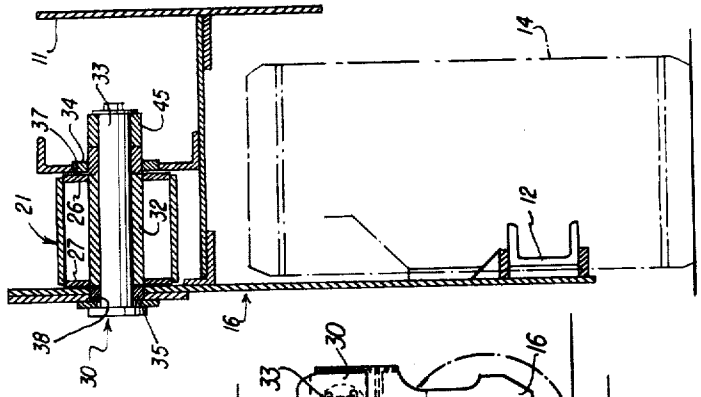
Nov. 25, 1958 E. H. KLUCKHOHN 2,861,704

MATERIAL HANDLING AND EARTH DIGGING MACHINES

Original Filed March 11, 1950 2 Sheets-Sheet 1

Fig. 2



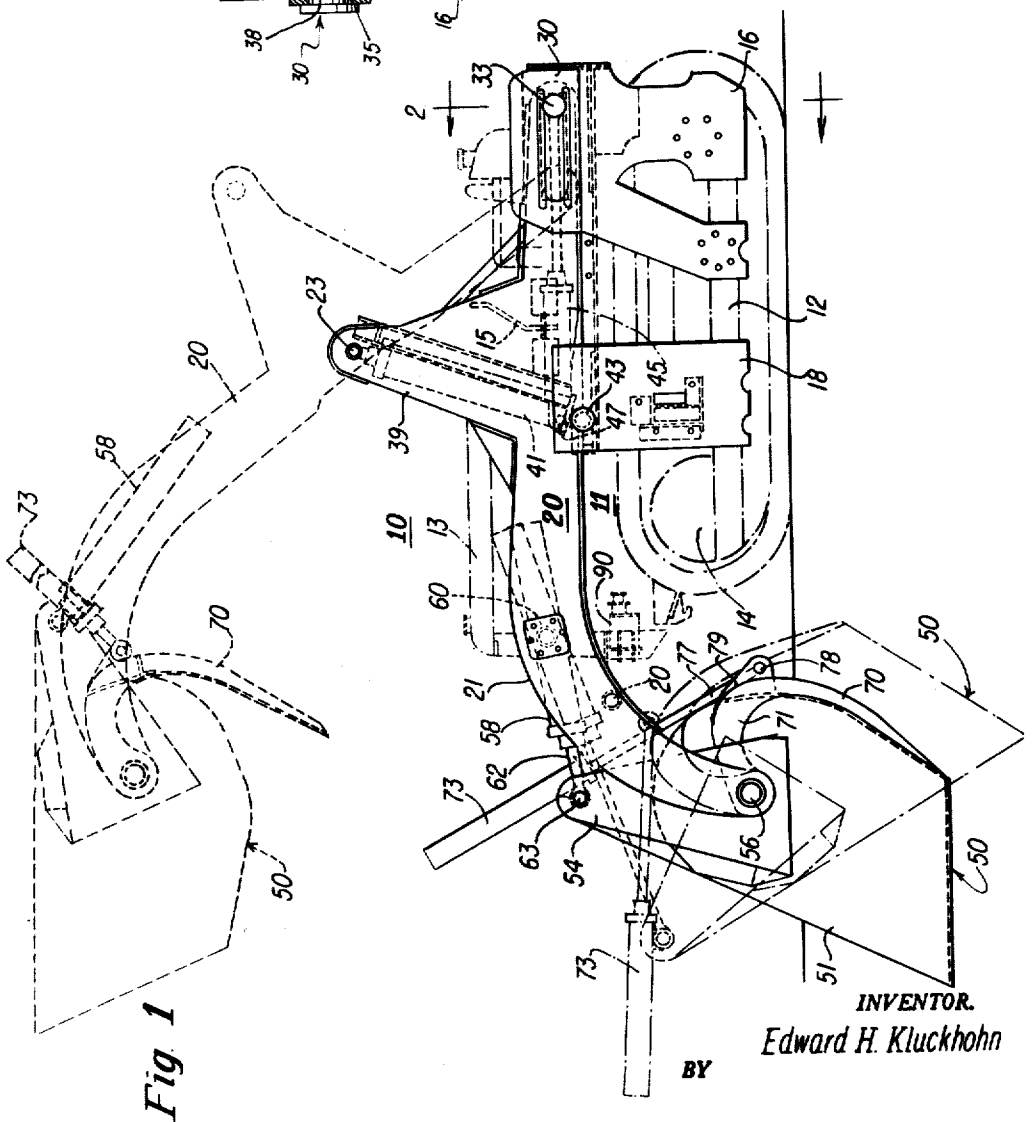


Fig. 1

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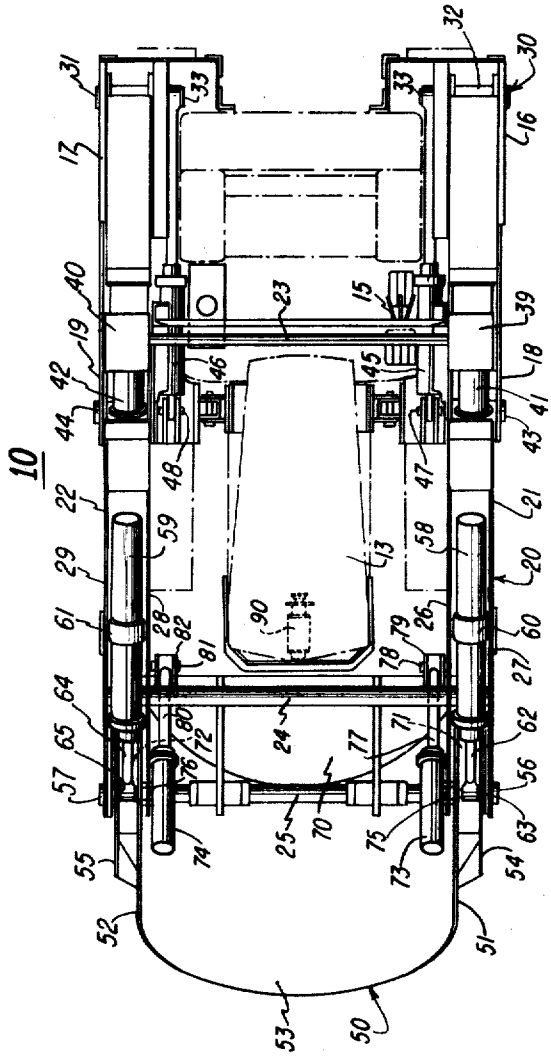
Smith Olsen, Baird & Gulbransen Attys.

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Fig. 3



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MATERIAL HANDLING AND EARTH DIGGING MACHINES

Edward H. Kluckhohn, Naperville, Ill.

Original application March 11, 1950, Serial No. 149,197. Divided and this application October 22, 1953, Serial No. 387,733

6 Claims. (Cl. 214—140)

The present invention relates to material handling and earth digging machines, and more particularly to improved machines of the general character of that disclosed in U. S. Patent No. 2,652,639, granted on September 22, 1953 to Edward H. Kluckhohn. The present application is a division of the copending application of Edward H. Kluckhohn, Serial No. 149,197, filed March 11, 1950, now abandoned.

In accordance with the method disclosed in the Kluckhohn patent, large trees may be removed from one location and replanted in another location without disturbing the mass of roots thereof or the clump of earth enveloping the mass of roots by predetermined manipulations of an earth digging machine comprising a frame supporting a pivotally mounted boom carrying a pivotally mounted and especially constructed bucket.

It has now been discovered that in carrying out the method noted, it is highly desirable to obtain in the machine a greater degree of flexibility of the control of the movements of the boom and of the movements of the bucket than has been heretofore realized.

Accordingly, it is a general object of the present invention to provide in a material handling and earth digging machine of the type noted, including a boom supporting a pivotally mounted bucket carrying a pivotally mounted rear gate, an improved motor arrangement for selectively pivoting the bucket with respect to the boom and for selectively pivoting the gate with respect to the body of the bucket.

Another object of the invention is to provide in a material handling and earth digging machine of the type noted, an improved motor arrangement of the character described, that accommodates selective and independent pivoting of both the bucket and the gate, so that the gate may be selectively opened and closed with respect to the bucket, as desired, and without regard to the position of the bucket with respect to the boom.

A further object of the invention is to provide a material handling and earth digging bucket of improved construction and arrangement.

Further features of the invention pertain to the particular arrangement of the elements of the material handling and earth digging machine and of the elements of the bucket thereof, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of a material handling and earth digging machine of the track-laying tractor type, incorporating a bucket embodying the present invention, certain operated positions of the elements of the machine being illustrated in dotted lines;

Fig. 2 is an enlarged vertical sectional view of the pivotal connection between the left-hand side of the frame

and the left-hand arm of the boom of the machine, taken in the direction of the arrows along the line 2—2 in Fig. 1; and

Fig. 3 is a plan view of the machine shown in Fig. 1.

Referring now to Figs. 1 to 3, inclusive, of the drawings, the material handling and earth digging machine **10** there illustrated, and embodying the features of the present invention, comprises a track-laying tractor **11** of the Allis Chalmers type. The tractor **11** comprises the usual component parts including a frame **12**, an engine **13**, continuous track-laying apparatus **14**, suitable transmission mechanism, not shown, between the engine **13** and the track-laying apparatus **14**, and manually operable control equipment **15** for selectively controlling the apparatus **14**. Specifically, the frame **12** comprises two laterally spaced-apart upstanding rear supporting members **16** and **17**, and two laterally spaced-apart upstanding intermediate supporting members **18** and **19**, the members **18** and **19** being disposed forwardly of the respective members **16** and **17**; the members **16**, **17**, **18** and **19** comprise rigid portions of the frame **12** and are movable directly therewith upon the track-laying apparatus **14** of the tractor **11**.

Also, the machine **10** comprises a boom **20** including two laterally spaced-apart and longitudinally extending arms **21** and **22** respectively disposed on opposite sides of the tractor **11**, the arms **21** and **22** being rigidly secured together by a plurality of longitudinally spaced-apart tie bars **23**, **24** and **25** extending laterally therebetween, whereby the boom **20** is of rigid strong construction. The arm **21** comprises inner and outer plates **26** and **27** arranged in laterally spaced-apart relation; and similarly the arm **22** comprises inner and outer plates **28** and **29** arranged in laterally spaced-apart relation. The extreme rear ends of the arms **21** and **22** are respectively mounted upon the supporting members **16** and **17** for both sliding and pivotal movements with respect thereto by an arrangement including two interposed and laterally spaced-apart mechanisms **30** and **31**.

As best shown in Fig. 2, the mechanism **30** that is disposed between the rear end of the arm **21** of the boom **20** and the supporting member **16** comprises a bearing sleeve **32** extending between the plates **26** and **27** and rigidly secured thereto, and a cooperating trunnion **33** extending through the bearing sleeve **32** and carrying on the inner and outer ends thereof sliding bearing structures **34** and **35** that are received in cooperating longitudinally extending guide slots **37** and **38** formed in the structure of the supporting member **16**. Accordingly, the mechanisms **30** and **31** mount the extreme rear ends of the respective arms **21** and **22** of the boom **20** upon the supporting members **16** and **17** for selective sliding movements of the boom **20** fore and aft with respect to the frame **12** and for selective pivotal movements of the boom **20** up and down with respect to the frame **12**. These sliding and pivotal movements of the boom **20** with respect to the frame **12** may be effected either simultaneously or sequentially, as explained more fully hereinafter.

The intermediate portions of the arms **21** and **22** are respectively provided with upstanding caps **39** and **40** providing hollow enclosures respectively disposed between the plates **26**, **27** and the plates **28**, **29**, and respectively receiving hydraulic motors **41** and **42** of the expansion-contraction type. Specifically, the motor **41** is arranged within the enclosure defined by the cap **39**, the lower end of the motor **41** being pivotally connected to the frame **12** upon the supporting member **18** by an arrangement including a laterally extending pivot pin **43**, and the upper end of the motor **41** being pivotally connected to the associated outer end of the rear tie bar **23** within the

cap 39. Likewise, the motor 42 is arranged within the enclosure defined by the cap 40, the lower end of the motor 42 being pivotally connected to the frame 12 upon the supporting member 19 by an arrangement including a laterally extending pivot pin 44, and the upper end of the motor 42 being pivotally connected to the associated outer end of the rear tie bar 23 within the cap 40. Thus it will be understood that when a hydraulic medium under pressure is supplied to the lower ends of the motors 41 and 42 an expansive thrust is exerted between the pivot pins 43 and 44 and the respective outer ends of the rear tie bar 23, whereby the boom 20 is pivoted upwardly with respect to the frame 12 about the mechanisms 30 and 31. The pivot pins 43 and 44 are arranged in lateral alignment with respect to each other in order to accommodate equal movements of the arms 21 and 22 of the boom 20 in its up and down pivotal motions with respect to the frame 12.

Two laterally spaced-apart hydraulic motors 45 and 46 of the expansion-contraction type are carried by the opposite sides of the frame 12 interiorly of the respective arms 21 and 22 of the boom 20. Specifically, the front end of the motor 45 is pivotally mounted upon the frame 12 inwardly with respect to the member 18 by an arrangement including a pivot pin 47, and the rear end of the motor 45 is pivotally mounted upon the inner end of the trunnion 33 incorporated in the mechanism 30. Likewise, the front end of the motor 46 is pivotally mounted upon the frame 12 inwardly with respect to the member 19 by an arrangement including a pivot pin 48, and the rear end of the motor 46 is pivotally mounted upon the inner end of the trunnion 33 incorporated in the mechanism 31. Thus it will be understood that when a hydraulic medium under pressure is supplied to the motors 45 and 46, either an expansive or a contractive thrust is exerted between the pivot pins 47 and 48 and the trunnions 33 respectively incorporated in the mechanisms 30 and 31, whereby the boom 20 is slid either aft or fore with respect to the frame 12 upon the mechanisms 30 and 31. The pivot pins 47 and 48 are arranged in lateral alignment with respect to each other, just as are the trunnions 33 incorporated in the respective mechanisms 30 and 31, in order to accommodate equal movements of the arms 21 and 22 of the boom 20 in its fore and aft sliding motions with respect to the frame 12.

In view of the foregoing description of the mechanisms 30 and 31 and the organization of the pairs of motors 41, 42 and 45, 46, it will be understood that the sliding and pivotal movements of the boom 20 with respect to the frame 12 may be carried out either simultaneously or sequentially, as required. When the motors 41 and 42 are contracted the boom 20 has a substantially horizontal forward position and a substantially horizontal rearward position depending upon the respective contraction and expansion of the motors 45 and 46. Similarly, when the motors 41 and 42 are expanded the boom 20 has a first upwardly inclined position and a second upwardly inclined position depending upon the respective contraction and expansion of the motors 45 and 46. It will be immediately observed that when the motors 41 and 42 are expanded and the motors 45 and 46 are expanded the angle between the boom 20 and the frame 12, or the earth, is more acute than is this angle when the motors 41 and 42 are expanded and the motors 45 and 46 are contracted. This arrangement permitting the very oblique angle between the boom 20 and the frame 12, or the earth, when the motors 41 and 42 are fully expanded and the motors 45 and 46 are fully contracted, it is very advantageous in view of the fact that it accommodates an extremely high lift by the front end of the boom 20 with a given distance between the rear and front ends thereof.

The front ends of the arms 21 and 22 of the boom 20 extend forwardly with respect to the front end of the tractor 11 and are curved downwardly with respect to the rear portions thereof so that the extreme front ends of the arms 21 and 22 are disposed fairly close to the earth when the principal portion of the boom 20 occupies a substantially horizontal position. The extreme front ends of the arms 21 and 22 removably carry an earth handling and digging bucket 50 including a body provided with upstanding laterally spaced-apart side walls 51 and 52 and a connecting laterally curved bottom wall 53. The side walls 51 and 52 of the bracket 50 are respectively provided with outwardly disposed hollow reinforcing structures 54 and 55 that are respectively normally arranged between the plates 26, 27 of the arm 21 and the plates 28, 29 of the arm 22 at the extreme front end of the boom 20. Specifically, the reinforcing structure 54 is pivotally mounted in place between the plates 26 and 27 at the front end of the arm 21 by an arrangement including a removable pivot pin 56, the pivot pin 56 extending between the plates 26 and 27 through the reinforcing member 54, and the inner end of the pivot pin 56 being detachably secured to the adjacent end of the front tie bar 25 extending between the respective plates 26 and 28 of the arms 21 and 22. Similarly, the reinforcing structure 55 is pivotally mounted in place between the plates 28 and 29 at the front end of the arm 21 by an arrangement including a removable pivot pin 57, the pivot pin 57 extending between the plates 28 and 29 through the reinforcing member 55, and the inner end of the pivot pin 57 being detachably secured to the adjacent end of the front tie bar 25 extending between the respective plates 26 and 28 of the arms 21 and 22. The pivot pins 56 and 57 are arranged in lateral alignment with respect to each other in order to accommodate smooth pivotal movement of the bucket 50 with respect to the front end of the boom 20. Moreover, the bucket 50 may be readily placed and removed with respect to the front end of the boom 20 by virtue of the pivotal mounting arrangement including the removable pivot pins 56 and 57.

Two laterally spaced-apart hydraulic motors 58 and 59 of the expansion-contraction type are respectively carried by the arms 21 and 22 of the boom 20 adjacent to the front ends thereof for the purpose of pivoting the bucket 50 upon the pivot pins 56 and 57. Specifically, the motor 58 is arranged between the plates 26 and 27 of the arm 21 and comprises a housing or casing that is pivotally mounted intermediate the ends thereof upon structure 60 extending between the plates 26 and 27. Likewise, the motor 59 is arranged between the plates 28 and 29 of the arm 22 and comprises a housing or casing that is pivotally mounted intermediate the ends thereof upon structure 61 extending between the plates 28 and 29. Also, the motor 58 comprises a movable plunger 62 the rear end of which is connected to a piston, not shown, arranged in the associated casing thereof, and the front end of which is connected by a pivot pin 63 to the upper end of the reinforcing structure 54. Likewise, the motor 59 comprises a movable plunger 64 the rear end of which is connected to a piston, not shown, arranged in the associated casing thereof, and the front end of which is connected by a pivot pin 65 to the upper end of the reinforcing structure 55. The pivot pins 63 and 65 are also removable with respect to the reinforcing structures 54 and 55 in order to accommodate the complete removal of the bucket 50 with respect to the front end of the boom 20 after removal of the pivot pins 56 and 57, as previously explained. Accordingly, it will be understood that when hydraulic medium is supplied to the casings of the motors 58 and 59 the associated pistons may be selectively moved in either direction in order to effect either expansion or contraction of the motors 58 and 59 as desired. When the motors 58 and 59 are expanded, the bucket 50 is pivoted in the counterclockwise direction, as viewed in Fig. 1, about the pivot pins 56 and 57, the mountings 60 and 61 accommodating the required pivotal movements between the casings of the motors

58 and 59 and the respective arms 21 and 22. On the other hand, when the motors 58 and 59 are contracted, the bucket 50 is pivoted in the clockwise direction, as viewed in Fig. 1, about the pivot pins 56 and 57, the mountings 60 and 61 accommodating the required pivotal movements between the casings of the motors 58 and 59 and the respective arms 21 and 22.

The rear end of the body of the bucket 50 is open and is provided with a pivotally mounted rear gate 70 that is movable between open and closed positions with respect to the associated opening. Preferably the upper end of the gate 70 terminates in a pair of laterally spaced-apart curved arms 71 and 72 that extend into the reinforcing structures 54 and 55 and are pivotally mounted therein concentric with the respective pivot pins 56 and 57 so that the rear gate 70 may move between its closed position engaging the rear edges of the side walls 51 and 52 and the bottom wall 53 of the bucket 50, and its open position disengaging the rear edges noted. For the purpose of moving the rear gate 70 between its open and closed positions about the pivot pins 56 and 57, two hydraulic motors 73 and 74 are respectively carried by the front tie bar 25, the motors 73 and 74 being arranged in laterally spaced-apart relation. Specifically, the motor 73 is arranged inwardly with respect to the plate 26 of the arm 21 and comprises a housing or casing that is pivotally mounted intermediate the ends thereof, as indicated at 75, upon the adjacent end of the front tie bar 25. Likewise, the motor 74 is arranged inwardly with respect to the plate 28 of the arm 22 and comprises a housing or casing that is pivotally mounted intermediate the ends thereof, as indicated at 76, upon the adjacent end of the front tie bar 25. Also, the motor 73 comprises a movable plunger 77 the front end of which is connected to a piston, not shown, arranged in the associated casing thereof, and the rear end of which is connected by a pivot pin 78 to an outstanding fixture 79 carried by the rear portion of the gate 70. Likewise, the motor 74 comprises a movable plunger 80 the front end of which is connected to a piston, not shown, arranged in the associated casing thereof, and the rear end of which is connected by a pivot pin 81 to an outstanding fixture 82 carried by the rear portion of the gate 70. The pivot pins 78 and 81 are arranged in lateral alignment adjacent to the opposite sides of the rear gate 70 in order to accommodate smooth movement of the gate 70 between its open and closed positions about the pivot pins 56 and 57. It will be understood that when the motors 73 and 74 are expanded the gate 70 is moved to its closed position, the gate 70 being pivoted in the clockwise direction about the pivot pins 56 and 57, as viewed in Fig. 1, the pivotal connections 75 and 76 accommodating the required pivotal movements of the casings of the motors 73 and 74 about the front tie bar 25. On the other hand, when the motors 73 and 74 are contracted the gate 70 is moved to its open position, the gate 70 being pivoted in the counterclockwise direction about the pivot pins 56 and 57, as viewed in Fig. 1, the pivotal connections 75 and 76 accommodating the required pivotal movements of the casings of the motors 73 and 74 about the front tie bar 25.

In view of the foregoing description it will be understood that the motors 58 and 59 for effecting pivotal movement of the bucket 50 about the front end of the boom 20 are operative independently of the motors 73 and 74, whereby the bucket 50, as a whole, may be pivoted in either direction about the front end of the boom 20 when the gate 70 occupies either its closed or open positions. Moreover, at any time and regardless of the pivotal position of the bucket 50 with respect to the front end of the boom 20, the gate 70 may be operated between its open and closed positions by selective operations of the motors 73 and 74.

The hydraulic arrangement for effecting operation of the various pairs of motors 41, 42 and 45, 46 and 58, 59 and 73, 74 is of substantially conventional construction and arrangement and is of the general character of that disclosed in the previously mentioned Kluckhohn application; the arrangement comprising a hydraulic medium pump, indicated generally at 90, that is driven by the engine 13. Also, the hydraulic arrangement includes a receiver, not shown, for supplying the hydraulic medium, usually oil, to the pump 90, as well as valve mechanism, not shown, that may be selectively controlled in order to supply the hydraulic medium under pressure from the pump 90 to the casings of the motor pairs, as required, to effect expansion or contraction thereof. Also, the valve mechanism, not shown, may be selectively controlled in order to effect the return of the hydraulic medium from the casings of the motor pairs back to the receiver, not shown. The arrangement is substantially conventional and contemplates the selective and independent control of any of the motor pairs, as previously explained, whereby selective and simultaneous movements of the various elements of the machine 10 may be effected by the operator thereof. The valve mechanism, not shown, may be selectively controlled by the operator by appropriate manipulation of the control equipment 15. The control equipment 15 also governs the general movements of the tractor 11 from the engine 13 by selective operation of the apparatus 14 in a conventional manner.

In view of the foregoing description of the construction and arrangement of the machine 10, it will be understood that it may be moved to the work site by the apparatus 14 under the control of the operator by appropriate manipulation of the control equipment 15. Thereafter the boom 20 may be selectively moved both fore and aft and up and down with respect to the frame 12, and consequently the earth, as required in the material handling or earth digging operation. Of course, the position of the bucket 50 with respect to the front end of the boom 20, as well as the position of the rear gate 70 with respect to the body of the bucket 50, may be selectively controlled as required in the material handling or earth digging operation.

The machine 10 is expressly useful in the transplanting of large trees in accordance with the method disclosed in the previously-mentioned Kluckhohn patent, as it will be appreciated that the bucket 50 may be lowered into the earth in a ready manner with the gate 70 in its open position adjacent to a tree that is to be removed from the earth. The machine 10, as a whole, may then be moved forwardly with respect to the tree so that the body of the bucket 50 may cut its way below the mass of the roots of the tree and the enveloping clump of earth. Thereafter, the boom 20 may be elevated and slid forwardly to effect lifting of the tree and the principal mass of the roots thereof and the enveloping clump of earth, in a ready manner. The load may then be moved to the new location where the tree is to be planted, since the machine 10 is of the mobile type. By following a substantially reverse procedure, the mass of the roots of the tree and the enveloping clump of earth may be placed in the previously prepared hole in the earth, without substantial disturbance of the mass of the roots of the tree or the enveloping clump of earth. This method, as disclosed in the previously-mentioned Kluckhohn patent is most advantageous as it permits of the successful transplanting of very large trees in a most expedient and successful manner obtaining satisfactory growth of the trees following transplanting in a great majority of the cases.

Of course, it will be appreciated that the machine 10 may be employed to prepare the holes in the earth in which the trees are transplanted, and is otherwise generally useful for digging, ditching and earth removal and handling purposes. In the machine 10 the bucket 50 is

very useful in the transplanting of trees since the rear gate **70** thereof may be readily manipulated between its open and closed positions, as required. After a tree has been removed from the earth, the rear gate **70** may be moved to a partially or substantially closed position as the bucket **50** is rotated somewhat to an inclined position in order to prevent the spillage of the earth comprising the clump enveloping the roots of the tree, whereby the center of gravity of the tree being transplanted may be rotated substantially over the machine **10**. This obtaining of the center of gravity of the load over the machine **10** is further facilitated by virtue of the oblique angle to which the boom **20** is moved with respect to the frame **12** as a consequence of the combination sliding and pivotal movements of the rear end of the boom **20** upon the mechanisms **30** and **31**.

In view of the foregoing, it is apparent that there has been provided a material handling and earth digging machine incorporating an improved bucket and motor arrangement for selectively moving the bucket with respect to the boom and for selectively operating the rear gate of the bucket between opened and closed positions with respect to the body of the bucket.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a material handling machine including a mobile vehicle provided with a frame carrying a movable boom, said boom being provided with a pair of laterally spaced-apart and longitudinally extending arms disposed on opposite sides of said vehicle; the combination comprising a bucket provided with a body arranged between the front ends of said arms, first means mounting said body upon the front ends of said arms for pivotal movements with respect thereto, said body having a rear opening therein, a gate arranged at the rear of said body and operatively associated with said rear opening, second means mounting said gate upon said body for pivotal movements with respect thereto and between open and closed positions with respect to said rear opening, said first and second mounting means including a common pair of laterally aligned pivot pins respectively carried by said arms, whereby said body and said gate are mounted for independent pivotal movements about a common laterally extending axis, a first motor mounted on said arms for pivoting said body with respect to said arms, and a second motor mounted on said bucket for pivoting said gate with respect to said body.

2. The material handling machine combination set forth in claim 1, wherein said first motor is pivotally connected to a portion of said body disposed above said pivot pins, and said second motor is pivotally connected to a portion of said gate disposed rearwardly of said pivot pins.

3. In a material handling machine including a mobile vehicle provided with a frame carrying a movable boom, said boom being provided with a pair of laterally spaced-apart and longitudinally extending arms disposed on opposite sides of said frame and a laterally extending tie-bar joining the front ends of said arms; the combination comprising a bucket provided with a body arranged between the front ends of said arms, first means mounting said body upon the front ends of said arms for pivotal movements with respect thereto, said body having a rear opening therein, a gate arranged at the rear of said body and operatively associated with said rear opening, second means mounting said gate upon said body for pivotal movements with respect thereto and between open and closed positions with respect to said rear opening, said first and second mounting means including a common pair of laterally aligned pivot pins respectively carried by the opposite ends of said tie-bar, whereby said body and said gate are mounted for independent pivotal movements about a common laterally extending axis, a first motor extending between said body and said arms for pivoting said body with respect to said arms, and a second motor extending between said gate and said body for pivoting said gate with respect to said body.

4. The material handling machine combination set forth in claim 3, wherein said first motor is carried by said arms, and said second motor is carried by said body.

5. The material handling machine combination set forth in claim 3, wherein said first motor comprises a pair of laterally spaced-apart hydraulic operated units respectively carried by said arms, and said second motor comprises a pair of laterally spaced-apart hydraulic operated units respectively carried by the opposite sides of said body.

6. A material handling machine comprising a mobile vehicle provided with a frame, a boom comprising a single arm at each side of said frame, means for mounting said arms for pivotal movement about a single common axis on said frame and for sliding movement of said axis on said frame, a bucket comprising a body pivoted on said arms and having a rear opening, a gate pivoted on the pivotal axis of said body for closing said opening, motor means carried by said frame for effecting pivotal movement of said boom, a second motor means for effecting said sliding movement of said boom, a third motor means carried by said arms for effecting pivotal movement of said body on said arms, and a fourth motor means mounted on said body for operating said gate.

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