United States Patent [19]

Shumaker

[11] **3,929,239**

[45] **Dec. 30, 1975**

[54] **BACKHOE ACTUATOR**

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[73] Assignee: **J. I. Case Company,** Racine, Wis.

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[52] **U.S. Cl.** ..... **214/138 R;** 212/66

[51] **Int. Cl.²** **F16H 27/02;** B66F 9/02

[58] **Field of Search** ..... 214/138 R, 138 C; 212/66

[56] **References Cited**

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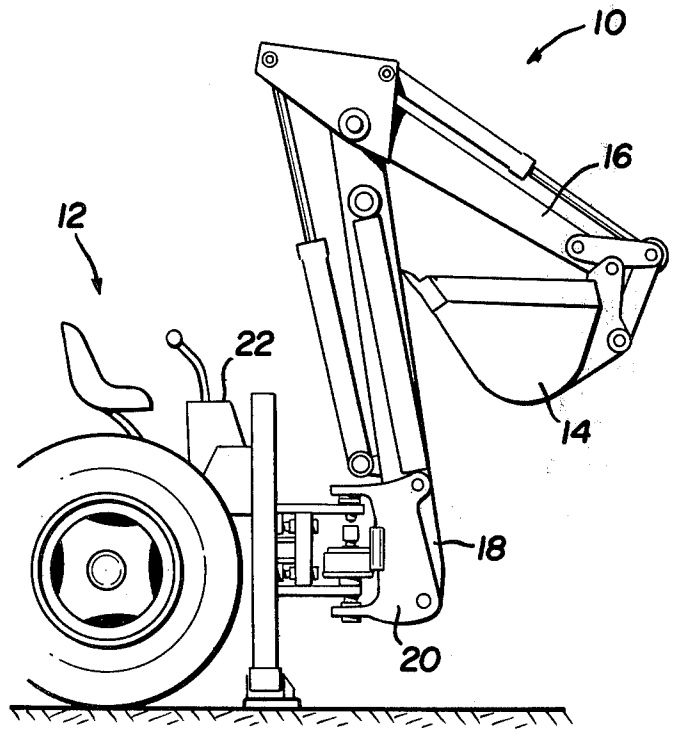
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Attorney, Agent, or Firm—Cullen, Settle, Sloman & Cantor

[57] **ABSTRACT**

A backhoe assembly is pivotally mounted to a prime mover by a C-shaped swing tower in a manner to reduce the moment arm between the prime mover support structure and the backhoe center of gravity. This is accomplished by nesting a hydraulic motor actuator and planetary gear reducer within the swing tower configuration for pivoting the backhoe assembly. In a preferred embodiment, the swing tower is pivotally mounted to a support which is slideable along a horizontal frame fixed to the prime mover. When the sliding support is positioned at either extremity of its sliding movement at one side of the prime mover, the backhoe may be swung toward the other side of the prime mover for transport and, because of the nesting arrangement, still be totally within the width defined by the frame.

10 Claims, 9 Drawing Figures



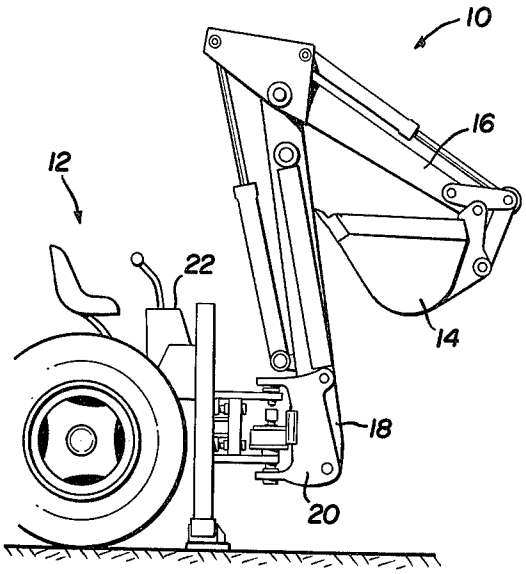


FIG. 1

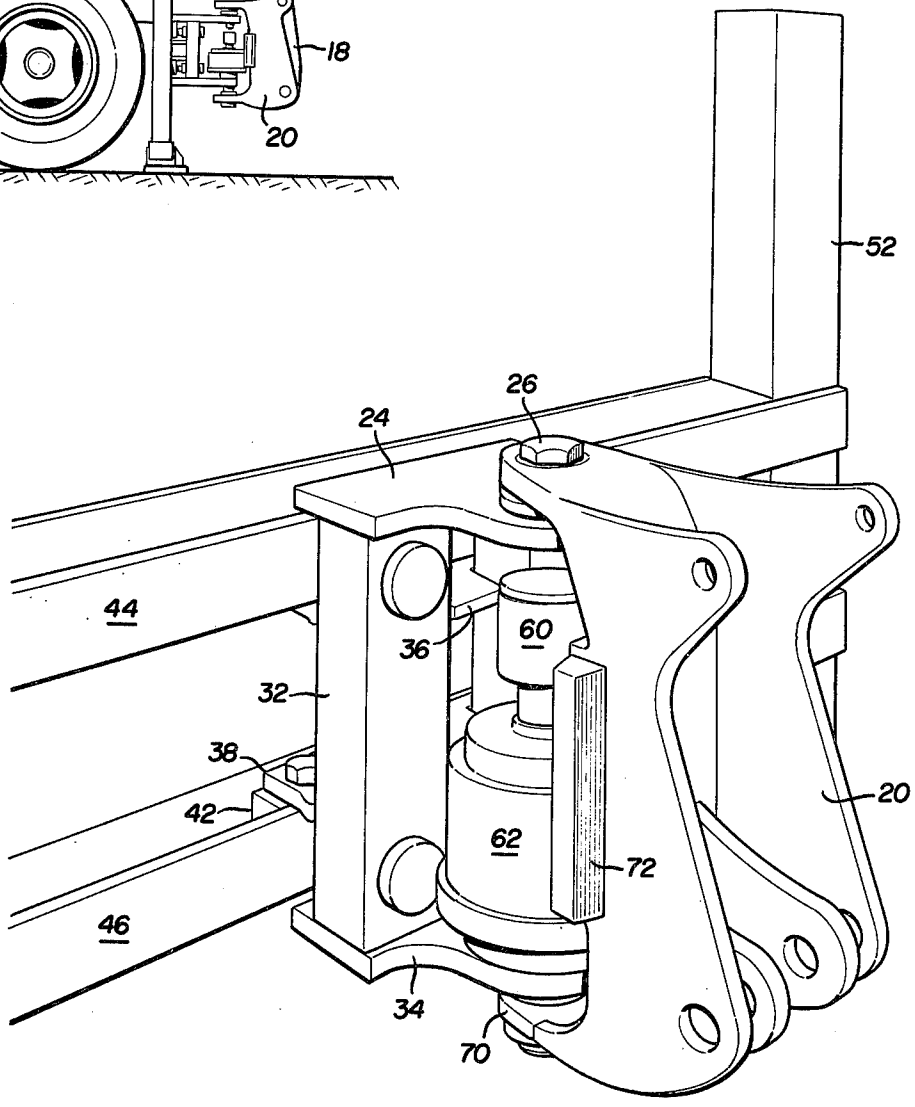


FIG. 2

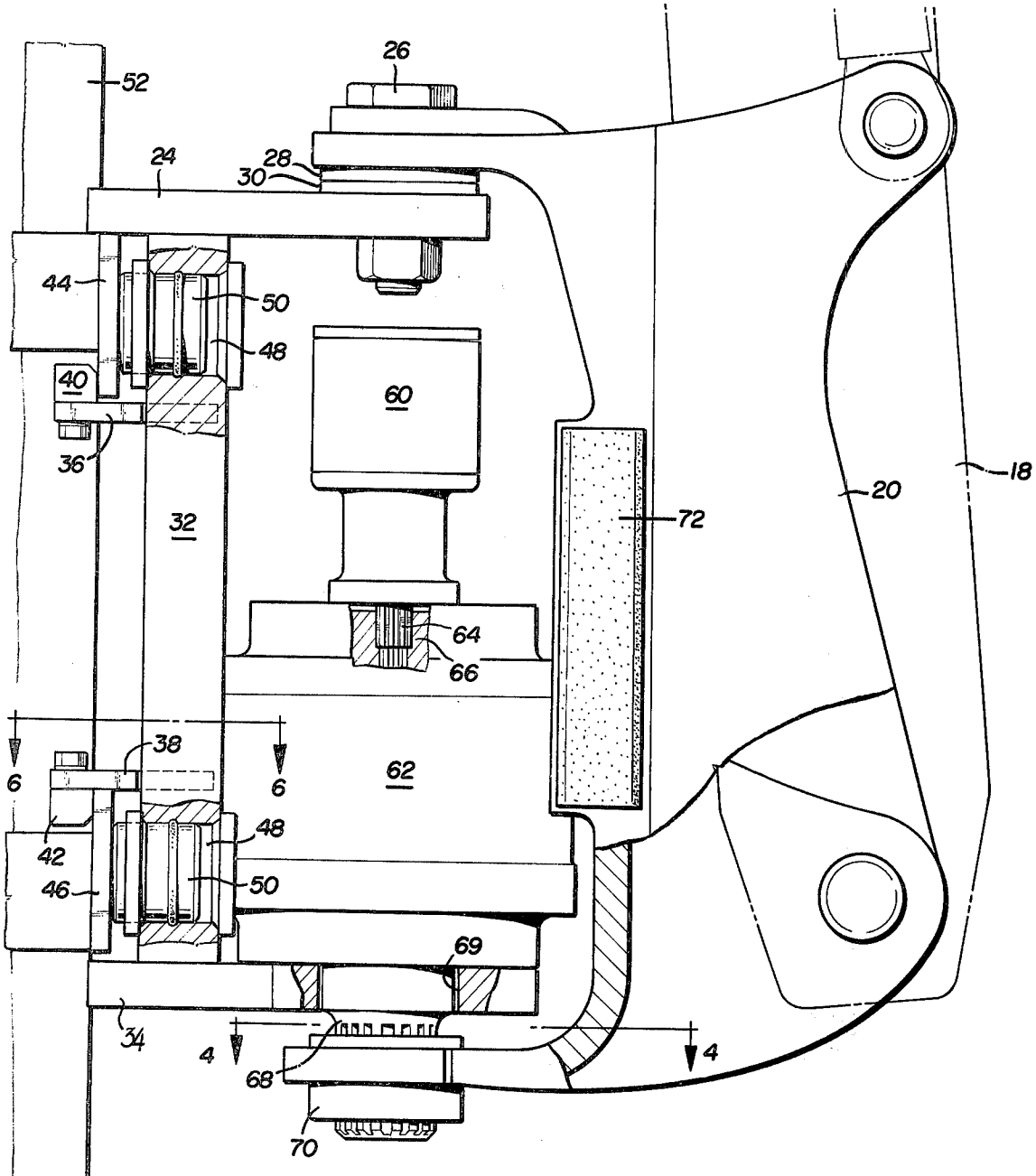

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FIG. 3

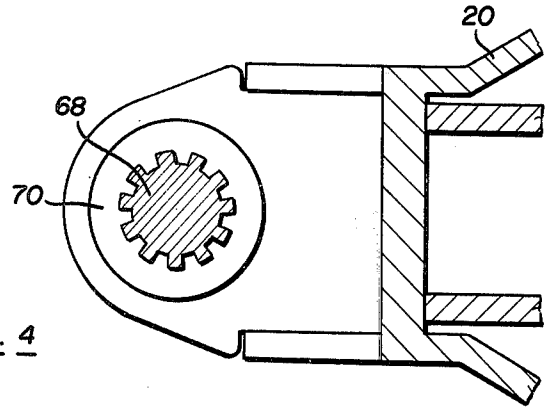

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68
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FIG. 4

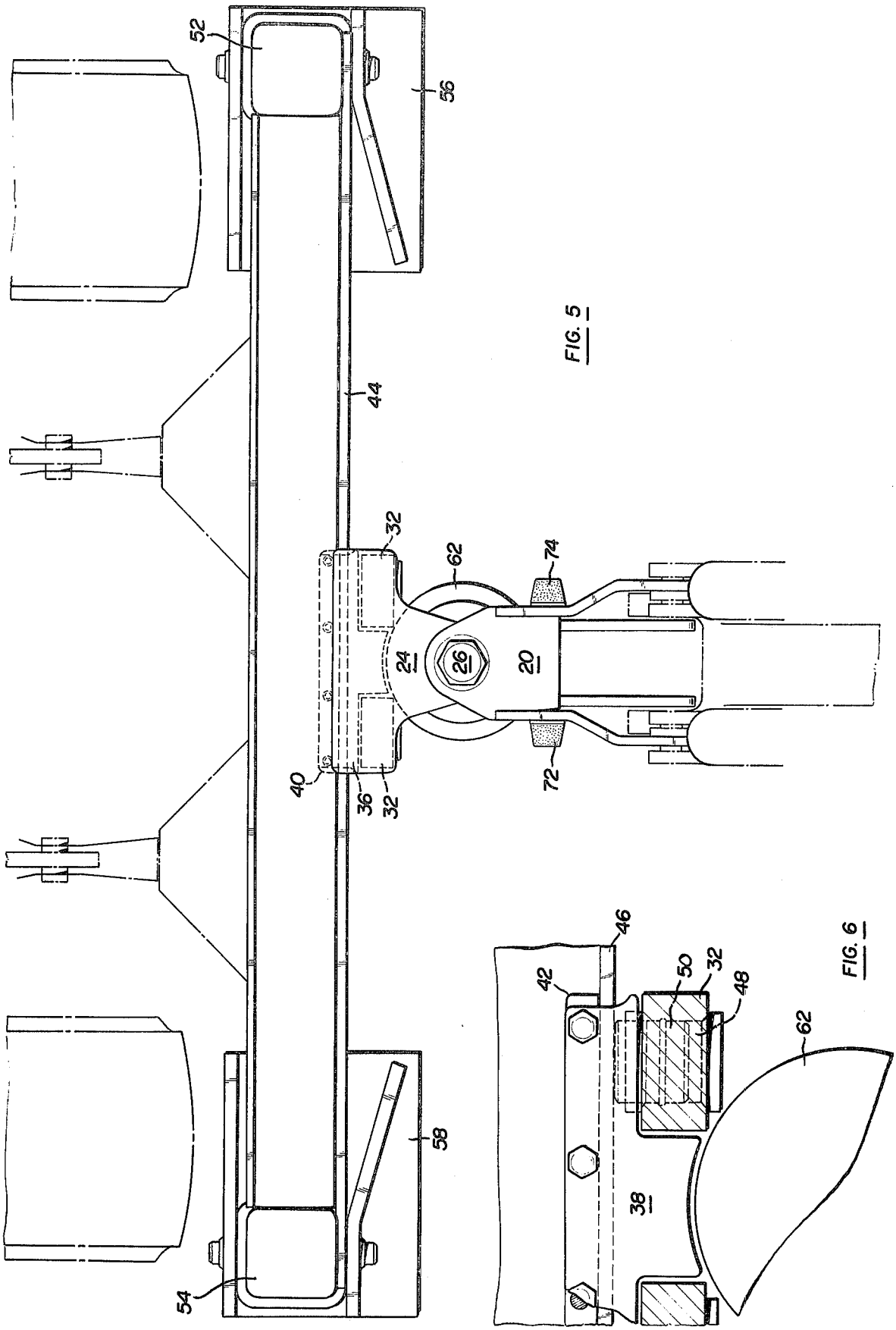


FIG. 5

FIG. 6

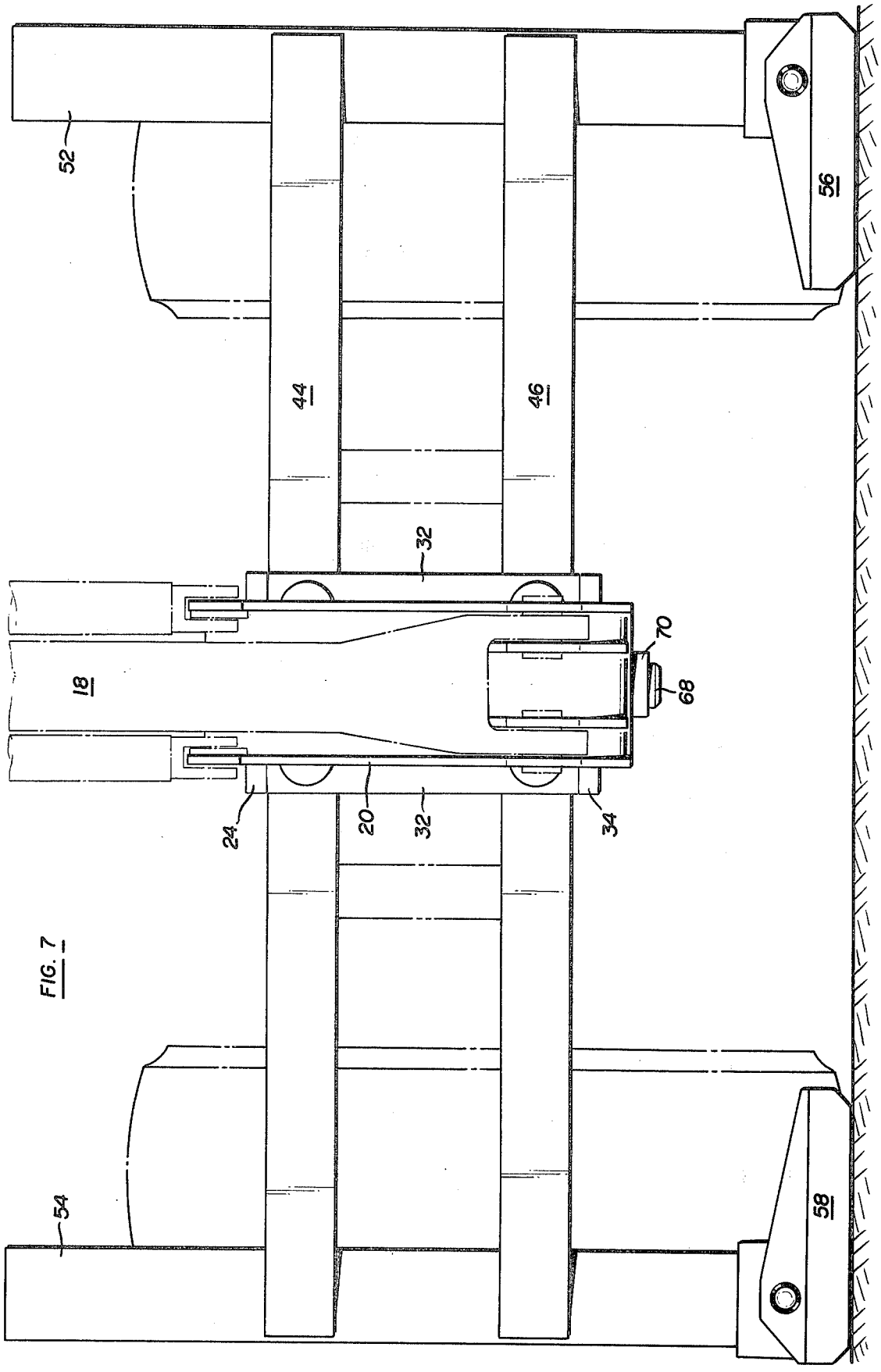


FIG. 7

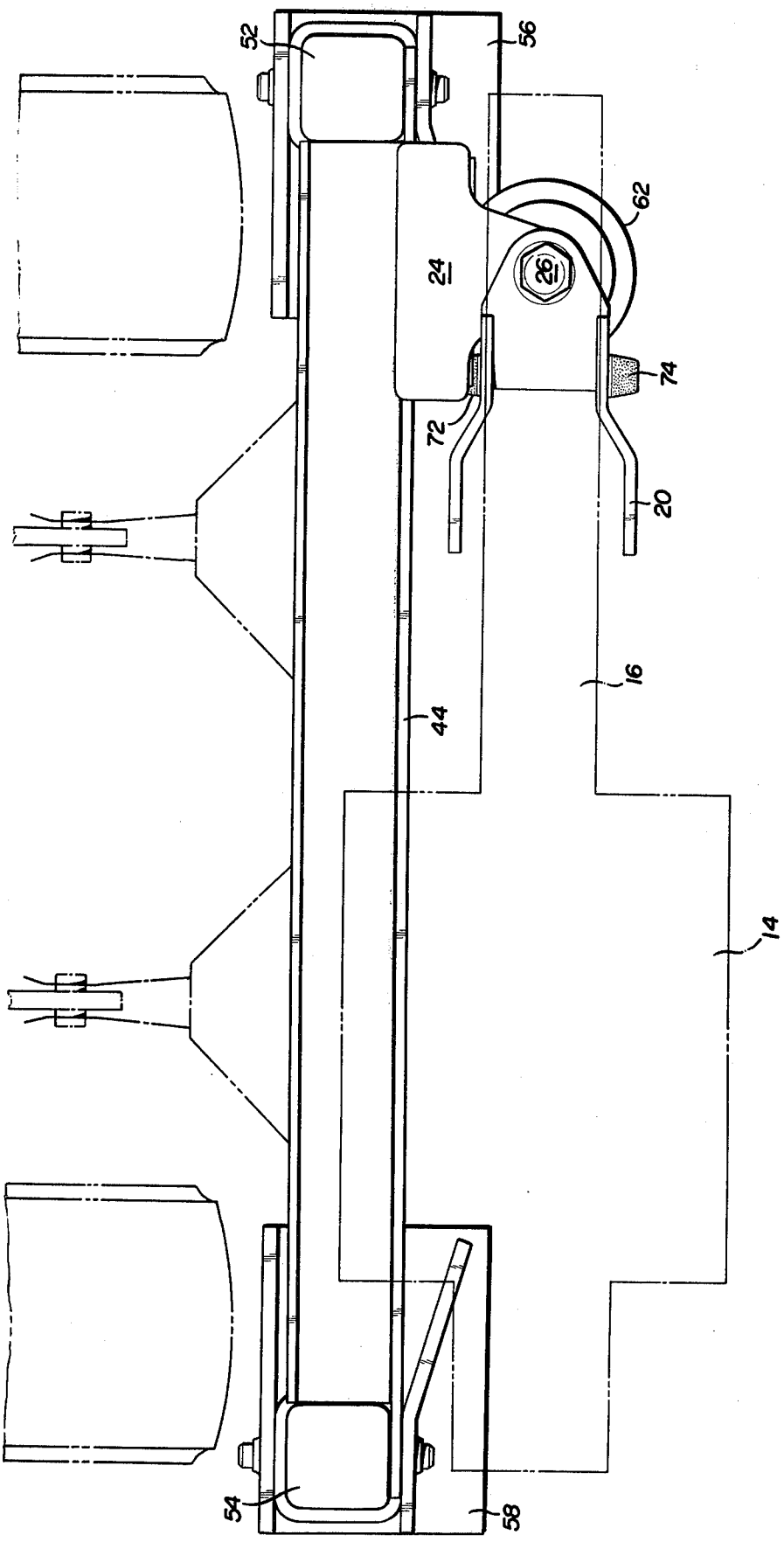


FIG. 8

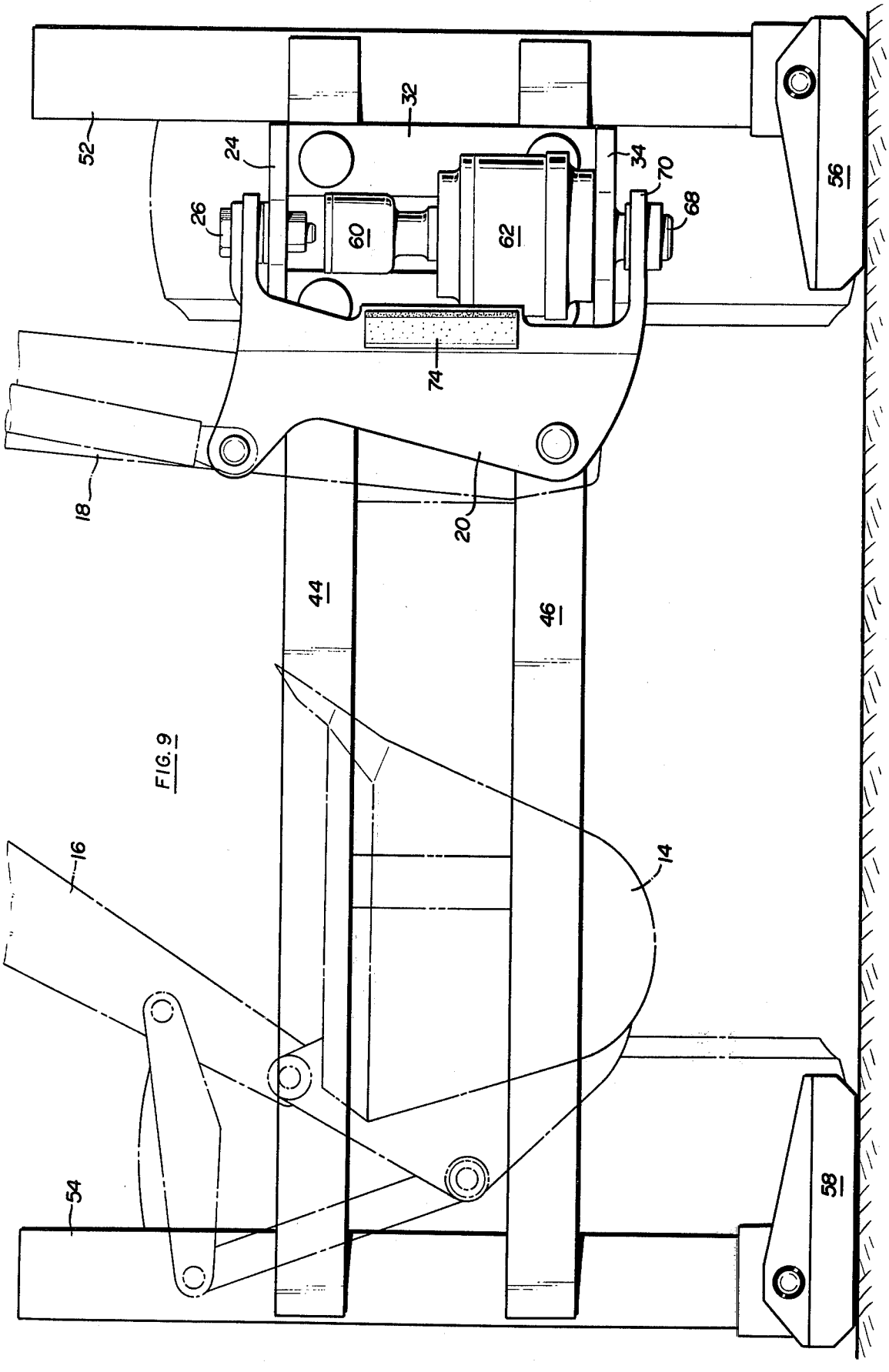


FIG. 9

BACKHOE ACTUATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a backhoe earth working implement mounted on a prime mover for pivotal movement, and more particularly to the pivotal connection and power means for swinging the backhoe.

2. The Prior Art

The backhoe, per se, is quite well known in the prior art, but many problems associated with its structure, and in particular with its swing structure, have not yet been solved.

First, the very nature of the power means employed for swinging the backhoe structure has been undesireable because of its inability to generate sufficient torque for swinging the backhoe under heavy load conditions. For example, prior art power means have included vane-type hydraulic motors and hydraulic cylinders which are driven by the power source on the prime mover. However, the hydraulic structure for manipulating the backhoe boom and dipper is also interconnected to the primary hydraulic pressure source on the prime mover. Therefore, when a backhoe bucket is being simultaneously lifted and swung, there is a limited amount of hydraulic pressure available for the backhoe swinging structure. This can result in a jerky backhoe swinging motion which is an annoyance to the backhoe operator. In order to overcome this problem through the use of conventional power means, both the hydraulic pressure source on the prime mover and the hydraulic power means for swinging the backhoe must be enlarged. Such modifications are not only costly, but add undesireable weight at the end of the prime mover to relocate the prime mover center of gravity and thereby interfere with its stability and operation during transport.

Prior art devices also are unable to provide a smooth, constant, and accurate swinging motion for the backhoe assembly. These characteristics are, again, due in part to the backhoe swinging power means being interconnected to the power source on the prime mover along with many other hydraulic components. Having the ability to accurately control the swinging motion of the backhoe is very important because it is at times absolutely necessary that the backhoe bucket be positioned within a small working area. For example, backhoes are commonly used for a trenching operation in an area where electrical lines, oil lines, or gas lines have previously been laid. In order to avoid these previously placed lines, it is imperative that the backhoe operator be capable of positioning the backhoe bucket where desired.

Another shortcoming in the prior art is the inability to position the backhoe assembly so that its center of gravity is near the prime mover for transport yet have the backhoe assembly totally within the width defined by the opposed sides of the prime mover. Many prior art devices are of the axial type wherein the supporting structure for the backhoe is stationary and centrally located behind the prime mover. For transport purposes, the backhoe assembly is generally collapsed to its greatest possible extent, i.e. the boom is raised to its highest inclination and the dipper is pivoted into close position with the raised boom, so that the center of gravity of the backhoe assembly is drawn near the mounting end of the prime mover. In this situation, the

center of gravity of the backhoe assembly is usually still well behind the end of the prime mover, so that during transport the prime mover experiences a great deal of bouncing because of the over-hanging backhoe weight.

Other prior art devices include a mounting frame for the backhoe assembly which is slideable transversely of the end of the prime mover. In these devices the mounting structure can be moved to one side of the prime mover, and the backhoe assembly is swung so that the boom projects toward the other side of the prime mover. Positioning the backhoe for transport in such a manner does indeed move the backhoe center of gravity closer to the prime mover; however, when the prior art devices are positioned in this manner, the bucket and dipper extend well beyond the side of the prime mover. This can be very undesirable when the prime mover is driven on a highway, because the prime mover in effect becomes a "wide-load". Should this be the case, the prime mover then must be driven partly on and partly off the highway to thereby create an unpleasant driving condition for the operator.

Another shortcoming in prior art backhoe assemblies arises from the mounting arrangement between the swing assembly and the power swing means, because those mounting arrangements generally produce an extended moment arm between the swing pivot axis and the backhoe center of gravity. Quite naturally, this also results in a greater dimension between the backhoe center of gravity and the mounting end of the prime mover with the resultant problems discussed previously. Moreover, the extended dimension between the backhoe center of gravity and the pivot axis increases the moment loads established on the pivot mounting structure to thereby cause undue wear at these points. The ultimate result of this particular problem is increased cost and maintenance that is occassioned by the necessity of having to replace worn parts.

Prior art devices exhibiting the previously described problems include, first, U.S. Pat. No. 3,244,301 to Vaughan, which illustrates the use of a hydraulic motor as the power source for the swinging backhoe. The particular arrangement disclosed by this patent results in several of the problems inherent in most of the prior art devices as previously discussed. For example, in order for a hydraulic motor alone to generate the sufficient port to swing the backhoe under heavy load conditions, the prime mover hydraulic power source and the hydraulic motor itself must be quite large in comparison to the power means proposed by the present invention. Further, as can be seen from the illustrations in the Vaughan patent, the very nature of the mounting structure for the backhoe assembly results in a relatively large moment arm measured for the backhoe pivot axis and the backhoe center of gravity. As discussed previously, this creates wear problems on the pivot connecting elements as well as locating the backhoe center of gravity further away from the rear wheel supporting axis of the prime mover.

U.S. Pat. No. 3,270,894 to Elliott also discloses the use of a hydraulic motor which can be removably positioned within the backhoe swing mast frame. The illustrations in this patent even more vividly point out the problems which were discussed in connection with the Vaughan patent, i.e. that the hydraulic motor for swinging the backhoe assembly must be quite large in comparison with the other backhoe components in order to generate sufficient torque to manipulate the swinging action of the backhoe under all loading condi-

tions and terrain conditions. As a result of the necessity in having to utilize an enlarged driving member for effecting the swinging action of the backhoe, the other components of the backhoe, for example, the boom, dipper and bucket, are positioned further away from the pivot axis and the prime mover. The Elliott patent also fails to recognize the problem associated with backhoe transport position and, quite naturally, therefore does not suggest the solution for positioning the backhoe center of gravity near the prime mover during transport yet maintaining the backhoe within the lateral widith defined by the opposed sides of the prime mover.

U.S. Pat. Nos. 2,994,446 and 3,174,635 to Van Auwelaer disclose yet another power source for swinging a backhoe assembly, i.e. a vane-type hydraulic cylinder. This type hydraulic power source also has its inherent problems, including the size problem as discussed previously in connection with the Elliott and Vaughan patents. The size problem with a vane-type hydraulic power source may even be more acute than with a hydraulic rotary motor; the vane-type hydraulic power source relies upon hydraulic pressure within the cylinder to act upon a single vane face to generate the necessary power output for rotating the backhoe. Because of this structural limitation, the vane and the other components of the cylinder must be made as large as possible. As a result, the entire backhoe structure must be positioned further away from the pivot axis and the prime mover, which results in the problems set forth above.

Another problem inherent and unique with the vane-type cylinder power source is hydraulic fluid leakage occasioned by misalignment between the shaft and barrel components. Any such leakage results in the backhoe boom becoming displaced from its proper angular relationship with respect to the power source, termed "angular boom structure creep". This particular characteristic can be quite annoying to a backhoe operator because it requires him to apply a constant hydraulic pressure for a side cutting operation. Further, the "creep" or "drift" can likewise be costly in terms of damage to surrounding structure if the operator cannot precisely and accurately control the swinging motion of the backhoe. As discussed previously, it is quite common that a backhoe be operated under such conditions that the backhoe bucket must be placed precisely to avoid buried telephone lines, or the like, during a trenching operation.

The specific vane-type cylinder mounting arrangement disclosed by the Van Auwelaer patents is particularly susceptible to shaft-barrel misalignment and resulting leakage problems due to the fact that the barrel structure will deflect under the loading conditions from the backhoe boom. This problem was recognized in U.S. Pat. No. 3,243,053 to Hanser and was attempted to be solved by the provision of an articulate connection between the main frame and the upper and lower ends of the upright shaft. However, the Hanser patent does not recognize the other problems associated with the use of a vane-type cylinder and accordingly does not suggest the far superior motive means suggested and proposed by the present invention.

Other prior art patents pertinent to the present invention include U.S. Pat. Nos. 3,155,250 to French and 3,207,048 Rumsey. These patents, likewise, do not even suggest the problems nor the solutions which the presently proposed invention solves. Specifically, neither of these patents discloses a structural arrangement which permits the use of a relatively small swinging power source so that the center of gravity of the backhoe components may be relocated closer to the prime mover during both normal operation and transport.

Even Pat. Nos. 3,376,984 and Re.26,439 to Long, which are assigned to the assignee of the present application, do not exhibit the entire range of desireable features which are afforded by the present invention.

In short, the prior art fails in several material respects to suggest a swinging power source which is relatively small in construction but which can constantly generate the necessary torque for the entire range of backhoe operations. Further, the prior art does not suggest a solution to the problem of having the backhoe center of gravity located far behind the prime mover, thereby resulting in instability for the prime mover during working operation and transport. These and other problems are overcome by the present invention.

SUMMARY OF THE INVENTION

The present invention overcomes the prior art problems previously discussed by employing and strategically locating a hydraulic motor actuator and planetary gear reducer to effect the swinging motion of the backhoe. This particular combination of power means, i.e. the hydraulic motor actuator and the planetary gear reducer, synergistically provides versatility and smooth, accurate operation for the backhoe. The hydraulic actuator is interconnected with the hydraulic power source on the prime mover and requires much less hydraulic fluid for driving purposes than does the prior art devices. The hydraulic motor actuator has a splined output shaft which drives an input shaft for a planetary gear reducer. The planetary gear reducer has a splined output shaft which drives a swing tower to which the backhoe boom is pivotally mounted. This unique arrangement enables the backhoe to be pivoted 180° or more about a vertical pivot axis at the rear of the prime mover so that the backhoe can be manipulated to a variety of attitudes for different working conditions. Moreover, the unique combination of hydraulic motor actuator in combination with the planetary gear reducer provides sufficient power output torque to properly swing the backhoe under heavy load conditions and on sloping terrain.

The hydraulic motor actuator and planetary gear reducer are rigidly mounted to a frame attached to the rear of the prime mover such that the planetary output shaft is free to pivot the backhoe swing tower and other backhoe components. The power which can be generated by the combination hydraulic motor actuator and planetary gear reducer is sufficiently great so that these two components can satisfy the maximum power requirements of the backhoe yet be small enough to be nested within the C-shape swing tower configuration. Because of this nested arrangement, the entire backhoe assembly is located closer to the rear of the prime mover to reduce the cantilever moment arm between the prime mover rear wheel axle and the backhoe center of gravity. As a result, the prime mover is more stable during both working operation of the backhoe and transport. Further, the nesting arrangement enables the entire backhoe assembly to be located closer to the swinging pivot axis to reduce the moment arm on the pivot components. As a result, the pivot components experience less wear to thereby add to the overall desireability of the pivot arrangement proposed by the

present invention.

In a preferred embodiment the support structure to which the hydraulic motor actuator and planetary gear reducer are mounted in slideable transversely across the end of the prime mover. This arrangement, per se, is known in the prior art to enable the backhoe to be positioned as desired relative to the prime mover. However, the nesting arrangement in the present invention enables the entire backhoe structure to be located closer to the vertical pivot axis, as described previously. This overall "tighter" arrangement enables the backhoe to be positioned very near the end of the prime mover for transport yet be totally within the lateral width defined by the opposed sides of the prime mover. Specifically, the sliding frame member may be positioned at one side of the prime mover and the backhoe may be swung so that it projects toward the other side of the prime mover without extending beyond that side of the prime mover. Accordingly, the backhoe center of gravity is positioned closer to the prime mover end to reduce the cantilever moment arm from its center of gravity to the prime mover rear wheel axle. This results in a more balanced state for the prime mover during transport without transforming the prime mover into a "wide load" by having the backhoe project beyond one side.

The entire realm of advantages afforded by the overall arrangement proposed by the present invention will be readily apparent from the following discussion to those who are skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of the backhoe for the present invention mounted on the rear of a prime mover.

FIG. **2** is a perspective view illustrating the swing mounting structure and power means for the present invention.

FIG. **3** is an enlarged side view of the swing mounting structure and power means.

FIG. **4** is a sectional view along line **4—4** in FIG. **3,** illustrating the splined connection between the backhoe swing tower and the power output shaft.

FIG. **5** is a top plan view of the backhoe swing mounting structure and the transverse sliding structure.

FIG. **6** is an enlarged view illustrating the sliding connection between the backhoe and prime mover.

FIG. **7** is a vertical view of the sliding frame and stabilizing members.

FIG. **8** is a top plan view illustrating the backhoe transport position.

FIG. **9** is a vertical view illustrating the backhoe transport position.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates a backhoe **10** operably mounted to the rear of a prime mover **12,** such as a tractor. The backhoe structure per se is well known in the art and includes the following pivotally interconnected elements: a bucket **14,** a dipper stick **16,** a boom **18** and a swing tower **20.** The operation of the backhoe is controlled by an operator on the prime mover by a control console **22.** The backhoe boom, dipper stick, and swing tower arrangement illustrated in FIG. **1** is substantially identical to that disclosed in U.S. Pat. No. 3,376,984 to Long, which is incorporated by reference. That patent discloses the manner of pivoting the backhoe boom to an "over-center" position for transport to complement the structural arrangement proposed by the present invention. The other components illustrated in FIG. **1,** for example the hydraulic cylinders for pivoting the boom, are conventional and therefore will not be described in greater detail here.

As illustrated in FIGS. **2** and **3,** the swing tower **20** has a C-shaped configuration opening toward the rear of the prime mover and is pivotally mounted to an upper support plate **24** by bolt **26** and anti-friction components **28** and **30.** The upper support plate **24** is rigidly mounted on a vertical supporting structure **32** which is rigidly mounted to a lower support plate **34.** The support plates **24, 32** and **34** comprise a sliding frame which can be positioned at an infinite number of transverse positions across the end of the prime mover. A pair of plates **36** and **38** are rigidly connected to the forward side of the vertical support structure **32** to support the sliding frame. A pair of stop blocks **40** and **42** are bolted to plates **36** and **38,** respectively, to fit around guide rails **40** and **42,** which are rigidly mounted to the prime mover to provide a slide frame by conventional structure not forming a part of the present invention. As illustrated in FIGS. **5** and **6,** the guide rails extend essentially entirely between the opposed sides of the prime mover. FIG. **6** further illustrates the manner in which support plates **38** and **42** are connected together to support the backhoe structure on the guide rail **46** of the slide frame.

A set of four hydraulic lock cylinders **48** and pistons **50** are provided in the vertical support structure **32** to lock the slide frame at the desired transverse position across the end of the prime mover. The hydraulic cylinder and piston arrangement is substantially identical with that disclosed in U.S. Pat. No. Re.26,439 to Long, which is incorporated by reference. Hydraulic cylinders **48** are connected to the hydraulic power source on the prime mover by a set of hydraulic lines (not shown). To maintain the backhoe structure as illustrated in FIG. **3,** hydraulic fluid under pressure is introduced into chambers **48** and **50** to maintain the pistons in abutting relationship against guide rails **44** and **46.** When it is desired to move the backhoe structure transversely across the end of the prime mover, cylinders **48** are relieved of pressure by exhausting hydraulic fluid from within through the hydraulic lines. To move the sliding frame relative to the prime mover, the backhoe is swung to one side or the other and the bucket is placed against a rigid object or in the ground. Then, the backhoe boom cylinder is actuated; since the dipper is held in position by the bucket the sliding frame assembly is moved along the guide rails to a different position. When the operator has positioned the sliding frame assembly in the desired location, hydraulic cylinders **48** are once again pressurized to cause pistons **50** to abut against the guide rails and thereby lock in frame in place.

As illustrated best in FIG. **7,** a pair of extendable stabilizer legs **52** and **54** having stabilizer feet **56** and **58** are mounted at the opposed ends of the guide rails **44** and **46.** As shown in FIG. **7,** the stabilizer legs have been extended downwardly to ready the prime mover for the backhoe digging or trenching operation. When the backhoe is not in operation, for example during transport, the stabilizer legs **52** and **54** will be raised. Stabilizer feet **56** and **58** are pivotally connected to the stabilizer legs **52** and **54** in order to seat properly on sloping terrain.

The power means for effecting pivotal movement of the backhoe boom includes a hydraulic motor **60** and a

planetary gear actuator **62.** Although not illustrated, the hydraulic motor actuator **60** is mounted on the planetary gear reducer **62** by a plurality of bolts. Likewise, the planetary gear reducer **62** is mounted on lower support plate **34** by a series of radially arranged bolts. Hydraulic motor actuator **60** is connected to the hydraulic power source on the prime mover by suitable hydraulic lines (not shown) through a cross-over relief valve or a check valve with an overload relief.

As illustrated in FIG. **3,** an externally splined output shaft **64** from the hydraulic motor actuator **60** is fitted in mesh with an internally splined input shaft **66** within the planetary gear reducer **62.** Output from the planetary gear reducer is by way of an externally splined output shaft **68,** which extends through an opening **69** in lower support plate **34** to interconnect to the swing tower **20** by an internally splined fitting **70.** It can be appreciated that much of the force transmitted to the swing tower **20** from the backhoe assembly is transmitted to the externally splined output shaft of the planetary gear reducer. In order for the output shaft to withstand these forces it is formed of a harden, heat-treated metal. Further, bearings can be mounted between the lower support plate **34** and the cylindrical portion of shaft **68** to withstand the backhoe loading forces.

In the preferred embodiment, the hydraulic motor **60** is comprised of a commercially available motor from T. R. W. Ross Gear Division. The specific motor proposed for utilization in the present invention is identified as a M.A.B. 16 motor series having an externally splined output shaft identified as 6-B (SAE J499 Standard).

The particular planetary gear reducer proposed for use in the present invention is commercially available from either Borg Warner or Fairfield Manufacturing Company, Incorporated. The unit manufactured by Borg Warner is identified as their Model 8 series and would require modifications to provide a power output shaft. The Fairfield unit is identified as their S3A Model series; the particular unit designed for the present invention is identified as S3A12636, which number specifies the output shaft size, and the motor mount, coupling and reduction arrangements. Either of these particular units will provide a torque output of 75,000 to 80,000 inch-pounds, which is sufficient to swing the backhoe under all normal operating conditions, even when overloaded and working on an incline. The proposed planetary gear reducer has a gear ratio of **36** to **1,** which is optimum for achieving the desired power output when utilizing the hydraulic motor manufactured by Ross Gear Division.

The particular hydraulic motor and planetary gear specifications set forth in the two preceding paragraphs are, of course, merely exemplary of the preferred mode contemplated by the inventor for carrying out the present invention. Other manufacturers also have available models which would be suitable for use in the overall invention of this application.

The advantages afforded by utilizing a power means comprising a combination hydraulic motor actuator and planetary gear reducer are numerous. First, the backhoe is capable of being swung a full 180° or more without having to sacrifice power output. Second, the power output from the power means can be varied according to the particular backhoe application and backhoe structure by utilizing a different gear ratio. In the prior art devices, such as the vane-type power cylinder, and hydraulic cylinders, the torque output was dependent upon the pressure of hydraulic fluid available from the power source on the prime mover and upon the size of the hydraulic power means. Since the available hydraulic power from the prime mover was generally fixed, the torque for the backhoe was governed by the size of the hydraulic cylinder, which necessarily required structural modifications depending upon the size of the hydraulic cylinder. As a further advantage, the combination hydraulic motor actuator and planetary gear reducer proposed by the present invention provides a smooth, accurate operation for the backhoe, which is necessary for neat and precise digging and trenching. The combination hydraulic motor and planetary gear actuator also reduces the amount of "play" or "sloppiness" at the bucket while "side-cutting" a trench, because it does not "drift off" like the more common types of swing mechanisms (such as hydraulic cylinders or rotary hydraulic vane cylinders).

A further major advantage afforded by the combination hydraulic motor actuator and planetary gear reducer is that the combination is relatively small in comparison to prior art power sources so that it can be "nested" within the C-shaped swing power as illustrated in FIGS. **1–3.** The "nesting" arrangement therefore enables the backhoe structure to be located closer to the prime mover to reduce the cantilever force produced at the end of the prime mover by the weight of the backhoe. As a result, the prime mover is much more stable both during backhoe operation and transport. Additionally, the "nesting" arrangement enables the backhoe center of gravity to be located nearer the swing pivot axis to reduce the moment load forces on the pivotal connections between the swing power **20,** the upper support plate **24** and the output shaft **68.** It can be appreciated that any reduction in the distance between the pivot axis and the backhoe center of gravity has a substantial effect on the reduction of the moment forces on the pivotal connections because the weight of the backhoe and the forces experienced during working operation are very substantial.

The "nesting" arrangement of the hydraulic motor actuator and planetary gear reducer within the C-shaped swing tower has yet another highly advantageous result. As illustrated in FIGS. **8** and **9,** the backhoe boom, dipper and bucket may be positioned for transport such that these components are located totally within the lateral width defined by the slideable support frame. To place the backhoe components in the position illustrated in FIGS. **8** and **9,** the sliding frame assembly is positioned on the slide frame rails **44, 46** at one side of the prime mover in a manner as previously described. Next, the backhoe boom and dipper hydraulic cylinders are actuated to collapse the backhoe components to the position illustrated in FIG. **1,** wherein the boom and dipper stick lie on both sides of a vertical plane perpendicular to the tractor longitudinal axis and through the swing tower pivot axis. Finally, the output shaft **68** from the actuator gear **62** is rotated until one of the rubber bumper pads **72** or **74** abut against the sliding frame member **32** to limit the pivoting action of the swing tower **20.** It can be seen from FIGS. **8** and **9** that when the backhoe components are in this position the backhoe center of gravity is located very close to the rear of the prime mover. Accordingly, the prime mover is much more stable during transport. As an example, the prime mover experiences much less bouncing action during transport movement since the backhoe center of gravity is much closer to the rear

wheel axle. Moreover, the entire backhoe assembly in this position is confined to a region between the opposed sides of the prime mover so that the prime mover can be driven on highways without being considered a "wide-load".

The present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the following claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are therefore intended to be included and embraced therein.

Having fully and completely described my invention, I now claim:

1. In a backhoe having a generally vertical support attachment, a swing tower having a pair of interconnected, vertically spaced support members, one of said support members being pivotally connected to said support attachment about a generally vertical pivot axis, a backhoe boom operably mounted on said swing tower for earth working, the improvement of means for pivoting said swing tower relative to the support attachment including a hydraulic motor actuator having an output component driving a planetary gear reducer said planetary gear reducer having a rotary power output shaft coaxial with said vertical swing tower pivot axis and nonrotatably connected to the other of said support members, said hydraulic motor actuator and planetary gear reducer being nonrotatably connected to said support attachment and being nested between the vertically spaced swing tower support members so that the moment arm from the backhoe center of gravity to the support attachment may be reduced.

2. In a backhoe as defined in claim **1**, wherein said swing tower is C-shaped in a vertical plane through the swing tower pivot axis, the further improvement of said hydraulic motor actuator and planetary gear reducer being nested within said C-shaped configuration.

3. In a backhoe as defined in claim **2**, wherein said support attachment is mounted to an end of a prime mover for slideable side-to-side movement along an axis generally perpendicular to the longitudinal axis of said prime mover, said backhoe further including a dipper pivotally mounted to said boom and an earth working implement, such as a bucket or the like, operably mounted on said dipper, said backhoe boom and dipper being pivotable to a retracted transport position, the further improvement of said planetary gear output shaft being rotatable 180° or more to swing said backhoe boom and dipper within a range of positions between 90° or more to either side of said prime mover longitudinal axis, said backhoe boom, dipper and earth working implement, in said transport position, being totally within the width defined by the opposed sides of said prime mover when said support attachment is at the extremity of its sliding movement toward one side of said prime mover and said boom and dipper are rotated 90° relative to said longitudinal axis toward the other side of said prime mover.

4. In an earth working implement, including a support structure having a pair of horizontally oriented, vertically spaced support plates, a swing tower having a C-shaped configuration in a vertical plane, said configuration defining a vertically oriented swing tower base and two horizontally disposed legs, the upper leg of said C-shaped swing tower being pivotally mounted to the uppermost of said support plates about a vertical pivot axis, the other of said swing tower legs being disposed only beneath the lowermost support plate, a planetary gear reducer rigidly mounted to said lower support plate and a rotary power source connected to and actuating said gear reducer, said rotary power source and said gear reducer being nested within said C-shaped swing tower between said pair of support plates, said gear reducer having a rotary output component driven by said rotary power source, said output component (a) being coaxial with said pivot axis, (b) extending beneath said lower support plate, and (c) being nonrotatably connected to the other of said swing tower legs for pivoting said swing tower.

5. In a backhoe including a support having a horizontally disposed load bearing plate, a swing tower having a C-shaped configuration in a vertical plane, an upper portion of said C-shaped swing tower being pivotally mounted to said load bearing plate about a vertical pivot axis, a backhoe boom, dipper and bucket operably mounted to said swing tower for earth working, said support being slidably mounted on a lateral frame secured to a prime mover, the support being horizontally slideable along an axis perpendicular to the longitudinal axis of the prime mover, wherein the improvement comprises:

a rotary power member and gear reducer rigidly mounted to said support and being nested with the C-shaped configuration of said swing tower;

said gear reducer having a rotary output shaft driven by said rotary power member, said output shaft being coaxial with said vertical pivot axis and being connected to said C-shaped swing tower for pivoting the backhoe boom, dipper and bucket 180° relative to said rotary power member and gear reducer; and

said output shaft being rotatable to swing the backhoe boom, dipper, and bucket to 90° on either side of said prime mover longitudinal axis, said backhoe boom, dipper, and bucket being pivotable relatively to one another to a collapsed transport position, and being totally within the lateral width of the lateral frame when (1) said support is at either extremity of its limited horizontal movement, (2) said boom, dipper, and bucket are pivoted to their respective transport positions, and (3) said boom, dipper and bucket are swung 90° relative to said longitudinal axis toward the other side of said prime mover.

6. In a combination tractor and backhoe having a guide frame mounted across the back end of the tractor perpendicular to the tractor longitudinal axis, a support slideable along the guide frame for positioning the backhoe at different positions relative to the tractor longitudinal axis, a C-shaped swing tower opening generally toward said tractor and being pivotally mounted to said slideable support about a vertical axis, said swing tower supporting the backhoe boom and dipper stick, the improvement of a rotary power means carried by the slideable support and being nested within the C-shaped swing tower for pivoting the swing tower and backhoe about said vertical pivot axis, wherein said rotary power means includes a rotary hydraulic motor actuator and a gear reducer, and said gear reducer having an output shaft non-rotatably interconnected with the swing tower, and said backhoe being positioned within the lateral width of the guide frame in a transport position defined by (a) said slideable support

being at one side of the tractor at the extremity of its sliding movement along the guide frame, and (b) the swing tower, backhoe boom and dipper stick being pivoted toward the other side of the tractor and being generally positioned perpendicular to the tractor longitudinal axis.

7. An earth working assembly operably mounted to one end of a prime mover, said earth working assembly including a member having a first load bearing surface, and earth working attachment having a pair of vertically spaced, interconnected attachment members, one of said attachment members being pivotally mounted to said first load bearing surface about a generally vertical pivot axis, said pivot axis intersecting the other of said attachment members, a rotary power hydraulic motor actuator drivingly interconnected with a planetary gear reducer, said power actuator and reducer being nested between the vertically spaced attachment members so that the moment arm between the earth working assembly center of gravity and the prime mover is reduced to correspondingly reduce stress on the pivotal connection between said support and attachment, said reducer having an output shaft and said hydraulic motor having an output component for driving the reducer output shaft through the planetary gear arrangement, wherein the torque requirements for manipulating said earth working assembly may be generated by a relatively compact power source and gear reducer nested between the attachment members, said output shaft being coaxial with said pivot axis and being operably connected to the other of said attachment members for pivoting said earth working attachment within a range of 180° or more to a plurality of attitudes relative to said prime mover.

8. The earth working assembly and prime mover defined in claim **7**, characterized by said motor being hydraulically interconnected and driven by a hydraulic power source on the prime mover.

9. The earth working assembly and prime mover defined in claim **7**, characterized by said earth working attachment including a swing tower having a C-shaped configuration in a vertical plane through the attachment pivot axis, said hydraulic motor actuator and planetary gear reducer being nested within said C-shaped configuration.

10. The combination defined in claim **9**, characterized by said earth working assembly including a backhoe having a boom pivotally mounted to said swing tower, a dipper pivotally mounted to said dipper and a bucket pivotally mounted to said dipper, said backhoe components being pivotable to a transport position, said support being slideably mounted on said prime mover along an axis perpendicular to the prime mover longitudinal axis, said actuator output shaft being 180° to swing said backhoe components within a range of positions between 90° to either side of said prime mover longitudinal axis, said backhoe components, in said transport position, being totally within the width defined by the opposed sides of said prime mover when said support is at either extremity of its sliding movement toward one side of said prime mover and said backhoe components are pivoted 90° relative to said longitudinal axis toward the other side of said prime mover.

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