United States Patent

[11] **3,580,406**

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[33] **France**
[31] **165170**

[54] **EARTHWORKING MACHINE**
10 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **214/137,** 214/141
[51] **Int. Cl.** **E02f 3/00**
[50] **Field of Search** 214/141, 132, 137

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ABSTRACT: The invention relates to an earthworking machine in which an earthworking implement, such as a drag bucket, is carried by extensible and retractable means to effect forward and backward movement of the bucket, the invention consisting in an improved form of extensible and retractable means which comprises two pairs of arms pivoted together to form a deformable quadrilateral which is pivoted at one of its ends to the jib and has pivoted to its other end the bucket assembly.

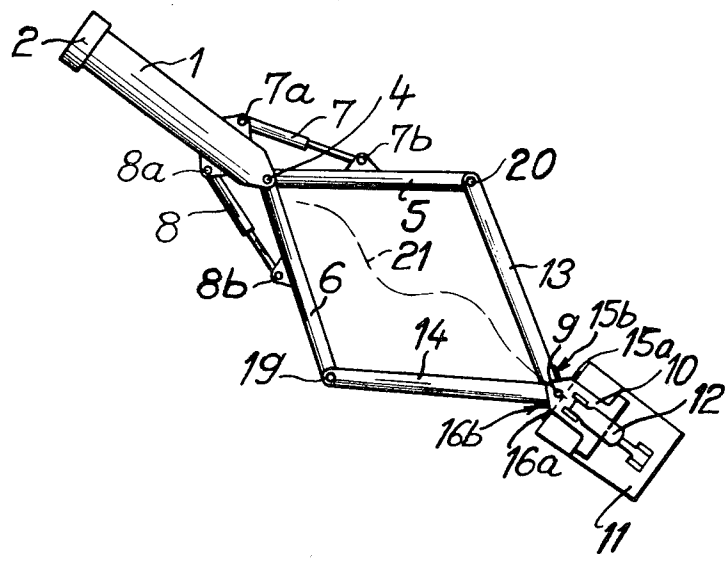
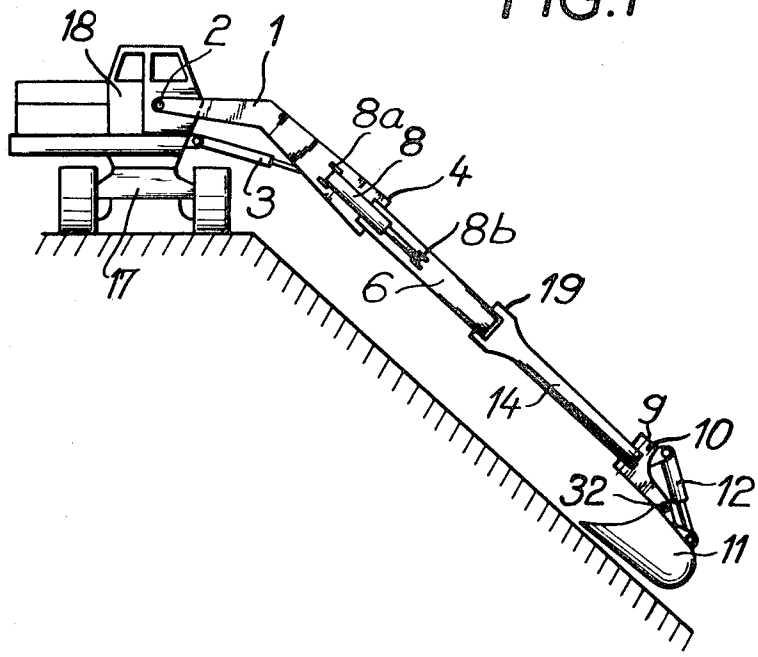


FIG.1



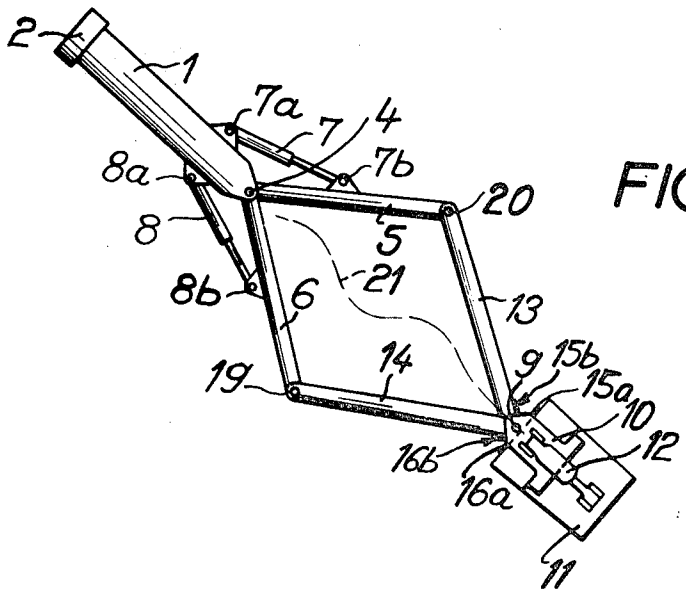


FIG.2

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FIG.3

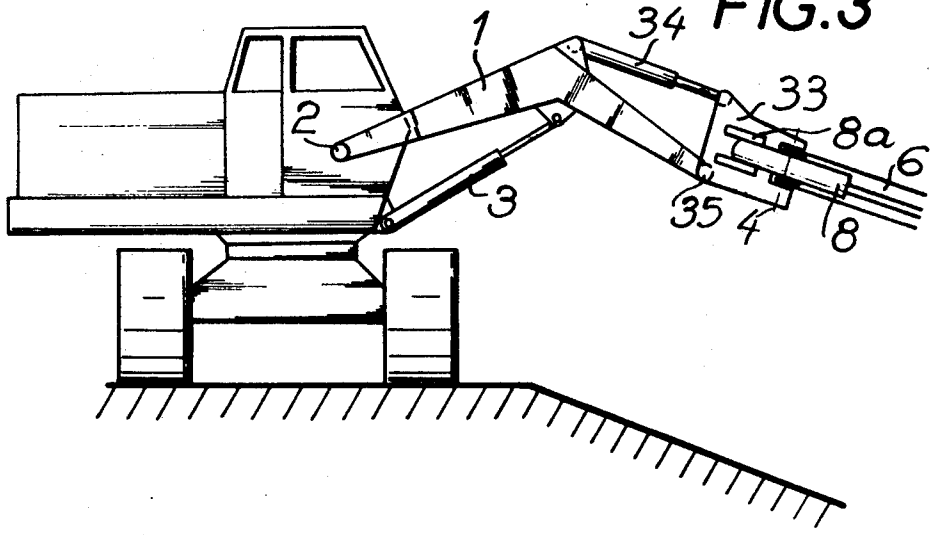
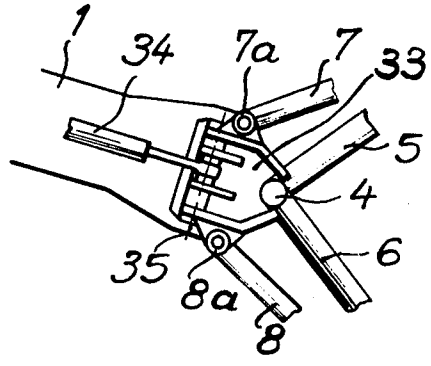


FIG.4



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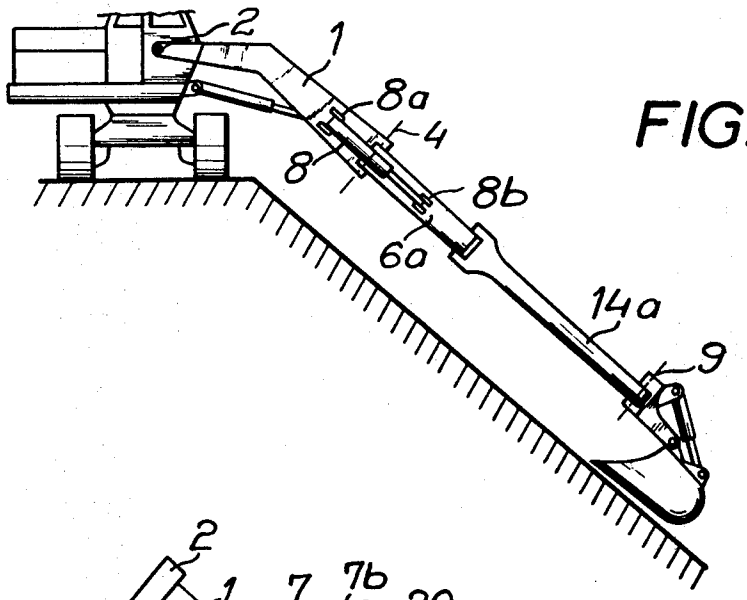

FIG.5

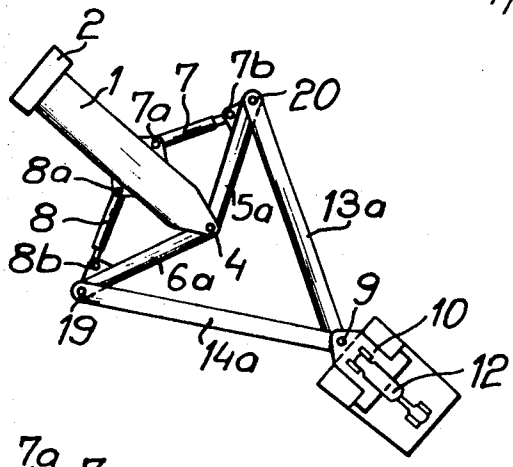

FIG.6

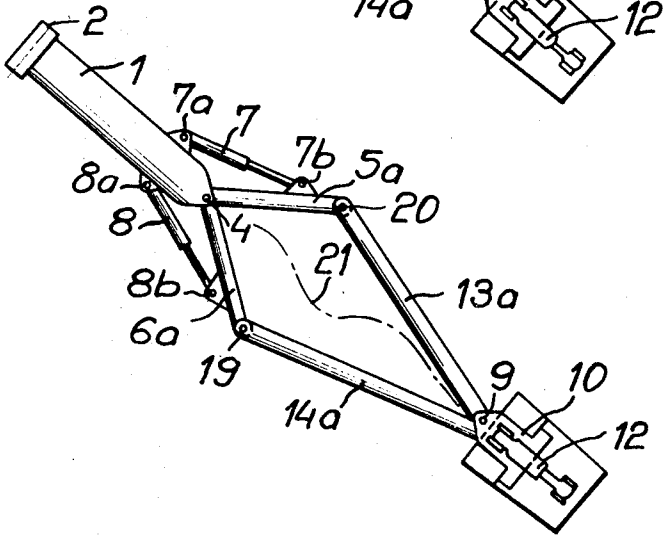

FIG.7

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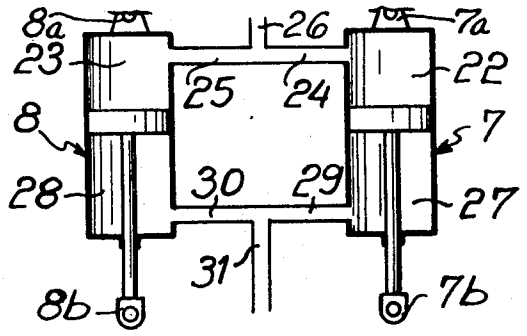

FIG.8

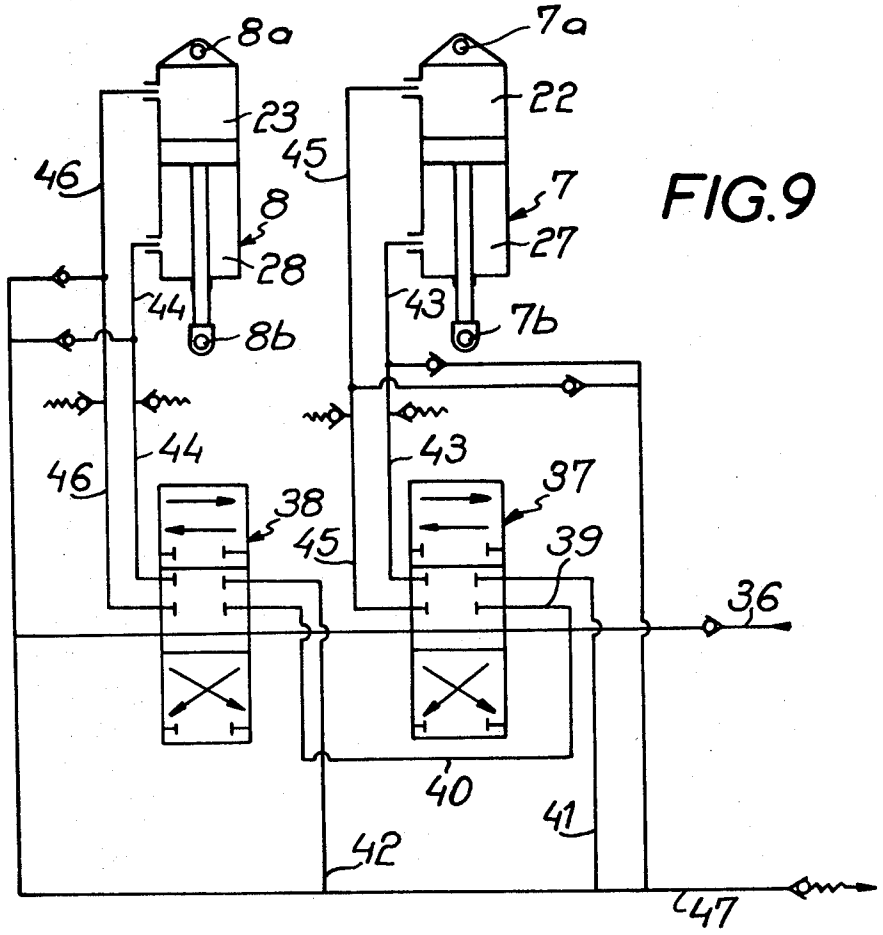

FIG.9

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EARTHWORKING MACHINE

This invention relates to an earthworking machine, such as a mechanical excavator, of the type comprising a turret, a jib pivotally mounted on said turret longitudinally extensible and retractable means mounted on said jib and an earthworking implement pivotally mounted on said extensible and retractable means.

Earthworking machines of this type are designed for carrying out earthworking operations on or forming sloping banking and the purpose of the extensible and retractable means is to enable the earthworking implement, such as a drag bucket, to be moved backwards and forwards up and down banking whilst the machine on which the turret is mounted remains on level ground above the banking. The extensible and retractable means hitherto employed consisted of telescopic means associated with the jib. Such telescopic means, while operating satisfactorily, has the disadvantage that it occupies considerable space, even in the retracted position, and relatively heavy guide means for the telescopic parts have to be provided to ensure satisfactory functioning of the machine.

The object of the present invention is to overcome the above-stated disadvantage and according to the invention this is achieved by substituting for the above described telescopic means an extensible and retractable means which comprises two pairs of arms with all of said arms pivotally connected at their ends to form a deformable quadrilateral, said quadrilateral being pivotally connected to said jib and having an earthworking implement assembly pivoted thereto and wherein ram means are connected between said jib and said quadrilateral for deforming said quadrilateral to effect longitudinal extension and retraction of said quadrilateral.

In a preferred embodiment of the invention the quadrilateral is pivoted to the jib and the earthworking is pivoted to the quadrilateral respectively at two opposite apices of said quadrilateral for pivotal movement about axes perpendicular to the pivotal axis of said jib and the ram means are connected respectively between the jib and each of a pair of adjacent arms of the quadrilateral by which said quadrilateral is pivoted to the jib.

In order that the invention may be more clearly understood embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of an earthworking machine according to the invention shown operating on a sloping banking;

FIG. 2 is a plan view of the extensible and retractable means of the machine according to FIG. 1;

FIG. 3 is a part side elevational view showing a modification of the machine shown in FIG. 1;

FIG. 4 is a part plan view of the modification shown in FIG. 3;

FIG. 5 is a view similar to FIG. 1 of another embodiment of the invention;

FIGS. 6 and 7 are plan views of the extensible and retractable means according to the embodiment of FIG. 5 showing said means in the retracted and extended conditions respectively;

FIG. 8 is a diagrammatic view of hydraulic control means for operating the rams for effecting the extension and retraction of the extensible and retractable means; and

FIG. 9 is a circuit diagram illustrating hydraulic means for controlling operation of said rams.

Referring first to FIGS. 1 and 2 of these drawings the earthworking machine according to the invention comprises a chassis 17 mounted on endless tracks and having mounted thereon a turret 18 rotatable about a vertical axis. A jib 1 is pivotally mounted on the turret 18 for pivotal movement about a horizontal axis 2 by means of an hydraulic ram 3 arranged between said turret 18 and the jib 1.

In accordance with the invention extensible and retractable means are mounted on said jib so as to be extensible and retractable in a direction longitudinally of said jib and an earthworking implement assembly in the embodiment shown comprising a drag bucket 11, is pivotally mounted on said extensible and retractable means.

The extensible and retractable means comprises two pairs of arm 5, 6 and 13, 14 which are pivotally connected together at their ends by pivots 4, 9, 19 and 20 to form a deformable quadrilateral. In the embodiment illustrated the arms 5, 6, 13 and 14 are of equal length. The quadrilateral 5, 6, 13, 14 is pivotally connected to the end of the jib 1 at 4 and the earthworking implement assembly 10, 11, 12 is pivotally mounted on said quadrilateral at 9. Thus the quadrilateral is pivoted to the jib and the earthworking implement assembly at two opposite apices of said quadrilateral for movement about axes 4 and 9 which are perpendicular to the pivotal axis 2 of the jib.

Between each of the adjacent arms 5 and 6, by which the quadrilateral is pivoted to the jib 1, and said jib is an hydraulic ram 8 and 7 respectively, said rams being pivotally connected with the jib at 8*a* and 7*a* respectively, and to a point intermediate and ends of arms 5 and 6 at 8*b* and 7*b* respectively. The axes 7*a* and 8*a* are equidistant from the axis 4 as are the axes 7*b* and 8*b*. The two adjacent arms 5 and 6 may be pivoted together at 4 by the same pivot pin as the quadrilateral is pivoted to the jib or two pivot pins may be provided. It will be noticed that the axes 7*a*, 7*b*, 8*a*, 8*b*, 4, 9, 19 and 20 are all perpendicular to the axis 2 about which the jib pivots.

The earthworking implement assembly comprises an intermediate member 10, of any desired length, which is pivoted to the quadrilateral at 9 for pivotal movement in a lateral plane and an earthworking implement in the form of a drag bucket 11 pivotally connected with said intermediate member 10 at 32 for movement in a vertical plane.

Between the intermediate member 10 and the drag bucket 11 is an hydraulic ram 12 for effecting pivotal movement of said bucket in a vertical plane about axis 32.

On the intermediate member 10 are abutments 15*a* and 16*a* with which opposite parts 15*b* and 16*b* on the arms 13 and 14 abut when the quadrilateral is in its retracted position thereby limiting the pivotal movement of said arms in one direction.

In the embodiment illustrated in FIGS. 3 and 4 the arms 5 and 6 of the quadrilateral are not pivoted directly to jib 1, as in the previously described embodiment, but are pivoted at 4 to an intermediate piece 33 which in turn is pivoted to the jib at 35, the pivotal axis 35 being parallel to the axis 2 about which the jib pivots. A single hydraulic ram 34 is connected between the jib 1 and the intermediate piece 33 for effecting pivotal movement the the quadrilateral and the earthworking implement carried thereby in a vertical plane.

In the embodiment of the invention illustrated in FIGS. 5, 6 and 7 the arms of the quadrilateral are not all of equal length, as in the previously described embodiments, but having pairs of equal length, thus the pair of arms 5*a*, 6*a* by which the quadrilateral is pivoted to the jib 1 are of equal length and the pair of arms 13*a*, 14*a*, are of equal length but arms 13*a* 14*a*, are of greater length than the arms 5*a*, 6*a*. In this arrangement it is unnecessary to provide abutments, such as 15*a*, and 16*b* in the FIG. 2 embodiment since in the retracted position of the quadrilateral, shown in FIG. 6, the arms 13*a*, 14*a* do not reach a position in which they contact the intermediate piece 10.

In the hydraulic control means for operating rams 7 and 8 illustrated in FIG. 8 said rams are supplied with pressure fluid in parallel, thus the upper chambers 22 and 23 of rams 7 and 8 respectively are connected to a common supply conduit 26 through pipe lines 24 and 25 respectively whilst the lower chambers 27 and 28 are connected to a common supply conduit 31 through pipe lines 29 and 30 respectively. An hydraulic distributor (not shown) may be provided for putting conduits 26 and 31 into communication respectively with the source of supply of pressure fluid and a fluid reservoir and vice versa.

In the hydraulic control means illustrated in FIG. 9 the rams 7 and 8 are also arranged in parallel but are supplied with pressure fluid through two distributors 37 and 38. Pressure

fluid is supplied to the hydraulic control circuit from a reservoir (not shown) through conduit 36 and returned to the reservoir through conduit 47 and the rams are connected in parallel through conduit 39. When the distributors are in the position indicated by the top arrows, fluid under pressure from supply conduit 36 is fed to chamber 23 of ram 8 through conduit 46 which leads also to the chamber 22 of ram 7 through the lower connections of the distributors 37 and 38. Fluid discharged from ram chambers 27 and 28 are conduits 41 and 42 respectively is discharged through conduit 47 to the reservoir.

When the distributors 37 and 38 are in the position indicated by the bottom arrows pressure fluid from conduit 36 is fed to chambers 27 and 28 through conduit 44, the two distributors 37 and 38 and conduit 43. Fluid discharged from chambers 22 and 23 passes the reservoir through conduits 45 and 46, distributors 37 and 38 and conduits 41 and 42 respectively, both of the latter being connected to the discharge conduit 47. This produces a retracting action of the rams. As will be understood, various pressure relief valves are provided in the circuit to prevent overloading.

The mechanical excavator as above described is operated as follows:

When it is desired to form a sloping banking such as is shown in FIGS. 1, 3 and 5, the machine is appropriately positioned at the site; the jib 1 is positioned in the raised or horizontal position by means of the hydraulic ram 3; the deformable quadrilateral 5, 6, 13, 14 is then positioned in its extended position by rams 7 and 8; the jib is then lowered by ram 3 until the drag bucket is lowered into contact with the ground; pressure fluid is then fed to rams 7 and 8 to cause said rams to retract and consequently retract the deformable quadrilateral thereby causing the drag bucket to be pulled towards the machine scraping soil with it. During this movement the drag bucket is caused to follow sideways movements in addition to a linear movement and thus follows a sinuous path as indicated by the broken line 21 (FIGS. 2 and 27). This movement results from the fact that the implement assembly 10, 11 is freely pivotable about axis 9 and the rams 7 and 8 are connected in parallel. For this reason the fluid pressure acting upon the rams is equal so that if the bucket 11 encounters any lateral resistance during its operating movement it will tend to move towards the side offering least resistance, since it is freely pivotable about axis 9 and consequently moves along a sinuous path as above described. It will of course be understood that during the above-described operation the angle of attack of bucket 11 is controlled by ram 12.

In the embodiment shown in FIG. 1 the above-described sideways or oscillating movement of the bucket is prevented when the quadrilateral is in its fully retracted position due to the parts 15*b* and 16*b* of arms 13 and 14 coming into contact with the abutments 15*a* and 16*a* on the member 10. This, as will be understood, locks the implement assembly 10, 11 relative to the jib thus facilitates employing of bucket 11.

The embodiment of machine shown in FIG. 3 is operated in a similar manner to that of FIG. 1 except that by virtue of rams 3 and 34 it has the advantage over the first-described embodiment that it permits a greater range of adjustment of the jib above the ground without adversely affecting the function of the machine. The bucket is moved into contact with the ground by the combined actions of rams 3 and 34.

The embodiment according to FIGS. 5 to 7 has the advantage that it permits the arms 5*a* and 6*a* of the deformable quadrilateral to be moved back past the axis 4 in the retracted position of the quadrilateral with the result that with the same stroke the space occupied by the implement assembly is less than that occupied by said assembly in the FIG. 1 embodiment.

An advantage of using the hydraulic control means illustrated in FIG. 9 is that it ensures that the rams 7 and 8 are supplied with pressure fluid in parallel by like action of distributors 37 and 38, thereby retaining the advantage accruing from the oscillation or sinuous movement of the bucket 11. Furthermore, the bucket can be locked in any position, which increases safety, and by differential action of the distributors 37 and 38 guiding of the bucket in the working plane according to a predetermined path is ensured.

It is to be understood that the invention is not limited to the particular embodiments herein described and illustrated but modifications can be made without departing from the scope of the invention defined in the appended claims. For example, more than one deformable quadrilateral may be provided, each quadrilateral having two of its arms connected with two arms of an adjacent quadrilateral, thus increasing the stroke of the implement assembly.

Although the rams controlling the extension and retraction are preferably operated in parallel they could be controlled independently whereby orientation with respect to the jib of the deformable quadrilateral and extension and retraction thereof could be effected simultaneously.

I claim:

1. An earthworking machine, such as a mechanical excavator, comprising a turret, a jib pivotally mounted on said turret, longitudinally extensible and retractible means mounted on said jib and an earthworking implement pivotally mounted on said extensible and retractible means, wherein said extensible and retractable means comprises two pairs of arms with all of said arms pivotally connected at their ends to form a deformable quadrilateral, said quadrilateral being pivotally connected to said jib and having an earthworking implement assembly pivoted thereto and wherein ram means are connected between said jib and said quadrilateral for deforming said quadrilateral to effect longitudinal extension and retraction of said quadrilateral.

2. An earthworking machine, such as a mechanical excavator, comprising a rotatable turret, a jib pivotally mounted on said turret, longitudinally extensible and retractable means mounted on said jib and an earthworking implement assembly pivotally mounted on said extensible and retractable means, wherein said extensible and retractible means comprises two pairs of arms with all of said arms pivotally connected together at their ends to form a deformable quadrilateral, the quadrilateral being pivoted to the jib and the earthworking implement assembly being pivotally mounted on the quadrilateral respectively at two opposite apices of said quadrilateral for movement about axes perpendicular to the pivotal axis of said jib and wherein rams are connected respectively between the jib and each of a pair of adjacent arms of the quadrilateral by which said quadrilateral is pivoted to the jib.

3. An earthworking machine according to claim 1, wherein said rams are supplied with pressure fluid in parallel.

4. An earthworking machine according to claim 2, wherein said rams are supplied with pressure fluid in parallel.

5. An earthworking machine according to claim 2 wherein the quadrilateral is pivoted to the jib by the same pivot as an adjacent pair of said arms are pivoted together.

6. An earthworking machine according to claim 2 wherein the arms forming said quadrilateral are of equal length.

7. An earthworking machine according to claim 2, wherein the pair of arms by which the quadrilateral is pivoted to said jib are of smaller length than the pair of arms to which the implement assembly is pivoted.

8. An earthworking machine according to claim 2, wherein the implement assembly comprises an intermediate member pivoted to the quadrilateral, an earthworking implement pivoted to said intermediate member, and ram means connected between said intermediate member and said implement for pivoting said implement.

9. An earthworking machine according to claim 2, wherein said jib is pivotable in a vertical plane by ram means connected between said jib and said turret.

10. An earthworking machine according to claim 9, wherein said deformable quadrilateral and the implement assembly are pivoted to said jib for movement in a vertical plane by ram means connected between said jib and said quadrilateral.