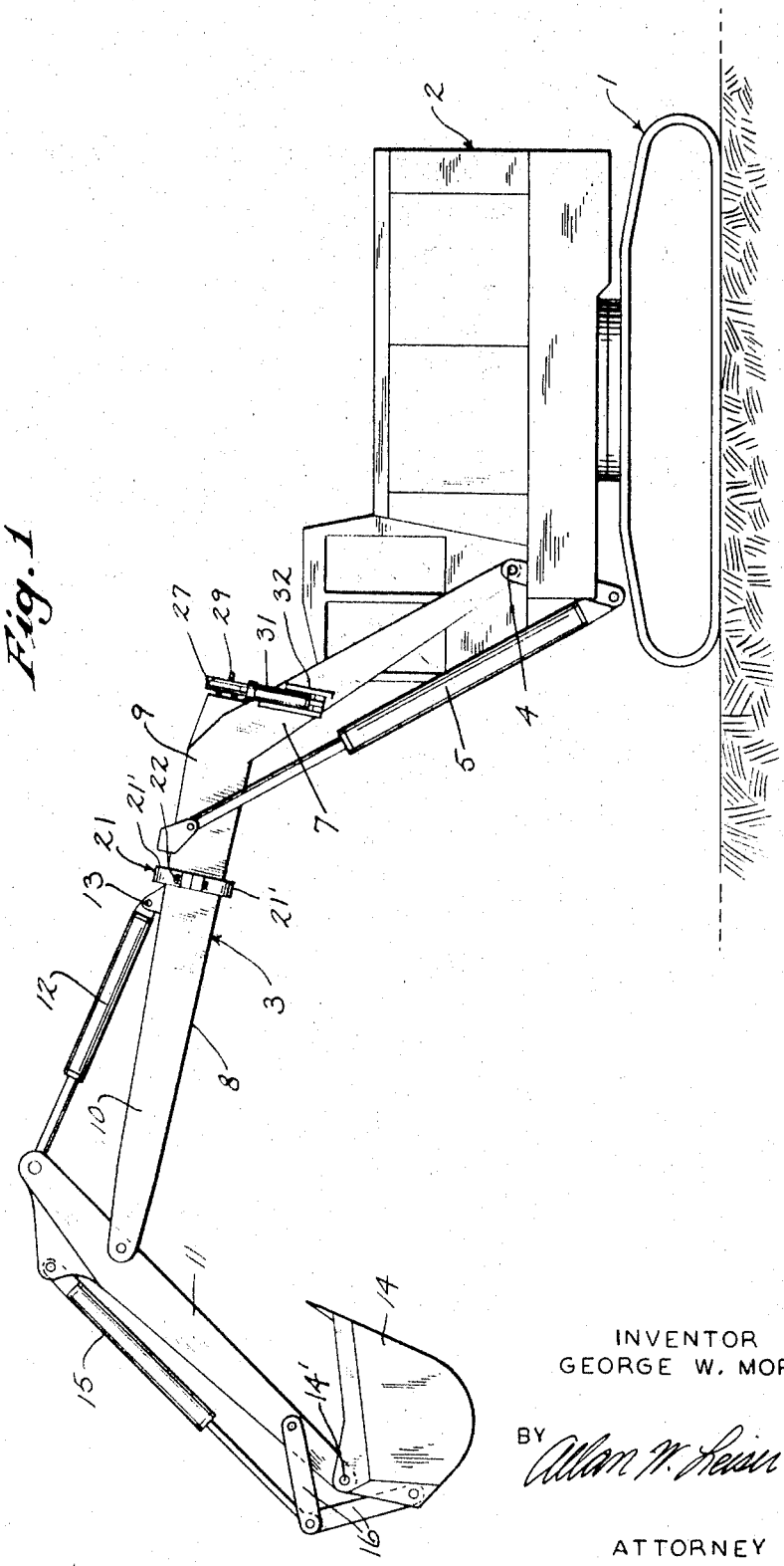
Aug. 26, 1969 G. W. MORK 3,463,336

BACKHOE EXCAVATOR OR THE LIKE WITH POWER ACTUATED SIDE TILTING HANDLE

Filed Nov. 15, 1967 4 Sheets-Sheet 1

Fig. 1



INVENTOR
GEORGE W. MORK

BY Allan W. Larson

ATTORNEY

Aug. 26, 1969 G. W. MORK 3,463,336

BACKHOE EXCAVATOR OR THE LIKE WITH POWER ACTUATED SIDE TILTING HANDLE

Filed Nov. 15, 1967 4 Sheets-Sheet 2

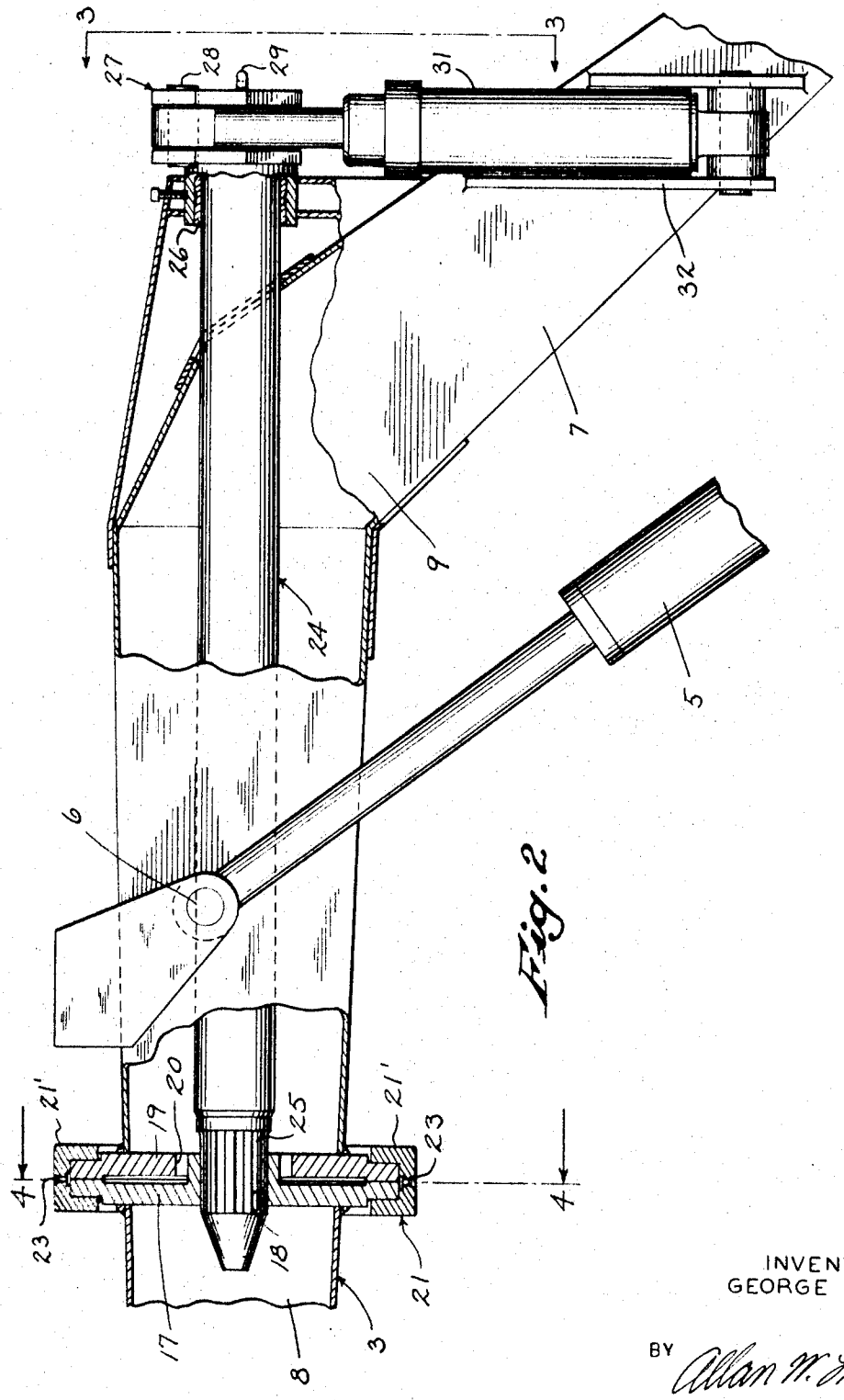


Fig. 2

INVENTOR
GEORGE W. MORK

BY Allan M. Lesser

ATTORNEY

Aug. 26, 1969 G. W. MORK 3,463,336

BACKHOE EXCAVATOR OR THE LIKE WITH POWER ACTUATED SIDE TILTING HANDLE

Filed Nov. 15, 1967 4 Sheets-Sheet 3

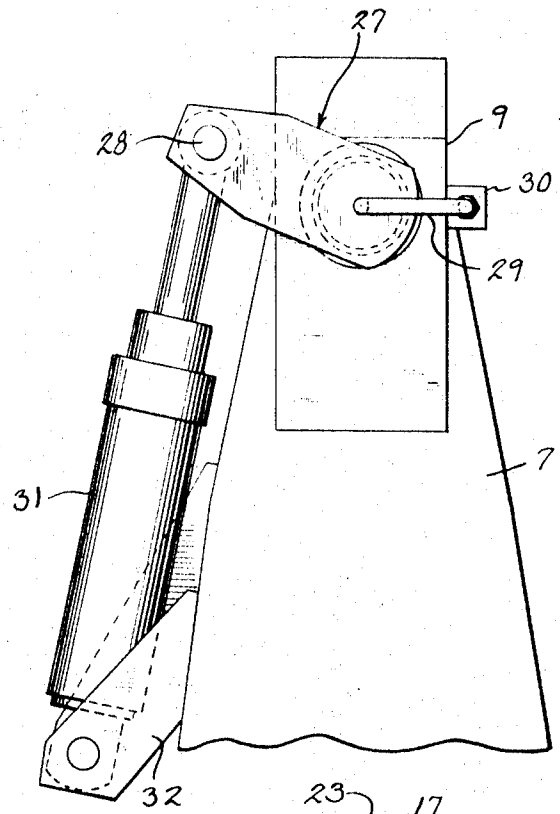


Fig. 3

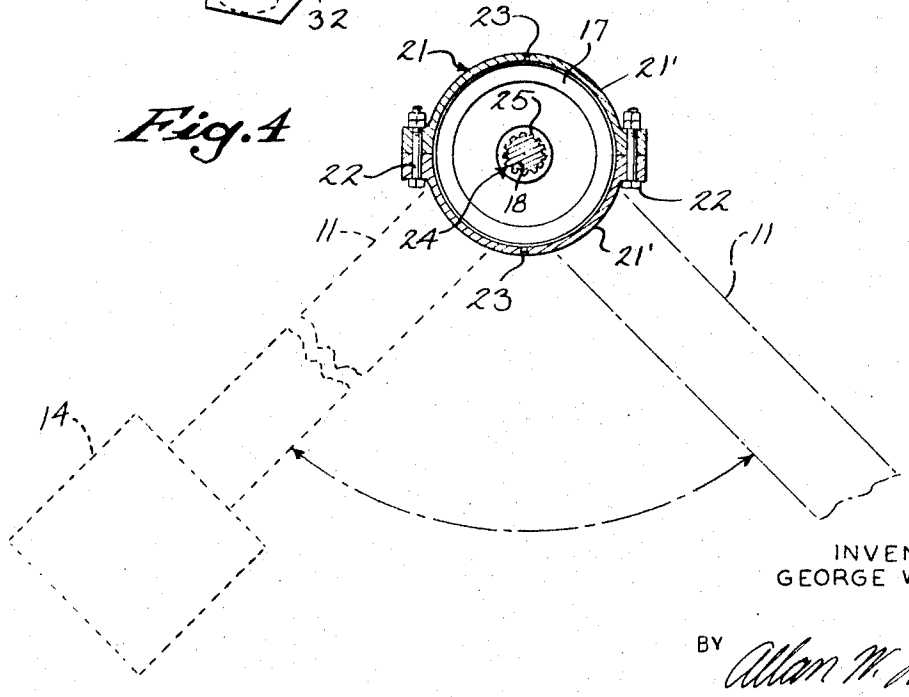


Fig. 4

INVENTOR
GEORGE W. MORK

BY Allan W. Lesan

ATTORNEY

Aug. 26, 1969 G. W. MORK 3,463,336

BACKHOE EXCAVATOR OR THE LIKE WITH POWER ACTUATED SIDE TILTING HANDLE

Filed Nov. 15, 1967 4 Sheets-Sheet 4

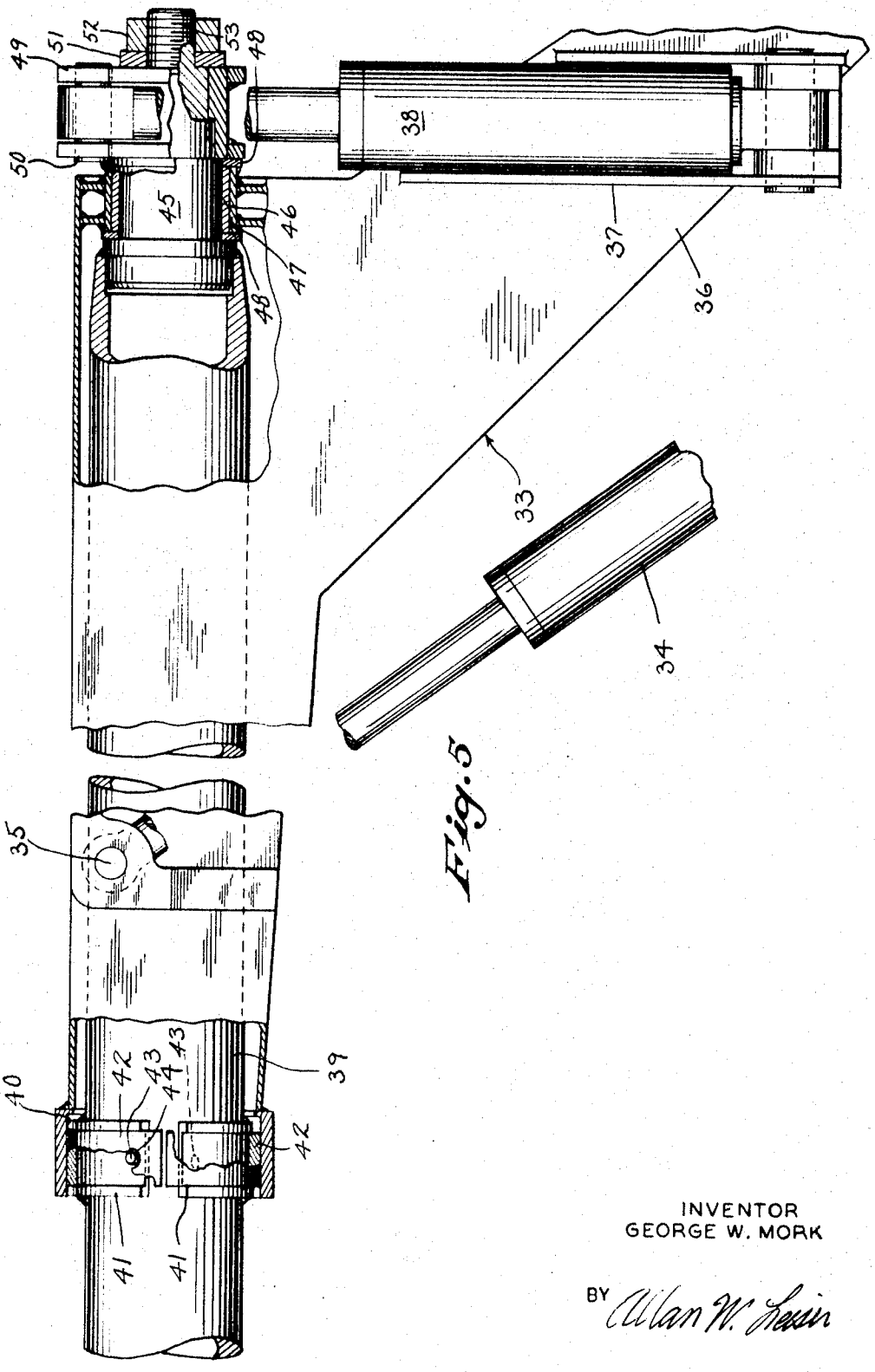


Fig. 5

INVENTOR
GEORGE W. MORK

BY Allan W. Lesin

ATTORNEY

United States Patent Office 3,463,336
Patented Aug. 26, 1969

3,463,336

BACKHOE EXCAVATOR OR THE LIKE WITH POWER ACTUATED SIDE TILTING HANDLE

George W. Mork, South Milwaukee, Wis., assignor to Bucyrus-Erie Company, South Milwaukee, Wis., a corporation of Delaware

Filed Nov. 15, 1967, Ser. No. 683,202
Int. Cl. E02f 3/00
U.S. Cl. 214—138 10 Claims

ABSTRACT OF THE DISCLOSURE

A backhoe includes a hydraulically actuated boom, handle, and bucket. The boom is L-shaped to define a vertical foot portion and a horizontal reach portion, and the reach portion is divided transversely to define inner and outer boom sections. The outer section is rotatable with respect to the inner section, and a tilt shaft extends rearwardly from the outer section through the remainder of the boom reach portion to terminate at an arm in line with the boom foot. A tilt cylinder on the foot is connected to the arm and is thereby operable to rotate the outer section. The dig cylinder which actuates the handle is connected to the outer boom section, so that it and the handle and bucket all move as a unit.

BACKGROUND OF THE INVENTION

This invention primarily relates, but is not necessarily limited, to hydraulic backhoe excavators. Such machines generally include a revolving frame, a boom footed on the frame and pivotal in a vertical plane, and a handle pivotally mounted at the boom tip. There is a scoop or bucket at the end of the handle, and it is preferable to have the bucket pivotal with respect to the handle to have a wrist action.

Where the frame, boom, handle and bucket are all movable, the machine has four degrees of movement, and is accordingly quite versatile. The boom, handle and bucket all move in the same plane, however, and it is desirable to also have a fifth degree of movement—a tilting action in which the handle, and the bucket with it, pivots about an axis corresponding to the centerline of the boom. This in effect shifts the plane of movement of the handle and bucket and provides for side reach which gives greatly increased efficiency in various types of digging operations.

The prior art shows arrangements for rotating or tilting part or all of the front end of an excavator, but none of the known arrangements provides for the efficiency and versatility afforded by this invention. By way of example, some prior art arrangements put a tilt actuating means at or near the tip of the boom, and having this additional weight thus located can very seriously impair the overall efficiency of the machine. Other known arrangements are too complicated or cumbersome and/or fail to provide all of the desired degrees of movement.

SUMMARY OF THE INVENTION

It is the object of this invention to provide an improved backhoe excavator or the like which allows for five degrees of movement including tilting or side reach, two embodiment being shown. It is a further object of the invention to provide for side reach by means of a novel mechanism, two emmbodiments of which are shown, that is highly efficient and of great mechanical strength while being relatively simple and inexpensive and easy to operate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 in a side view, schematic in some respects, showing a backhoe excavator according to this invention,

FIG. 2 is an enlarged fragmentary side view, with parts shown broken away and in cross section, more clearly illustrating the tilt mechanism of the excavator of FIG. 1,

FIG. 3 is an enlarged fragmentary end view, through the plane 3—3 shown in FIG. 2, further illustrating the tilt mechanism,

FIG. 4 is a fragmentary view in cross section, through the plane 4—4 shown in FIG. 2, in which the range of tilting movement of the handle and bucket is illustrated in broken lines, and

FIG. 5 is an enlarged fragmentary side view, with parts shown broken away and in cross section, similar to FIG. 2, which illustrates a second embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to the embodiment of FIGS. 1–4, the excavator shown therein includes a conventional crawler 1 and a revolving frame 2 which is revolvably mounted on the crawler 1 in known manner to provide for what is termed a swing action in which the whole frame 2 and all of its associated elements revolve about a vertical axis at about the center of the crawler 1.

A boom designated generally by the reference numeral 3 is pivotally footed on the frame 2 at 4 to be movable in a vertical plane, thus providing for what is referred to as a hoisting action. Hoisting movement of the boom 3 is effected by means of a pair of parallel, hydraulic hoist cylinders 5, only one of which can be seen in the drawings, disposed on either side of the boom 3, the cylinders 5 being mounted on the frame 2 and connected to the boom 3 at 6.

The boom 3 is angled or L-shaped to define a generally vertical foot portion 7 and a generally horizontal reach portion 8. The reach portion 8 is divided immediately forward at the point of connection 6 of the hoist cylinders 5 to define an inner boom section 9 and an outer boom section 10 that is coaxial therewith. As will be discussed more fully below, the outer boom section 10 is rotatable with respect to the inner boom section 9 to provide the desired tilting action.

A handle 11 is connected to the outer boom section 10 and is pivotal with respect thereto to provide a digging action. Digging movement of the handle 11 is effected by a hydraulic digging cylinder 12 which is connected and operable between the upper end of the handle 11 and a point 13 on the boom 3 which is on the outer boom section 10.

A bucket 14 is connected to the lower end of the handle 11 at 14', and is pivotal with respect thereto to provide what is called a wrist action. This pivotal or wrist motion is provided by a hydraulic wrist cylinder 15 which is connected to and operable between the handle 11 and a pair of rigid links 16 which have inner ends pivotally connected together at the point of connection to the cylinder 15 and outer ends respectively pivotally connected to the handle 11 and bucket 14.

With the exception of the divided construction of the boom 3, the elements thus far described are generally conventional and operate in fashion known to those skilled in the art, so that no further description is necessary. The general arrangement shown provides four degrees of movement, a swinging movement resulting from the frame 2 revolving on the crawler 1, a hoisting movement resulting from raising and lowering of the boom 3 by the cylinders 5, a digging movement resulting from actuation of the handle 11 by the cylinder 12, and a wrist movement resulting from pivoting of the bucket 14 about the point 14' by the cylinder 15 through the links 16. Suitable hydraulic circuitry (not shown but known to

those skilled in the art) is of course provided for the several cylinders.

The boom 3 is of a hollow, box-like construction with a generally rectangular cross section, and is provided with suitable structural bracing members (not shown). A circular disc 17 is welded or otherwise affixed to the inner end of the outer boom section 10 and defines an outwardly extending circumferential flange. The disc 17 is provided with a splined, rearwardly extending central quill portion 18. A second disc 19 is affixed to the outer end of the inner boom section 9 and defines a second circumferential flange which mates with and faces the flange defined by the ring 17. The ring 19 is provided with a relatively larger central opening 20 through which the quill 18 extends.

A split-collar coupling 21 comprises two sections 21' which are releasably held together by bolts 22. The sections 21' are of a generally U-shaped cross section seen best in FIG. 2, and receive the flanges defined by the rings 17 and 19, the several elements shown thus serving as coupling means to connect the inner and outer boom sections 9 and 10 together while allowing for relative rotation therebetween. Grease ports 23 are provided through the coupling 21 to allow for lubrication.

A tilt shaft 24, preferably tubular, has a splined forward end 25 which is received in the quill 18 so that the shaft 24 is keyed to the disc 17 and, therefore, the outer boom section 10. The shaft 24 extends rearwardly through the remainder of the reach portion 8, which forms a part of the inner boom section 9, and outwardly through a suitable collar bearing 26. A bifurcated arm 27 is fixed to the rear end of the shaft 24 immediately to the rear of the bearing 26 and is generally in line with the boom foot portion 7. A transverse pin 28 extends between the parts of the arm 27 and is disposed radially outwardly from the longitudinal axis of the shaft 24. A latch 29 is pivotally mounted on the boom 3 at 30 and can be swung over the rear surface of the arm 27 to help hold the shaft 24 axially in position.

A double acting hydraulic tilt cylinder 31 has its cylinder end pivotally attached to a bracket 32 formed on one side of the boom foot portion 7. The piston end of the cylinder 31 is attached to the pin 28 to pivotally connect the cylinder 31 thereto.

It will be obvious that extension and retraction of the cylinder 31, again through suitable hydraulic circuitry, will cause pivoting of the arm 27 and result in rotation of the shaft 24 which will in turn cause the outer boom section 10 and the handle 11, and all their associated elements, to rotate about an axis approximately corresponding to the longitudinal centerline of the boom 3 (actually the centerline of the reach portion 8 which constitutes the major portion of the boom 3). The cylinder 31, arm 27, shaft 24 and their associated elements thus serve as a tilt mechanism. In the embodiment shown, the tilt mechanism is adapted to afford rotational movement of 45° in either direction from vertical, so that the plane of movement of the handle 11 is shiftable over a total of 90° between the extreme positions illustrated in broken lines in FIG. 4. It will be appreciated that this provides a very substantial side reach which will be of great value in various types of digging operations.

It is important to note that the digging cylinder 12, which constitutes an actuating means for the handle 11, is connected to the outer boom section 10 and moves with it and the handle 11 as a unit. This distinguishes, for example, from prior art constructions in which cable operating means for a handle or dipper stick led backwardly from the upper end of the handle or stick to a frame and, therefore, were subjected to side forces upon a tilting of the forward end of the boom. Similarly, the hoist cylinders 5 are connected to the inner boom section 9, so that rotation of the forward portion 10 does not affect their operation.

It is also extremely important to note that the tilt cylinder 31 and arm 27 are located well toward the rear of the boom 3 as a whole. This distinguishes from prior art constructions in which actuating elements for a rotating boom section are located toward the outer end of the boom where their weight can seriously affect the capacity of the boom and the machine overall. The L-shaped boom 3 divided in the reach portion 8 is also important in that it allows for a relatively simple shaft and cylinder tilt actuating mechanism as shown. The shaft 24 can easily be properly supported by the remainder or rear portion of the boom reach portion 8, and the foot 7 affords a desirable location for the mounting of the cylinder 31 in a position normal to the shaft 24 and at the rear of the boom 3.

The embodiment of the invention shown in FIG. 5 is basically very much the same as the embodiment of FIGS. 1–4, but is especially suitable for larger machines in which the weight of the discs 17, 19 and the coupling 21 might present a problem.

The embodiment of FIG. 5 includes an inner boom section 33, like the section 9, which is raised and lowered in a hoisting action by a pair of hoist cylinders 34 (only one of which can be seen) which are like the cylinders 5 and are connected to the boom section 33 at 35. The section 33 includes a boom foot portion 36, like the portion 7, which has a bracket 37, like the bracket 32, which mounts a tilt cylinder 38 which is like the cylinder 31.

In the embodiment of FIG. 5, however, the outer boom section 10 and the tilt shaft 24 have, in essence, been combined into a continuous cylindrical tube member 39. The forward end of the tube 39 extends to the left as seen in FIG. 5 to serve as a forward boom section, and the rear end extends to the right to serve as a tilt shaft.

The boom section 33 is provided at its forward end with a tubular bearing portion 40. A pair of outwardly opening curved channels 41, each having an arcuate extent of somewhat less than 180° are fixed to the tube 39 in line with the bearing 40. A pair of curved bearing segments 42 are received in the channels 41 and extend radially outwardly therefrom so that they serve to provide a bearing surface in engagement with the bearing 40 as the tube 39 rotates. The segments 42 preferably have an arcuate extent of 180° each to form a continuous bearing surface. A pair of diametrically opposite headed dowel pins 43, only one of which can be seen, are fixed to the tube 39 and channels 41, and have heads which are received in corresponding openings 44, one in each segment 42, to hold the segments 42 against movement about the axis of the tube 39. The segments 42 provide an efficient bearing surface, and are easily replaceable when necessary.

The bearing 40, segments 42 and associated elements serve of course to define the dividing point between the boom and shaft portions of the continuous tube 39. A digging cylinder (not shown but like the cylinder 12) is of course connected to the outer boom section portion of the tube 39 to be movable therewith.

At its rear end, the tube 39 is fitted with a solid, stepped plug 45. Near its end closest to the tube 39, to the left as seen in FIG. 5, the plug 45 supports a tubular bearing collar 46 which is received in and engages a tubular bearing 47 provided on the boom section 33. Washers 48 are disposed on either side of the bearings 46, 47.

An arm 49, like the arm 27, has a spline connection with the section of the plug 45 immediately to the rear of the bearings 46, 47, and is connected to the cylinder 38 by a pin 50. A washer 51 is immediately to the rear of the arm 49, and the several elements are fixed in place by means of a nut 52 on a threaded portion 53 at the rearmost end of the plug 45.

It will be obvious that the tube 39 is held against axial movement but is capable of rotating in response to actuation of the cylinder 38. This will of course cause tilting of a handle and its associated elements (not shown in FIG. 5 but like those shown in FIGS. 1–4). As previously

indicated, the construction of FIG. 5 is especially suitable for large machines because it eliminates the discs **17**, **19** and the coupling **21** of FIGS. 1–4, coupling in the case of FIG. 5 being accomplished by the several elements associated with the plug **45**. Even though these elements constitute a different form of coupling means and even though the outer boom section and tilt shaft are one rather than separate elements, however, the operation of the embodiment of FIG. 5 is essentially the same and this embodiment offers corresponding generic advantages.

Both embodiments of the invention shown herein provide for five degrees of movement and are extremely versatile, being suitable for almost any type of digging operation. The mechanisms for effecting the fifth degree of movement, the tilting action, are both relatively simple and inexpensive, but quite effective. It will be obvious that the tilt shaft and cylinder arrangement shown is easily adaptable to large and heavy machines, and is especially satisfactory in that the primary additional weight is located toward the rear of the boom. Although preferred embodiments of the invention have been shown and described herein, however, it will be obvious that modifications might be made without departure from the spirit of the invention. Other tilt mechanisms or coupling means might be substituted, for example; or the same tilting arrangements might be used in a different type of excavator, even one which does not provide one or more of the four basic degrees of movement such as the wrist action, or in similar or related machines used for similar or related purposes. The invention is not, therefore, intended to be limited by the showings herein or any other manner except insofar as limitations appear specifically in the following claims.

I claim:

1. In an excavator or the like having: a frame that is revolvable about a vertical axis; a boom pivotally mounted on the frame and hoist means to pivot the boom; a handle pivotally mounted on the boom and digging actuator means to pivot the handle; and a bucket pivotally mounted on the handle and wrist means to pivot the bucket, the boom, handle and bucket all ordinarily being pivotal in a common vertical plane,

the improvement wherein:

the boom is transversely divided intermediate its ends to define aligned inner and outer sections, the inner section being mounted on the frame and the handle being mounted on the outer section; and there is a coupling means connecting the boom sections which prevents relative axial movement but allows relative rotation therebetween; and there is a power tilt mechanism operable to rotate the outer boom section with respect to the inner section to shift the plane of pivotal movement of the handle about an axis corresponding to the centerline of the boom.

2. An excavator or the like according to claim **1** wherein the digging actuator means comprises a hydraulic cylinder connected to and operable between the handle and the outer boom section.

3. An excavator or the like according to claim **2** wherein the tilt mechanism comprises: shaft means leading rearwardly from the outer boom section to terminate at a rear end near the inner end of the boom; an arm affixed to and radially extending from the rear end of the shaft means; and a hydraulic cylinder connected to and operable between the inner section of the boom and the outer end of the arm.

4. An excavator or the like according to claim **3** wherein: the boom is L-shaped to define a generally vertical foot portion and a generally horizontal reach portion, the division in the boom being in the reach portion so that the inner boom section includes a rear portion of the reach portion as well as the foot portion; and wherein the shaft means extends rearwardly along the rear portion of the reach portion and has its rear end in alignment with the foot portion; and wherein the tilt cylinder is connected and generally parallel to the boom foot portion.

5. An excavator or the like according to claim **4** wherein: the facing ends of the inner and outer boom sections are provided with mating circumferential flanges; and wherein the coupling means comprises a split collar which encircles the boom and has a U-shaped cross section to receive the flanges.

6. An excavator or the like according to claim **4** wherein: the rear portion of the boom reach portion is of a hollow box-like construction; and the outer boom section and the shaft means comprise a continuous cylindrical member having a rear portion extending through and supported by the rear reach portion.

7. In an excavator or the like including; a pivotal boom and hoist means to pivot the boom; a handle pivotally mounted on the boom and digging actuator means to pivot the handle; and a bucket on the handle, the boom and handle ordinarily being pivotal in a common plane,

the improvement wherein:

the boom is divided intermediate its ends to define aligned inner and outer sections, the inner section being adapted to be pivotally mounted on a frame and the handle being mounted on the outer section; and there is a coupling means connecting the boom sections which prevents relative axial movement but allows relative rotation therebetween; and there is a power tilt mechanism operable to rotate the outer boom section with respect to the inner boom section to shift the plane of movement of the handle.

8. An excavator or the like according to claim **7** wherein the tilt mechanism comprises: shaft means leading rearwardly from the outer boom section to terminate at a rear end; an arm fixed to the rear end of the shaft means and extending radially outwardly therefrom; and a hydraulic cylinder connected to and operable between the inner section of the boom and the outer end of the arm.

9. An excavator or the like according to claim **8** wherein: the boom is L-shaped to define a generally vertical foot portion and a generally horizontal reach portion, the division in the boom being in the reach portion so that the inner boom section includes a rear portion of the reach portion as well as the foot portion; and wherein the shaft means extends rearwardly along the rear portion of the reach portion and has its rear end in alignment with the foot portion; and wherein the tilt cylinder is conneced and generally parallel to the boom foot portion.

10. An excavator or the like according to claim **9** wherein: the rear portion of the boom reach portion is of a hollow box-like construction; and wherein the outer boom section and shaft means comprise a continuous cylindrical member having a rear portion which extends through and is bearingly supported in the rear reach portion.

References Cited

UNITED STATES PATENTS

2,305,566	12/1942	Weston et al.	214—138
3,237,791	3/1966	Soyland	214—138

HUGO O. SCHULZ, Primary Examiner

U.S. Cl. X.R.

214—768