

Jan. 31, 1956

H. A. KIRCHNER
LAND LEVELLING MACHINE

2,732,640

Filed Dec. 9, 1952

2 Sheets-Sheet 1

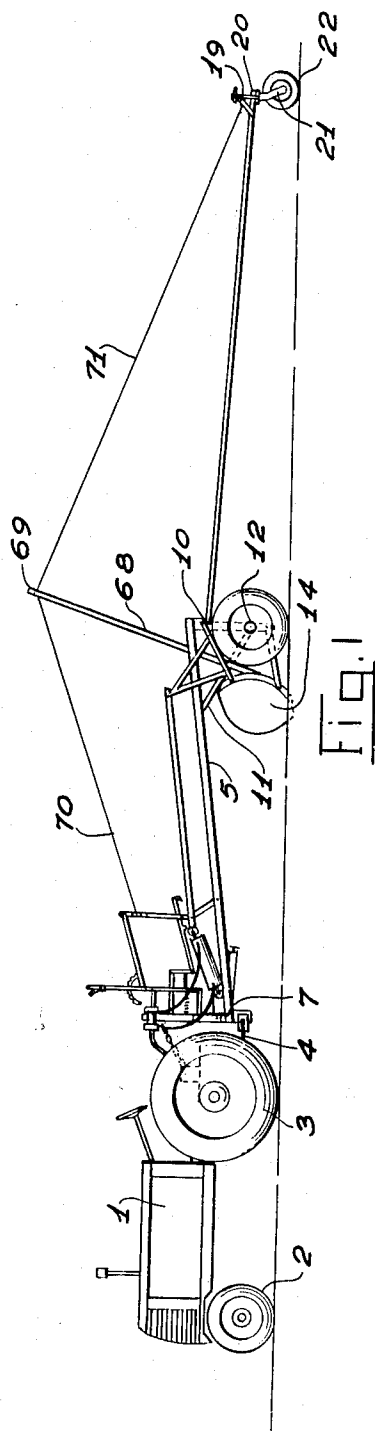


FIG. 1

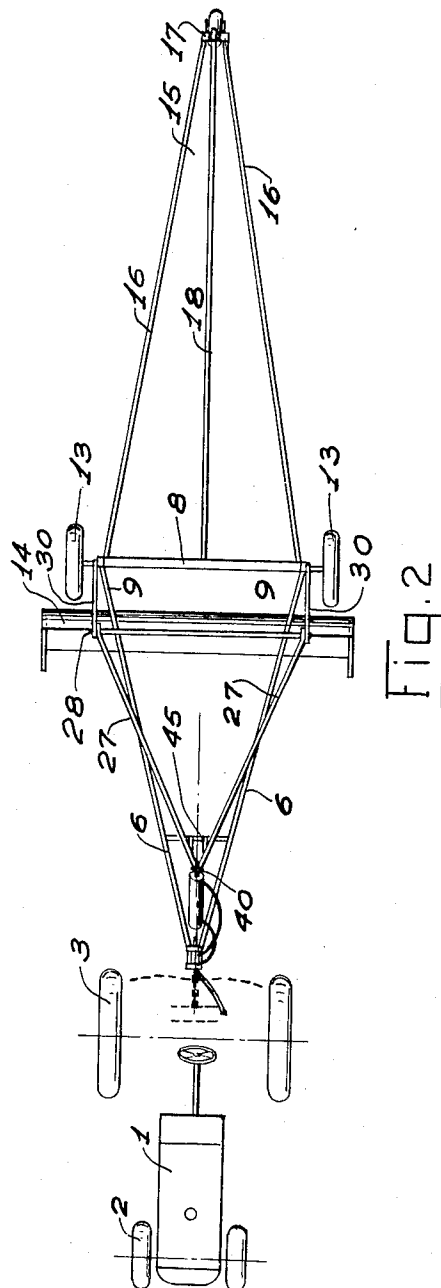


FIG. 2

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2 Sheets-Sheet 2

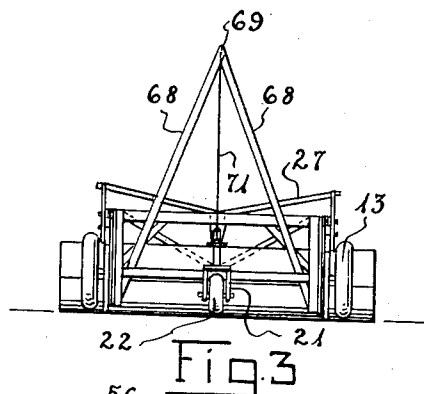


Fig. 3

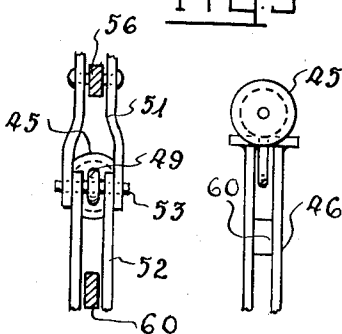


Fig. 5 Fig. 6

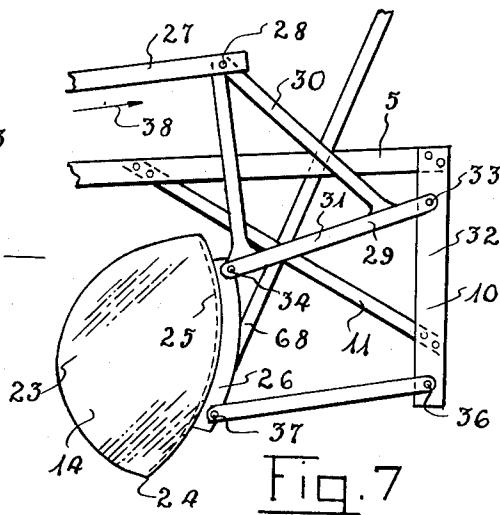


Fig. 7

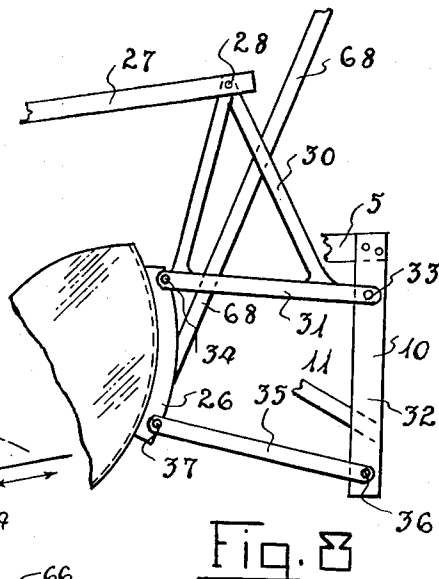


Fig. 8

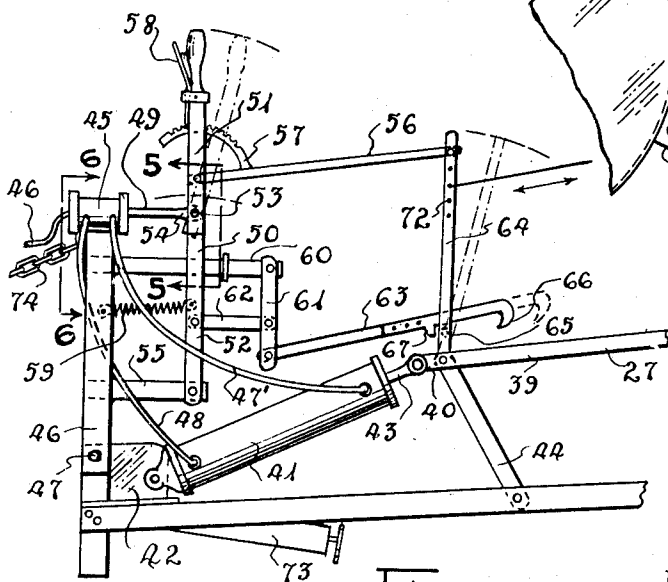


Fig. 4

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1

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LAND LEVELLING MACHINE

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9 Claims. (Cl. 37-169)

My invention relates to new and useful improvements in automatic land levelling machines, in particular to land levelling machines actuated by a source of power such as a tractor, it being understood that the tractor is a component part of my device and is utilized in the self-levelling characteristics thereof, an object of my invention being to provide a device of the character herewithin described which is capable to traversing uneven land and substantially levelling same automatically as it progresses thereacross.

A further object of my invention is to provide a device of the character herewithin described which is adjustable manually within limits to operate efficiently on either slightly uneven land or extremely broken terrain.

Another feature of my invention is to provide a device of the character herewithin described which includes novel means for tilting the bucket component thereof so that the cut is either efficient or inefficient according to circumstances.

Still another object of my invention is to provide a device of the character herewithin described wherein the characteristics of the land being traversed by the front wheels of the tractor are transmitted to the bucket assembly which thus is adjusted to suit these characteristics as they are encountered.

A further object of my invention is to provide a device of the character herewithin described which is readily adaptable for use as a conventional soil moving device as contrasted to a land levelling device.

A still further object of my invention is to provide a device of the character herewithin described which is relatively simple in construction, easy in operation and otherwise well suited for the purpose for which it is designed.

With the foregoing objects in view, and such other objects and advantages as will become apparent to those skilled in the art to which this invention relates as this specification proceeds, my invention consists essentially in the arrangement and construction of parts all as hereinafter more particularly described, reference being had to the accompanying drawings in which:

Figure 1 is a side elevation of my device shown situated behind a tractor.

Figure 2 is a top plan view of Figure 1.

Figure 3 is a rear view of my device per se.

Figure 4 is a side elevation of the linkage and hydraulic cylinder portion of my device but enlarged with respect to Figure 1.

Figure 5 is an enlarged detail substantially along the line 5-5 of Figure 4.

Figure 6 is a substantially enlarged detail substantially along the line 6-6 of Figure 4.

Figure 7 is an enlarged fragmentary side elevation of the bucket and linkage associated therewith showing the bucket in the lowered or cutting position.

Figure 8 is a view similar to Figure 7 but showing the bucket in the raised or unloading position.

In the drawings like characters of reference indicate corresponding parts in the different figures.

2

Attempts have been made in the past to provide an automatic land levelling machine which automatically adjusts the depth of cut to the terrain over which it is traversing. However, most of these suffer from several disadvantages, the principal one of which is that no co-operation is established between, firstly, the land about to be traversed and, secondly, the level land behind the device.

Furthermore, most of these automatic land levelling devices are extremely complicated and difficult to operate, but the device hereinafter to be described overcomes these disadvantages, as will be appreciated.

Proceeding now to describe my invention in detail, it will be seen upon reference to the accompanying drawings that I have illustrated a source of power in the form of a tractor 1 including front wheels 2 and rear wheels 3. Secured to the hitch 4 of the tractor is a framework collectively designated 5 which is substantially triangular when viewed in plan and consists of a pair of side members 6 diverging from the apex 7 (by which it is attached to the hitch 4) rearwardly to terminate in a vertically rectangular back frame collectively designated 8. It will be seen that the rear end 9 of the members 6 are secured to the back frame 8 adjacent the upper corners 10 thereof and that I have provided braces 11 to add rigidity to this structure.

Spanning the lower end of the back frame 8 is an axle 12 upon which are journaled for rotation a pair of ground engaging wheels 13. Earth moving means in the form of a bucket 14 are pivotally connected to the back frame 10 as will hereinafter be described, but it will be seen that this bucket is in advance of the ground engaging wheels 13.

Extending rearwardly from the back frame 10 is a depth control means collectively designated 15, said means consisting of a pair of braces 16, pivotally secured to the sides of the back frame 10 and converging rearwardly therefrom to a common apex 17. Also pivotally connected to the back frame in a similar plane to the braces 16 is a support tube 18 also terminating at the apex 17. A stern post 19 is journaled for rotation within vertical bearing means 20 at the apex 17, said stern post carrying a wheel fork 21 within which is journaled for rotation a castoring wheel 22.

Dealing now with the connection of the bucket 14 to the framework, reference should be made to Figures 7 and 8 which show this connection in detail. The bucket 14 which is formed in the shape of an elongated scoop, is provided with a pair of side flange members 23 and a horizontal lower cutting edge 24. The rear panel 25 of the scoop or shovel is provided with supporting flanges 26 one upon each side of the bucket, these flanges containing the pivotal connections of the bucket to the back frame. Bucket thrust beams 27 connect pivotally to the apex 28 of what I define as offset linkage components collectively designated 29. These components include triangular units 30, one upon each side of the bucket, the base members 31 of which are connected pivotally to the vertical members 32 of the back frame and to the aforementioned support flanges 26 of the bucket, the pivotal connections being designated by the reference characters 33 and 34 respectively. Resistant arms 35 also extend between the back frame 10 and the support flanges 26 and are pivotally connected thereto by pivots 36 and 37 respectively. In this connection, it should be noted that the vertical distances between pivots 33 and 36 are substantially greater than the vertical distances between pivots 34 and 37 so that movement of the beams 27 in the direction of arrow 38 causes pivot point 34 to move upwardly and forwardly in an arc while the front ends 37 of the resistance arms move upwardly and backwardly in an arc, thus tilting the bucket into the unloading position shown in Figure 8 as well as raising same with respect to the ground. Conversely movement of the beams 27 in

the direction opposite to arrow 38 causes the reverse motion to take place so that the bucket lowers and takes up a ground engaging or cutting position shown in Figure 7.

Following through the previous definition, as the bucket is raised it moves into the unloading position thereby giving a thorough unloading of soil and the reverse tilting of the bucket, as it is lowered, gives the blade or cutting edge 24 a more efficient cutting angle and tilts the bucket to a position where it carries a considerably greater proportion of loads than in the other position.

Turning now to the linkage involved in the automatic adjustment of the bucket 14, reference should be had primarily to Figure 4 of the accompanying drawings in which the front end 39 of one of the beams 27 is shown, and in this connection, reference to Figure 2 will show that these beams converge forwardly to the common apex identified by the reference character 40.

All movement of the bucket 14 is controlled by a hydraulic cylinder and piston assembly 41 pivotally secured at one end thereof to a plate 42 adjacent the forward junction of the framework 5, the piston rod 43 being pivotally connected to the beam 27 adjacent the aforementioned apex 40 and in this connection it will be seen that a pair of cylinder pivot arms 44 mounted for partial rotation upon a cross bar 45 spanning the members 6 of the framework 5, act as a vertical support for the apex 40 adjacent this locus. The movements of the cylinder and piston assembly 41 are controlled directly through a four-way control valve 45 mounted upon the upper end of a control stand 46 which in turn is pivotally connected as at 47 adjacent the front end of the framework 5. Details of the internal construction of the control valve are not given in this specification because the same are conventional, but it may be stated that fluid under pressure entering via conduits 46 may pass either through conduit 47' to the front end of the cylinder and piston assembly 41 or through conduit 48 to the rear end thereof thus controlling the movement of piston rod 43. The routing of the fluid through these conduits 47 and 48 is controlled by means of a plunger 49, it also being understood that when the plunger is in its innermost or forward position, fluid is routed through conduit 48, thus extending piston rod 43 and raising the bucket 14. Alternatively, when the plunger is in its fully extended or rearmost position, fluid is routed through conduit 47' thus retracting piston rod 43 and lowering the bucket. Furthermore, it should also be noted that the construction of the valve is such that with the plunger 49 in the intermediate position, then the flow of fluid is halted, thus maintaining the status quo of the bucket at that particular point.

The linkage controlling the movement of the plunger 49 consists of a primary lever 50 including an upper portion 51 and a lower portion 52, said portions being adjacently connected together by a pivot pin 53 which also connects the distal end 54 of the plunger 49 to the lever. The lower end of the portion 52 is pivotally secured to a fixed strut 55 extending rearwardly from the control stand 46. In this connection, reference to Figure 5 will show that the lever 51 consists of two parallel straps, the various components being connected to said lever passing between said straps. A link 56, the purpose of which will hereinafter become apparent, is pivotally connected at the forward ends thereof to the upper portion 51 of lever 50 and also includes a quadrant 57 engageable by a ratchet component 58 situated on top of the lever 51. Reference to this particular portion of the design will show that this gives a basic setting to plunger 49, which plunger incidentally is normally maintained in the forward or innermost position by means of a tension spring 59 extending between the lower portion 52 of the lever 50 and the aforementioned control stand 46. Also, at this point it will be seen that the lower portion 52 of lever 50 passes freely over an upper strap 60 also extending rearwardly from the control stand 46 and vertically above the aforemen-

tioned strap 55. In order to complete the leverage involved in this portion of the operation, reference should be made to the drop link 61 depending from the rear end of the upper strap 60, a cross link 62 extending between the drop link and the lower portion 52 of the lever 50, and a check bar 63 pivotally connected to the lower end of the drop link 61 and extending rearwardly above the aforementioned apex 40 of the beams 27. The rear end of the link 56 is pivotally connected to what I define as an efficiency lever 64, which is also pivotally connected adjacent the apex 40 to the beams 27 and it should be appreciated that the efficiency lever 64 consists of two straps in parallel relationship, having a bolt 65 spanning same adjacent the lower ends thereof and over which the aforementioned check bar rides. Reference to Figure 4 will also show that the check bar includes a pair of dependent hooks 66 and 67 thus limiting the actual movement of the check bar as these hooks will engage around the bolt 65 for the purpose hereinafter to be described.

Before a description of the function of the previously described linkage is undertaken, reference should be made once again to Figures 1 and 2 in which will be seen a cable support assembly collectively designated 68. This cable support consists of a pair of members pivotally connected by the lower ends thereof to the pivotal point 37 of the bucket and converging upwardly to a common apex 69. A cable 70 extends between this apex 69 and the aforementioned efficiency lever 64, reference to Figure 4 showing a selection of apertures 71 adjacent the upper end of this lever through which the cable 70 may be engaged.

A further cable 71 extends from the apex 69 to the aforementioned support tube 18 of the depth control unit 15, it being understood that the length of this cable is also adjustable within limits by conventional means (not illustrated).

Referring back to the linkage system hereintofore described, it will be appreciated that movement of the piston rod 43 moves the lower end of the efficiency lever 64 backwardly or forwardly, the pin or bolt 65 contacting hooks 66 and 67 in the check bar to push or pull same, which in turn operates drop link 61 and through cross link 62, operates lever 52 to control the push rod 49 and hence the valve 45 and this portion of the linkage has but one purpose, namely, to stop the travel of the piston at the desired extreme.

When the pump (not illustrated) associated with the tractor, pumps oil through the valve 45 with the plunger 49 held in the foremost position by means of spring 59, the bucket 14 will raise upwardly until the upward force of the bucket through the cable support 68 puts sufficient tension on the cable 70 through the link 56 to overcome the tension in spring 59 and pulls the plunger 49 into the neutral position, thus holding the bucket stationary.

The height of the cables 70 and 71 at the apex 69 of the cable support always remain at an equal distance above the plane between the front wheels of the tractor and the depth control wheel 22 with the cables being held taut by the actions hereinabove explained. The only exception to this is when the distance between the front wheels of the tractor and the top of the cable support is changed by means of the hand control lever 58 acting in quadrant 57. This change of distance raises or lowers the bucket as follows. Moving the hand lever 58 increases the effective distance between the front wheels of the tractor and the top of the cable support, permitting the spring 59 to pull the valve plunger into the bucket raising position, after which the bucket will rise until the cable support pushes on the cable to again pull the plunger back to its neutral position. Conversely, if the hand control lever 58 is moved forwardly within the quadrant 57, its leverage over the front pivot of link 56 pulls the top or upper portion of lever 50, including the plunger 49, back into the bucket lowering position where it will lower the bucket according to the amount the effective distance is shortened between the front wheels of the tractor

5

and the top of the cable support 68 by this movement of the hand control.

Downward movement of the control wheel 22 will also put tension in the cables 70 and 71 and, through link 56, will move the valve plunger into its bucket lowering position.

When the front wheels of the tractor are lowered, as when entering a depression, the valve 45 is moved forwardly and the plunger 49 held stationary which in other words moves the control valve into the bucket lowering position with a similar effect as hereinabove described, so that the tractor itself becomes part of the automatic control and the front wheels of the tractor and the depth control wheels 22 actually control the levelling of the land within the limits described.

Conversely if the front wheels of the tractor are raised as when riding a hummock, the valve 45 is moved rearwardly by the action of spring 59, thus maintaining chains 74 in the taut position, the plunger being held stationary and moving the control valve into bucket raising position.

Conventional land levelling machines having considerable length usually require a considerable amount of manual control unless the bucket is designed to permit the soil to spill over the top of the bucket, or conversely, considerable amount of power is available at all times. The combination of the linkage principles involved herein combined with the hydraulic controls, make it possible to vary the efficiency of this machine as compared with its overall levelling length, so that it adapts itself well to the different positions of soil roughening as follows.

The height of the cable support 68 on the machine controls the height of the buckets, but the tilting of the buckets changes the comparison of the cutting edge (angle of attack) with the point of pivot between the cable rest and the bucket. The cutting edge travels a shorter distance vertically than the cable support, therefore the machine loses a considerable amount of its efficiency. This makes the machine ideal for use on extremely rough ground.

Alternatively, extra slackening of the cables during the rise of the bucket, caused by the action of the cylinder on the efficiency lever 64, increases the normal rise of the bucket, thereby counteracting the loss of efficiency caused by the tilting thereof.

As the bucket lowers, the cylinder moves the bottom of the efficiency lever forward, which shortens the cable to reverse the above action and also lengthens the downward travel of the bucket. It is therefore evident that with an adjustment to the place where the cable attaches to the efficiency lever to give proper ratio between the cylinder and the two automatic controls (front wheels of tractor and depth control wheels 22), any desired efficiency can be obtained for the desired results on land of almost any degree of roughness.

In conclusion, it should be mentioned that the machine can be used as a conventional soil moving device by either removing the depth control wheel 22 including the pipe 18 carrying same, or, alternatively, hanging the depth control wheel in the air by shortening the length of the cable 71. This has the effect of holding the valve plunger in a position where the control on the hydraulic pump will raise and lower the bucket without being affected by the irregularities of the terrain.

It should also be noted that a pivoted jack or stand 73 is provided in order to support the front end of the framework 5 when hitching and unhitching same from the tractor. Also, a check chain 74 extending between the outer end of the member 46 and the framework of the tractor is necessary in order to give direct linkage between vertical movement of the front wheels of the tractor and the control valve 45.

Since various modifications can be made in my invention as hereinabove described, and many apparently widely different embodiments of same made within the spirit

6

and scope of the claims without departing from such spirit and scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

What I claim as my invention is:

1. An automatic land levelling device adapted to be drawn by a source of power comprising in combination, a framework hitched to said source of power and extending rearwardly therefrom, a pair of wheels supporting the rear end of said framework, earth moving means pivotally secured to the rear of said framework, means secured to said framework and cooperating with said earth moving means to raise and lower said earth moving means with relation to said framework, said means to raise and lower said earth moving means including further means coacting between said source of power and said earth moving means adapted to control the angle of attack of said earth moving means with the ground, and the height of said earth moving means with the ground, and depth control means secured to and extending rearwardly from said framework also coacting with said means to raise and lower said earth moving means.

2. An automatic land levelling device adapted to be drawn by a source of power comprising in combination, a substantially triangular framework hitched by the apex thereof to said source of power and extending rearwardly therefrom, a pair of wheels supporting the rear end of said framework, and vertical back frame also secured to the rear end of said framework, an earth moving bucket pivotally secured to the rear of said framework, means to raise and lower said bucket with relation to said framework, said means including a cylinder and piston assembly secured adjacent to the front end of said framework, said cylinder and piston assembly being connected to the hydraulic system of said source of power, a valve component controlling the movement of said piston and cylinder assembly, linkage extending between said valve component and the rear end of said framework, offset linkage component extending between said back frame, said bucket and said first-mentioned linkage, all adapted to control the angle of attack of said bucket with the ground and the height of said bucket edges with the ground.

3. The device according to claim 2 in which said offset linkage includes a pair of triangular units connected by the apexes thereof to said first-mentioned linkage, the base members of said unit extending between said back frame and said bucket, a pair of resistant arms also extending between said back frame and said bucket but below said base members, said base members and said resistant arms being pivotally connected to said back frame and said bucket, the vertical distance between the pivotal points of connection of said base members and said resistant arms to said back frame being greater than the vertical distance between the points of pivotal connection of said base members and said resistant arms to said bucket.

4. The device according to claim 2 which includes depth control means extending rearwardly from said framework.

5. The device according to claim 2 in which said offset linkage includes a pair of triangular units connected by the apexes thereof to said first-mentioned linkage, the base members of said unit extending between said back frame and said bucket, a pair of resistant arms also extending between said back frame and said bucket but below said base members, said members and said resistant arms being pivotally connected to said back frame and said bucket, the vertical distance between the pivotal points of connection of said base members and said resistant arms to said back frame being greater than the vertical distance between the points of pivotal connection of said base members and said resistant arms to said bucket, and depth control means extending rearwardly from said framework.

7

6. The device according to claim 2, which includes a cable rest situated above said wheels, a cable extending between said first-mentioned linkage and said cable rest, and a further cable extending between said cable rest and the rear end of said depth control means.

7. The device according to claim 5 in which said depth control means includes a triangular framework pivotally secured to said first-mentioned framework adjacent the wheel supporting frame, a longitudinally extending tube also pivotally connected to said first-mentioned framework, and extending to adjacent the apex of said last-mentioned framework, a castoring wheel pivoted for vertical rotation from the apex of said last-mentioned framework, and means extending from said last-mentioned apex to said first-mentioned linkage to control the depth of said bucket.

8. The device according to claim 5 which includes a

8

cable rest situated above said wheels, a cable extending between said first-mentioned linkage and said cable rest, and a further cable extending between said cable rest and the rear end of said depth control means.

9. The device according to claim 7 in which said last-mentioned means includes a cable rest situated above said wheels, a cable extending between said first-mentioned linkage and said cable rest, and a further cable extending between said cable rest and the rear end of said depth control means.

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