a horizontal axis 14 and is pivoted about the horizontal axis 14 by a power means 15.

The boom structure 13 includes a boom member 20 which is pivotally supported for movement about the axis 14 by pivot pin means which extends through a pair of spaced support frame members 21 secured to the platform 12. Upon actuation of the power means 15, the boom 20 moves relative to the support platform 12 and support frame members 21. The boom 20 on its outermost end carries a dipper stick 22 for pivotal movement relative to the boom 20. The dipper stick 22 may be pivoted about a pivot axis 23 by a hydraulic cylinder 24. The outermost end of the dipper stick 22, of course, carries a suitable material handling implement, a digging bucket 26, as shown in the drawings and which is suitably actuated by a hydraulic power means 27.

The power means 15 for effecting vertical movement of the boom is preferably a hydraulic power means including a cylinder 28 and a piston rod 29 pivotally connected at its outer end to the boom 20 at a location above the pivot axis 14 for the boom 20. The piston rod 29 is pivotal relative to the boom about a pivot axis 29a. The piston rod, when it moves, applies a force to the boom 20 to effect movement thereof.

In accordance with the present invention, the material handling machine 10 is constructed so that the speed-power relationship for boom movement can be varied. Thus, the boom 20 may be moved at different speeds and have different lifting capabilities. The speeds and power capabilities can be varied over a substantial range, and at one limit the boom can move through a speed stroke

wherein the boom moves through a wide range of movement at a relatively fast speed, while at the other limit, the boom 20 moves through a power stroke wherein the boom moves through a lesser range of movement than in the speed stroke but is capable of handling greater loads.

During the speed stroke, the hydraulic mechanism 15 applies a given force to the boom to effect movement thereof about the pivot axis 14, whereas during the power stroke the hydraulic mechanism applies a greater effective force to the boom to effect movement of the boom about the pivot axis 14. In view of the fact that a greater effective force is applied to the boom for movement about the pivot axis, the boom is capable of handling greater loads during the power stroke.

The fact that the speed-power relationship for boom movement can be varied enables the material handling machine 10 to be utilized highly effectively and with a great flexibility. The boom is, of course, capable of moving at higher rates of speed through a wider range of movement, thereby enabling light loads to be handled relatively quickly and through a wide range of movement. The fact that the boom is capable of moving through a power stroke enables the mechanism to be utilized for handling heavier loads and more readily enables the material handling machine to be utilized as a lifting device.

The material handling machine 10 includes a suitable means for selecting and adjusting the speed-power relationship for boom movement. This selecting and adjusting means is generally designated 30 and includes a hydraulic cylinder 31. The hydraulic cylinder 31 is pivotally connected at 32 to the support platform 12, and a piston rod 33 extending from the cylinder 31 is pivotally connected at its outer end at 34 to a support plate member 35. The member 35 is pivotally carried by the support platform 12 and is pivotal relative thereto about a pivot axis 36. The member 35 is connected to the platform 12 for movement from the full-line position shown in FIG. 2 to the dotted-line position shown in FIG. 2. The support member 35 is pivotally connected to the hydraulic cylinder 28 forming a part of the hydraulic lift mechanism 15 for relative movement about a pivot axis 39 which is spaced from the axis 36.

Referring to FIG. 3 wherein parts are illustrated by lines for descriptive purposes, the hydraulic cylinder 31 is shown in full lines in a retracted or unenergized position wherein the support surface 44 of the plate member 35 engages the upper surface 45 of the support platform 12. In this position, the pivot axis 39 of the cylinder 28 is above the pivot axis 36 for the member 35. When the cylinder 31 and the support member 35 are in this position, the cylinder 28, when fluid is applied thereto, effects movement of the boom 20 through its speed stroke. The boom may move from the position designated 20a to the position designated 20b, and the range of movement of the boom is designated as A in FIG. 3.

The cylinder 31, when energized, effects movement of the pivot axis 39 of the cylinder 28 to the position shown in FIG. 3 and designated 39a. This movement of the pivot axis of the cylinder 28 is relative to the pivot axis 14 of the boom 20 and, specifically, is downwardly away from the pivot axis 14 of the boom 20.

With the support 35 in this position, when fluid is applied to the cylinder 28, the force applied to the boom is applied to the boom at a greater angle, that is, the angle X at which the force is applied to the boom is greater than the angle Y at which the force was applied to the boom when the pivot axis 39 was in its speed position. Moreover, a longer lever arm is provided for the boom lifting force. The lever arm is the perpendicular distance between the center line of the boom lift cylinder 28 and the boom pivot axis 14. This distance in the speed position is designated LS in FIG. 3 and in the power position is designated LP. The lever arm, when in the power position, is greater at all positions of the boom.

In this manner, a greater effective force is applied to the boom to effect movement of the boom. This greater effective force is as a result of the larger lever arm and greater component of the force, acting normal to the boom and, specifically, normal to the line through the axis 14 of the boom and the pivot axis 29a. While in this position, the boom is moved with greater power, and the boom moves through a lesser extent of movement than when the boom is in its speed position. As shown in FIG. 3, when in its power stroke, the boom moves from an uppermost position 20a' to a lowermost position 20b', which gives a range of movement through an angle indicated B in FIG. 3, which is substantially less than the angle A of boom movement when the boom moves through its speed stroke. The angular movement B of the boom in its power stroke is within the angular movement A of the boom in its speed stroke, but is substantially less.

While the above description sets forth the limits of the speed-power relationship for the boom movement, namely, the speed stroke wherein the boom moves fastest but with a minimum of power and the power stroke wherein the boom moves slowest but with a maximum of power, it should be clear that the speed-power relationship for boom movement may be varied between these limits. This may be accomplished by energizing the cylinder 31 so as to move the member 35 to an intermediate location about its pivot axis 36.

A modified material handling machine embodying the present invention is illustrated in FIG. 4 and is constructed so that the boom may be moved through a power stroke or a speed stroke in the same manner as that described above in connection with the machine of FIG. 2. The material handling machine shown in FIG. 4 includes a boom 50 movable about a pivot axis 51 for vertical movement of the boom. The boom is moved about the pivot axis 51 by a hydraulic lift cylinder 53 which is pivotally connected at 54 to the support structure and has a piston rod pivotally connected at 55 to the boom 50. The pivotal connection 55 of the piston rod to the boom 50 is below the pivot axis 51 of the boom.

The boom 50 in the embodiment shown in FIG. 4 is carried by a support plate 60 and the boom pivot axis 51 comprises the axis of a pin connected with the support plate 60. The support plate 60 is pivotally connected to a support frame member 61 by the pin for pivotal movement relative thereto about the axis 51 upon movement of the boom 50. The boom 50 is pivotally connected to the support plate 60 for pivotal movement about an axis 61a. The support plate 60 may be pivoted about the axis 51 independent of the boom movement by a hydraulic cylinder means 62 which is suitably carried on the upper side of the boom, as shown in FIG. 4, and which includes a piston rod 63 pivotally connected to the upper end of the support plate 60 at 64.

The hydraulic cylinder or power means 62 and the link connecting plate 60 comprise a means for selecting and adjusting the relative location of the boom pivot axis 51 and the axis 55 where the lifting force is applied to the boom and determines the speed-power relationship. When the cylinder 62 is actuated and the parts are in the position shown in FIG. 4, the boom is moved through a speed stroke upon energization of the hydraulic cylinder 53. When the cylinder 62 is not actuated, the boom moves through its power stroke.

Referring now to FIG. 5 wherein the parts are indicated schematically by lines, when the parts are as shown in full lines in FIG. 5, that is adjusted so that boom 50 moves through its speed stroke, the boom moves from its highest position 50a to its lowest position 50b through an angle designated E. When the cylinder 62 is de-energized, the axis 61a moves downwardly to position 61a'. This also causes movement of the cylinder 53 somewhat to position 53a and moves axis 55 to position

55a. Moreover, when so moved, the angle that the force applied by the hydraulic mechanism 53 forms with a line through the pivot axes 51 and 55 is more nearly normal, i.e., the angle S is closer to 90° than the angle W, and thus a greater force is applied by the hydraulic mechanism 53 to the boom to effect movement of the boom. Moreover, a longer lever arm for the boom lifting force is provided. The lever arm LS is substantially shorter than the lever arm LP. In this position, the boom is moved through its power stroke when cylinder 53 is actuated.

The boom when it moves through its power stroke, is moved through a smaller range of movement than when it is moved through its speed stroke. The range of movement in the power stroke is shown schematically and designated angle G in FIG. 5. As with the modification of FIG. 3, the movement of the boom through the power stroke completely overlaps and is contained completely within the limits of the speed stroke movement. Moreover, as with the modification of FIG. 3, intermediate positions of the pivots 61a and 55 provide for intermediate speed-power relationships.

The modification of the present invention in FIG. 6 is similar to the modifications described hereinabove in that it also includes a means for adjusting for movement of the boom through a power stroke or a speed stroke. More specifically, as shown in FIGS. 6 and 7, the machine includes a boom 90 which is pivotally supported for movement about the axis 91 of pivot pins suitably carried by a support frame member 92. The boom 90 is moved about the axis 91 through a power stroke and a speed stroke by a hydraulic mechanism 93. The hydraulic mechanism 93 includes a hydraulic cylinder 94 pivotally connected at 95 to a support member and a piston rod 96. The piston rod 96 is pivotally connected at 97 to a plate or link member 98 which, in turn, is pivotally connected at 99 to the boom. The link 98 is also pivotally connected at 97 to a piston rod 101 of a hydraulic cylinder 102. The hydraulic cylinder 102 is pivotally connected to the frame for pivotal movement about an axis 103 of a pivot pin 104 and which axis is spaced a slight distance from the boom pivot axis 91. The point 97 at which the lifting force is applied to the boom is located below the boom axis.

The hydraulic cylinder 102 and the link 98 comprise means for selecting whether the boom moves through a power stroke or a speed stroke. Specifically, when the cylinder 102 is in its de-energized condition and the parts are in the position shown schematically in full lines in FIG. 8, the boom, when moved about its pivot axis 91 is moved through a speed stroke through an angle of movement designated H in FIG. 8. However, when the cylinder 102 is energized and the link 98 is moved about its pivot 99, the point 97 at which the force is applied by the hydraulic mechanism 93 to the boom is moved away from the boom pivot point 91 and downwardly to the location designated 97a.

When the point 97 is moved to 97a, a lengthening of the lever arm for the boom lifting force occurs. The lever arm LS for the speed stroke is considerably shorter than the lever arm LP for the power stroke. Moreover, the angle T which is the angle formed by a line indicating the force applied by the mechanism 93 and a line extending through the boom pivot axis 91 and the point of connection of the hydraulic mechanism 93 to the link 98 is less than the angle U which is formed between these same lines during the speed stroke and is more nearly 90°. Thus, the effective force applied to the boom is substantially greater when the parts are in the power position. When in this position and the hydraulic mechanism is energized, the boom moves through a power stroke and through a range of movement, designated I in FIG. 8, which is substantially less than the range of movement designated H. Moreover, here as in the modifications shown in FIGS. 3 and 5, the boom power stroke

lies entirely within the range of movement of the speed stroke. Furthermore, the speed-power relationship can be varied within these limits so that intermediate speed-power relationships are available by moving link 98 to a position intermediate its limit positions.

From the above, it should be apparent that applicant has provided a number of modifications of a material handling machine for providing a power stroke for a boom which moves in a vertical plane about a horizontal pivot, as well as a speed stroke for the boom. When the boom moves through the speed stroke, it moves through a wider range of movement than it does through its power stroke, but when it moves through the power stroke, it is capable of handling greater loads and thus the various modifications shown do provide a material handling machine capable of great flexibility and efficiency.

It should be apparent from the above that the preferred embodiment of the present invention has been described in considerable detail, but that certain modifications, changes, and adaptations may be made therein by those skilled in the art to which it relates, and it is hereby intended to cover all such modifications, changes, and adaptations thereof which fall within the scope of the appended claims.

Having described my invention, I claim:

1. A material handling machine comprising a support, a boom member carried by said support, a dipper stick pivotally carried on one end of said boom member, a pivotal interconnection between said boom member and said support adjacent the other end of said boom member and providing for pivotal movement of said boom about a boom pivot axis, a hydraulic lift power means acting between said boom and support for selectively effecting pivotal movement of said boom through a predetermined angular distance in a speed stroke and a lesser predetermined angular distance in a power stroke, said hydraulic lift power means comprising a hydraulic lift cylinder and piston rod, separate pivotal interconnections between said boom and said piston rod and between said support and said cylinder, and means for selecting said power stroke or said speed stroke for said boom comprising power means for moving one of the pivotal interconnections from a speed position wherein said hydraulic power means applies a first effective force to said boom for moving said boom about said boom pivot axis and a power position wherein said hydraulic power means applies a second effective force greater than said first force to said boom for moving said boom about said boom pivot axis, said one pivotal interconnection comprising the pivotal interconnection of said cylinder to said support, said support pivotally carrying a link member, said link member carrying said one pivotal interconnection, and said power means comprising a hydraulic power cylinder for effecting movement of said link member about its pivot axis to effect movement of said one pivotal interconnection about the pivot axis of said link member.

2. A material handling machine as defined in claim 1 wherein said piston rod of said hydraulic power means is pivotally connected to said boom member at a location above the axis of said boom member, and said hydraulic power cylinder is generally below the boom pivot axis and acts between said link member and said support and is pivotally connected to said link member and to said support.

3. A material handling machine as defined in claim 1 wherein said link member has a first edge surface engageable with said support when in its power position and a second edge surface engageable with said support when in its speed position.

4. A material handling machine comprising a support, a boom member carried by said support, a dipper stick pivotally carried on one end of said boom member, means supporting said boom for pivotal movement relative to said support adjacent the other end of said boom mem-

ber and about a boom pivot axis, a hydraulic power means acting between said boom and support for selectively effecting pivotal movement of said boom through a first predetermined angular distance in a speed stroke and a lesser second predetermined angular distance in a power stroke with said second angular distance being contained within said first angular distance, said hydraulic lift power means comprising a hydraulic cylinder and piston rod each having pivotal interconnections with said boom or support respectively, means for selecting said power stroke or said speed stroke for said boom comprising power means for moving one of said pivotal interconnections from a first speed position wherein said hydraulic power means applies a first effective force for moving said boom about said pivot and a second power position wherein said hydraulic lift power means applies a second effective force greater than said first effective force to said boom for moving said boom about said boom pivot axis, said one pivotal interconnection comprising the pivotal interconnection of said hydraulic power means to said support, said support pivotally carrying a link member, said link member carrying said one pivotal interconnection, and said power means comprising a hydraulic power cylinder for effecting movement of said link member about its pivot axis to effect movement of said one pivotal interconnection about the pivot axis of said link member.

5. A material handling machine as defined in claim 4 wherein said piston rod of said hydraulic power means is pivotally connected to said boom member at a location above the pivot axis of said boom member, and said hydraulic power cylinder is generally below the boom pivot axis and acts between said link member and said support and is pivotally connected to said link member and to said support.

6. A material handling machine comprising boom support means, a boom member carried by said boom support means, a pivotal interconnection between said boom member and said boom support means adjacent one end of said boom member and providing for pivotal movement of said boom member relative to said boom support means, a hydraulic lift power means acting between said boom member and said boom support means for effecting pivotal movement of said boom member relative to said boom support means, a first pivotal interconnection between said boom member and a first part of said hydraulic lift power means and a second pivotal interconnection between said boom support means and a second part of said hydraulic lift power means, at least one support member carrying said second pivotal interconnection, and means supporting said support member on said boom support means for movement relative to said boom support means to position said support member and of said second pivotal interconnection to provide for boom movement upon energization of said hydraulic lift power means with a power-speed ratio depending upon the position of said second pivotal interconnection.

7. A material handling machine as defined in claim 6 wherein said support member is pivotally carried by said boom support means.

8. A material handling machine as defined in claim 6 further including power means for moving said support member through the extent of its movement.

9. A material handling machine comprising boom support means, a boom member carried by said boom support means, a pivotal interconnection between said boom member and said boom support means adjacent one end of said boom member and providing for pivotal movement of said boom member relative to said boom support means, lift power means acting between said boom member and said boom support means for effecting pivotal movement of said boom member relative to said boom support means, a first pivotal interconnection between said boom member and a first part of said lift power means and a second pivotal interconnection be-

tween said boom support means and a second part of said lift power means, at least one link member carrying said second pivotal interconnection, and means supporting said link member on said boom support means for movement relative to said boom support means to locate said second pivotal interconnection at different positions relative to said boom support means. 5

10. A material handling machine as defined in claim 9 wherein said link member is pivotally carried by said boom support means and further including a power means 10

for pivoting said link member to effect positioning of said second pivotal interconnection.

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