March 13, 1956 W. W. EVERETT 2,737,733

TRENCHING MACHINE EXCAVATING CONTROL APPARATUS

Original Filed May 16, 1949 4 Sheets-Sheet 1

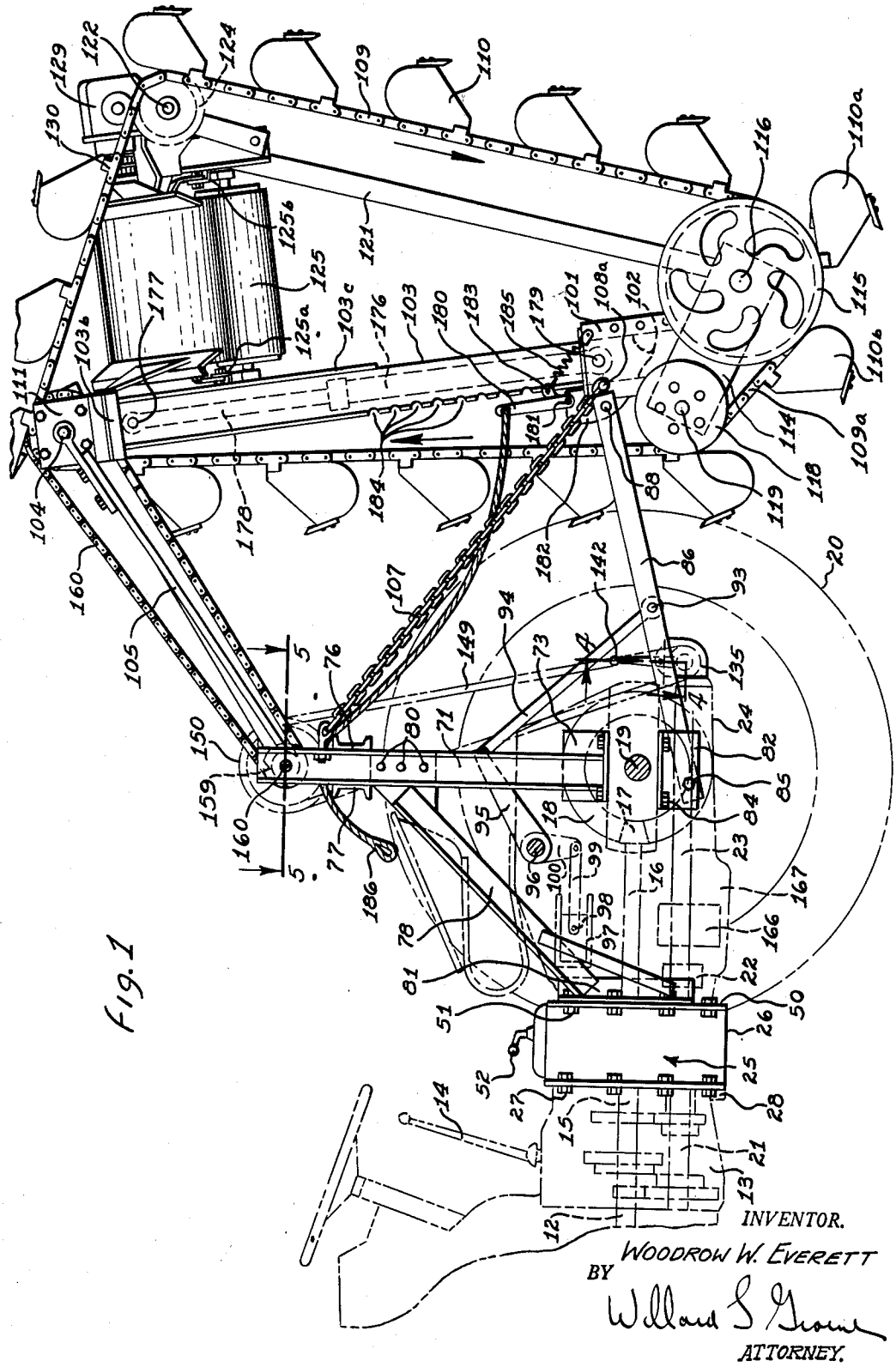


Fig. 1

INVENTOR.
WOODROW W. EVERETT
BY
Willard S. Grove
ATTORNEY.

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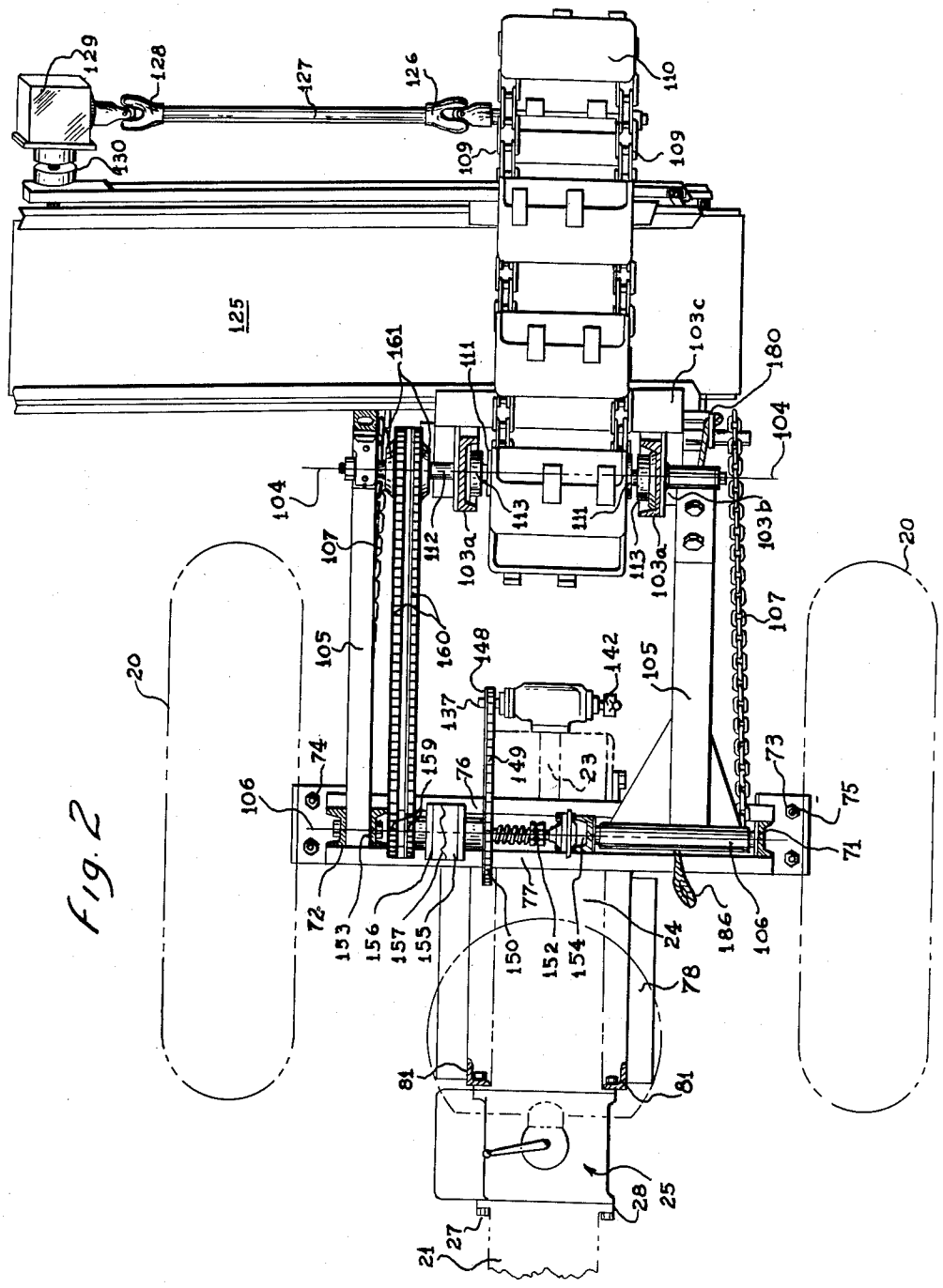


Fig. 2

INVENTOR.
WOODROW W. EVERETT
BY
Willard S. Grimm
ATTORNEY

March 13, 1956 W. W. EVERETT 2,737,733

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Original Filed May 16, 1949

4 Sheets-Sheet 3

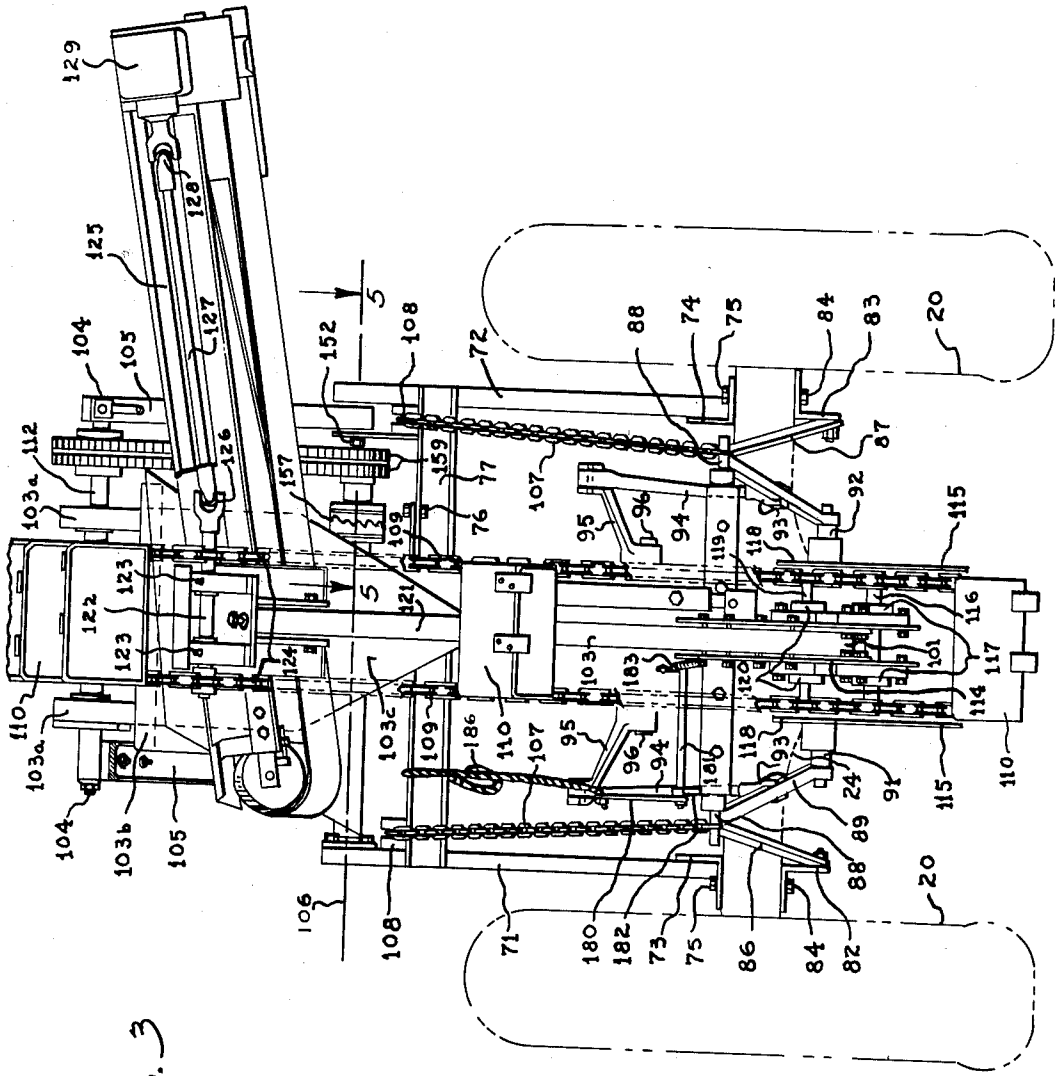


Fig. 3

INVENTOR.
WOODROW W. EVERETT
BY
Willard S. Grosscup
ATTORNEY

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TRENCHING MACHINE EXCAVATING CONTROL APPARATUS

Original Filed May 16, 1949 4 Sheets-Sheet 4

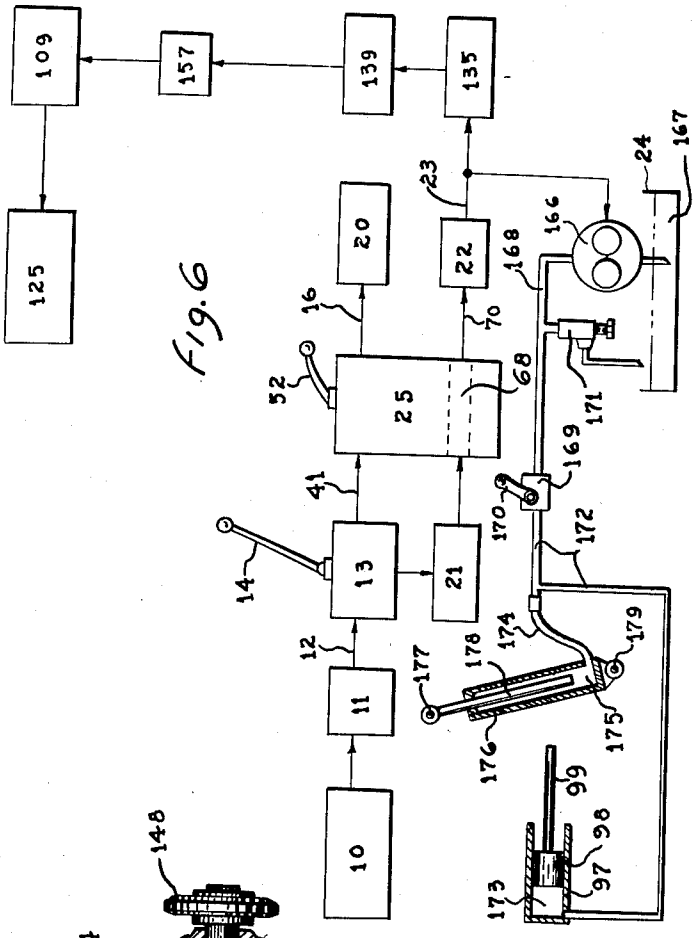


Fig. 6

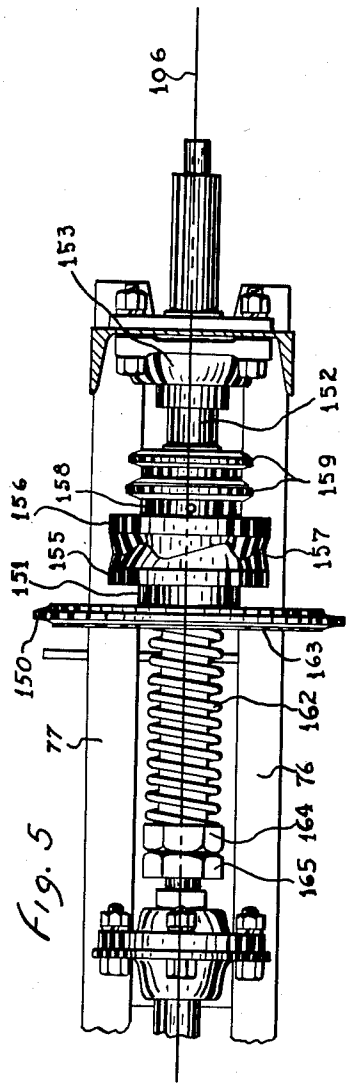


Fig. 5

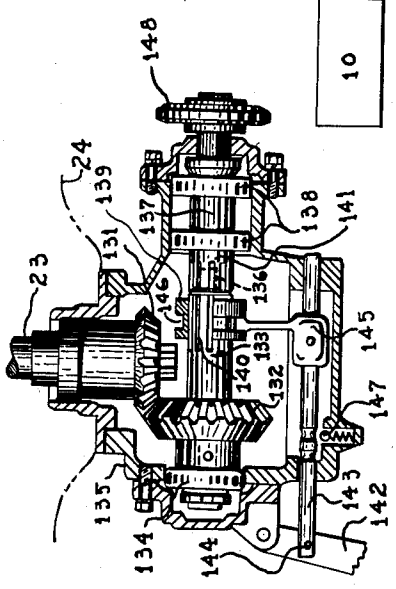


Fig. 4

INVENTOR.
WOODROW W. EVERETT
BY
Willard S. Grow
ATTORNEY.

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2,737,733

TRENCHING MACHINE EXCAVATING CONTROL APPARATUS

Woodrow W. Everett, Phoenix, Ariz., assignor, by mesne assignments, to Earth Equipment Corporation, Los Angeles, Calif., a corporation of California

Original application May 16, 1949, Serial No. 93,470. Divided and this application July 16, 1951, Serial No. 236,910

8 Claims. (Cl. 37—90)

This invention relates to excavating machines and is particularly directed to trenching or ditching machines employing a supporting frame and an endless chain bucket line carrying a series of excavating buckets mounted on an ordinary tractor.

This is a divisional application of original application Serial No. 93,470, filed May 16, 1949 now Patent No. 2,617,314 issued November 11, 1952.

One of the objects of this invention is to provide an excavating device which shall be a self contained unit adapted for use with farm tractors which is of simple, compact and durable mechanical construction, and which may be readily attached to or removed from the tractor proper.

Another object of this invention is to provide an excavating device especially adapted for digging ditches in which the cutting or excavating mechanism is adjustable relative to its supporting frame structure to vary the depth of excavation to control the profile of the bottom of the ditch being cut.

And a still further object is to provide an improved hydraulic control system for positioning the boom or supporting frame for profile control and for bodily moving the trenching device to a withdrawn position on the tractor when it is to be transported to another working location by the tractor.

Further features and advantages of this invention will appear from the following detailed description of the drawings in which:

Fig. 1 is an enlarged side elevation of the trenching device shown applied to a conventional farm tractor with the tractor linkage in at its lowermost position at the beginning of the digging operation.

Fig. 2 is a plan view of the arrangement shown in Fig. 1.

Fig. 3 is a rear view of the apparatus shown in Fig. 1.

Fig. 4 is an enlarged sectional view of the power take-off control unit for driving the bucket chain line indicated by the line 4—4 in Fig. 1.

Fig. 5 is an enlarged fragmentary view of the overload clutch drive shaft indicated by the line 5—5 in Figs. 1 and 3.

Fig. 6 is a diagram showing the essential elements and their operative association in the trenching apparatus.

For illustrative purposes this invention is shown applied to a conventional farm tractor having the usual internal combustion engine 10 and main drive clutch 11, shown diagrammatically in Fig. 6, which connects power from the engine to the input shaft 12 of the usual change speed and reversing transmission 13 controlled from the gear shift lever 14. Such a transmission has the usual output shaft 15 which is connected to the propeller shaft 16 having the bevel pinion 17 which drives the differential ring gear for application of power to the tractor axles 19 and the main driving wheels 20. The transmission 13 also has the usual back gear shaft 21 which connects through a disconnect clutch 22 to the power take-off shaft 23 extending to the rear of the differential housing 24 in a well known conventional manner.

In order to provide a suitable slow speed drive for feeding the tractor along while the trencher is in operation cutting a ditch, there is provided an auxiliary low speed transmission indicated generally at 25, Fig. 1, preferably as shown in co-pending application Serial No. 93,470 filed May 16, 1949, now Patent No. 2,617,314 issued November 11, 1952. The auxiliary transmission 25 has a housing 26 which has a flange portion 27 secured by suitable bolts to the rear flange 28 of the regular transmission 13 and its flange portion bolted at 51 to the flange 50 of the rear axle housing 24 so that power from the shaft 15 of the regular transmission is connected through the auxiliary transmission 25 to the propeller shaft 16.

The power take-off shaft 21 of the regular transmission 13 is connected through a by-pass take-off shaft in the auxiliary transmission 25 to the regular power take-off shaft 23 in the differential housing 24 of the tractor.

The trenching device is mounted on the tractor by means of the main supporting frame comprising a pair of upright standards or channels 71 and 72 which are welded to the brackets 73 and 74 which in turn are fixed to the differential housing 24 by suitable bolts 75. Cross channels 76 and 77 are suitably welded to the upright channels 71 and 72. Suitable angular braces 78 and 79 are riveted at 80 to the upright channels 71 and 72 and are welded at their lower ends to angle plates 81 secured to the flange portion 50 of the differential housing 24 by the bolts 51.

Below the differential housing 24 is secured the brackets 82 and 83 by suitable bolts 84 and in these brackets are trunnions 85 upon which are pivotally mounted the stabilizer arms 86 and 87 which terminate in pivotal connections 88 to which are also connected the lifting arms 89 and 90 which are pivotally connected to the differential housing 24 by suitable trunnions 91 and 92 as best seen in Fig. 3. The lift arms 89 and 90 are connected at 93 to the links 94 which in turn are connected to the lifting levers 95 carried on the rock shaft 96 journalled in the differential housing 24 of the tractor. The rock shaft 96 is actuated by the usual hydraulic cylinder 97 of the tractor having a piston 98 and a connecting rod 99 connected to a lever arm 100 fixed to the rock shaft 96 inside of the differential housing 94.

Supported pivotably at 88 on the stabilizer arms 86 and 87 and the lift arms 89 and 90 is the slide assembly or guide box member 101 which has suitable guide ways 102 in which slides the main frame or profile control bar 103. The upper end of this bar 103 is provided with channels 103*a* which are connected through transverse channel 103*b* and the plate member 103*c* to the member 103. The upper ends of the members 103*a* are pivotally supported at 104 on an arm 105 which in turn are pivotally supported at 106 on the upright channel 71 and 72. Limit chains 107 fastened at 108 to the vertical channels 71 and 72 and connected to the guide box member 101 at their other ends at 108*a* serve to limit the downward swinging position of the stabilizer and lift arms and the guide box 101 to the position shown in Fig. 1.

The endless chain bucket line 109 having the buckets 110 is carried on the drive sprockets 111 carried on a shaft 112 journaled on suitable bearings 113 in the upper portion of the members 103*a*, as best seen in Figs. 2 and 3, with the axis of the shaft 112 coinciding with the pivot axis 104. On the lower end of the channel 103, where it projects downwardly through the guide box 101, is fixed a supporting member 114 which carries a pair of large idler wheels 115 carried on a shaft 116 journaled in suitable bearings 117 in the member 114. A smaller pair of idler wheels 118 located toward the front and upwardly from the idler wheels 115, are fixed on a shaft 119 journaled in suitable bearings 120 in the member 114. It will be noted that the bucket chain line 109 passes downwardly over the idler wheels 115 and then diagonally upwardly

along the line 109a to the smaller idler pulleys 118, as best seen in Fig. 1, so that the buckets 110 pass through a greater radius of sweep in the bottom of the ditch. It will also be noted that at least two of the buckets such as 110a and 110b are digging at the same time so as to provide an overlap in the entrance and leaving of the buckets from the cut to thus greatly reduce vibration during the digging operation.

Also fixed to the member 114 is the channel member 121 which extends upwardly and rearwardly to support a shaft 122 on suitable bearings 123. On the shaft 122 are fixed the sprockets 124 over which operates the bucket chain line 109 so as to positively rotate the shaft 122. A conveyor indicated generally at 125 is mounted on and interconnects the members 103 and 121 by suitable bolts at 125a and 125b so as to rigidly hold these members together at their upper portions. Since the conveyor belt forms no specific part of this invention, it will not be described in detail herein, it being sufficient to note that the conveyor may be driven from the shaft 122 through the universal joint 126, the propellor shaft 127, and the universal joint 128 connected to the drive gear box 129 which is connected through the coupling 130 to drive the conveyor belt 125 in any suitable and well known manner.

The bucket chain line 109 is driven from the power take-off shaft 23 of the tractor. Referring to Fig. 4, the power take-off shaft 23 is provided with a bevel pinion 131 which engages a mating bevel pinion 132 fixed on the shaft 133 journaled in the bearing 134 in the housing 135 attached to the differential housing 24 of the tractor. The other end of the shaft 133 is supported in a pilot bearing 136 in the out-put shaft 137 journaled in suitable bearings 138 in the housing 135. A shiftable clutch spool 139 carried on the splined portion 140 of the shaft 133 may be shifted over the splined portion 141 of the shaft 137 for connecting or disconnecting the drive for starting and stopping the bucket chain line. The clutch spool 139 may be shifted by suitable control lever 142 connected to a shifter rod 143 by a suitable pin 144, a shifter yoke 145 being fixed to the rod 143 and engaging the annular slot 146 to effect the shifting of the clutch spool 139. A suitable spring urged ball detent 147 serves to position the rod 143 and the clutch spool 139 in an engaged or disengaged position.

On the outer end of the shaft 137 is fixed a sprocket 148 which drives a chain 149 operating over a sprocket 150 having a hub portion 151, Fig. 5, journaled on a shaft 152 which in turn is journaled in suitable bearings 153 and 154 about the pivot axis 106 of the supporting frame upright channels 71 and 72. Fixed on the hub 151 is one member 155 of an overload clutch having a second member 156 interengaging the member 155 through serrated teeth 157. The member 156 has a hub member 158 fixed to the shaft 152 upon which is formed a pair of chain sprockets 159 over which operate the chains 160 which operatively connect with the pair of sprockets 161 fixed on the shaft 112.

The members 155 and 156 are normally held with their teeth in engagement by means of a compression spring 162 located around the shaft 152 and confined axially against the face 163 of the sprocket 150 by an adjusting nut 164 and a locked nut 165. Should an obstruction be encountered by the bucket train so as to overload the drive transmission for the bucket chain line, the clutch members 155 and 156 will slip relative to one another compressing the spring 162 as the high points of the serrations 157 ride over one another. As soon as the obstruction has been removed, resumption of the normal drive immediately takes place.

The raising and lowering of the bucket chain line is controlled hydraulically in a unique manner. Referring particularly to Figs. 1 and 6, the usual hydraulic pump 166 of the tractor is connected to be driven from the power take-off shaft 23 and receives a supply of fluid from a suitable fluid reservoir 167 in the bottom of the differential housing 24. Pressure from the pump 166 is delivered through a supply line 168 to a control valve 169 operated by a suitable manual control member 170 conveniently placed for manipulation by the operator. A suitable pressure relief valve 171 is provided in the pressure line 168 to regulate the maximum pressure in this line to prevent damage to the hydraulic circuit. This discharge line 172 from the control valve 169 is connected to the pressure chamber 173 of the cylinder 97 and through a flexible conduit 174 to the pressure chamber 175 of the profile control cylinder 176 which cylinder has its piston rod 178 pivotally connected at its upper end at 177 to the member 103, the cylinder being pivotally connected at 179 to the guide box 101.

When the lever 170 is operated to open the valve 169 fluid pressure is applied simultaneously to both cylinders 97 and 176 so that the member 103 will be held in its uppermost position as shown in Fig. 1 and the stabilizing and lift arms will be raised by the levers 95 allowing the limit chains 107 to sag while the trenching device as a whole is swung upwardly around the pivot axes 85, 88, 104 and 106 to raise the trenching device bodily above normal operating position shown in Fig. 1. In this position the apparatus is in condition to be hauled about on the tractor to the location of the work to be done.

After the tractor has been driven to the desired position to start the digging operation, the operator manipulates the control lever 52 on the auxiliary transmission to shift in the low feeding speed drive as described. He then closes the valve 169 releasing pressure from the cylinders 97 and 176. Release of pressure from the cylinder 97 allows the trenching device as a whole to swing down to operating position where it is held by the limit chains 107. A latch device, Fig. 1, comprising a lever 180 mounted on a rock shaft 181 carried on a suitable bracket 182 fixed to the member 101, has a latch arm 183 adapted to engage various stop notches 184 in the member 103 and is normally held into these notches by suitable tension spring 185 interconnected between the latch member 183 and the member 101. The operator pulls the release cord 186 which allows the member 103 to drop down to any desired depth of ditch.

The position of the member 103 for regulating the profile of the bottom of the ditch being out, may be readily controlled by manipulating the control valve 169 and the latch cord 186 without causing operation of the cylinder 197. The arrangement of the pivotal mounting 85, 88, 106 and 104 is such that a much greater pressure is required in the cylinder 97 to operate the lifting action that is required to move the member 103 relative to the member 101 by the cylinder 176. Thus after the completion of the digging operation, this arrangement provides means for automatically sequentially lifting first the member 103 to the top of its stroke as shown in Fig. 1 when the valve 169 is opened, and then upon continued application of fluid pressure after the conclusion of the movement of the piston rod 178 to the top of its stroke, pressure further builds up to cause the cylinder 97 to then operate to bodily raise the entire ditching apparatus to position to be transported to another job.

Having thus fully set forth and described this invention, what is claimed is:

1. In a trenching machine having, a frame mounted on a tractor, a bucket chain line, a first support, a bucket chain line frame for supporting said bucket chain line carried on said first support, means pivotally connecting said first support to said frame to allow bodily movement of said bucket chain line frame to an operating position or to a retracted position on said frame on said tractor, a second support pivotally mounted on said frame on said tractor and pivotally and slidably connected to said bucket chain line frame, a first hydraulic actuating cylinder on said frame on said tractor connected to move said second support, a second hydraulic actuating cylinder

mounted on said second support and connected to said bucket chain line frame for relatively moving said second support and said bucket chain line frame, a source of fluid pressure on said frame on said tractor, a common control valve on said frame on said tractor interconnected between said source of fluid pressure and both of said cylinders, said pivotal and slidable connection of said second support with said bucket chain line frame being so arranged as to allow independent operation of said second mentioned hydraulic actuating cylinder with the simultaneous application of fluid pressure to both of said cylinders upon manipulation of said common control valve.

2. In a trenching machine bucket chain line control apparatus including a tractor having, a frame, an upper support arm pivotally mounted at its forward end on the frame of said tractor, a lower support arm pivotally mounted at its forward end on the frame of said tractor below said upper support arm, a bucket chain line support frame, a pivotal connection between the upper end of said bucket chain line support frame and the outer end of said upper support arm, means for slidingly supporting said bucket chain line frame member at its lower end in a guide member, means for pivotally mounting said guide member on the outer end of said lower support arm, means carried on and interacting between said guide member and said pivotal connection of said chain line support frame on said upper support arm for relatively moving said guide member and said chain line support frame, and stop means connected between said tractor frame and said lower support arm to limit downward pivotal motion of said lower support arm on said tractor frame to a predetermined fixed position.

3. In a trenching machine bucket chain line control apparatus mounted on a tractor having, a tractor frame, an upper support arm pivotally mounted at its forward end on the tractor frame, a lower support arm pivotally mounted at its forward end on the tractor frame below said upper support arm, a bucket chain line support frame, a pivotal connection between the upper end of said bucket chain line support frame and the outer end of said upper support arm, means on the outer end of said lower support arm for slidingly supporting said bucket chain line frame member at its lower end in a guide member, means on the outer end of said lower support arm for pivotally mounting said guide member on the outer end of said lower support arm, means carried on and interacting between said guide member and said pivotal connection of said bucket chain line support frame on said upper support arm for relatively moving said guide member and said bucket chain line support frame, stop means on said tractor frame connected to said lower support arm for limiting downward pivotal motion of said lower support arm on said tractor frame to a predetermined fixed position, and power means on said tractor frame connected to said lower support arm for raising and lowering said lower support arm to and from said predetermined fixed downward position.

4. In a trenching machine apparatus including a tractor having, a tractor frame, a first support arm pivotally mounted at one end on said tractor frame, a second support arm pivotally mounted on said tractor frame below said first mentioned support arm, a bucket chain line supporting frame pivotally mounted on the opposite end of said first support arm, and a support on said second mentioned support arm for slidingly and pivotally supporting said bucket chain line supporting frame on the outer end of said second mentioned support arm, extensible and retractable power means carried on and interconnected between said bucket chain line supporting frame and said slidable and pivotal support for relatively moving the pivotal mounting of said bucket chain line frame on said first support arm relative to said slidable and pivotal support of said bucket chain line support frame on said second mentioned support arm.

5. In a trenching machine apparatus including a tractor having a tractor frame for said tractor, a first support arm pivotally mounted at one end on the said tractor frame, a second support arm pivotally mounted at one end on said tractor frame, a guide member pivotally mounted on the opposite end of said second support arm, a bucket chain line supporting frame member pivotally mounted on the opposite end of said first support arm and slidably mounted in said guide member, power means carried on and interconnected between said bucket chain line supporting frame and said guide member for relatively moving the bucket chain line supporting frame member and said guide member, and means on said bucket chain line supporting member for supporting an endless chain bucket line.

6. In a trenching machine apparatus including a tractor, a frame for said tractor, a first support arm pivotally mounted at one end on the frame of said tractor, a second support arm pivotally mounted at one end on the frame of said tractor, a guide member pivotally mounted on the opposite end of said second support arm, a bucket chain line supporting frame member pivotally mounted on the opposite end of said first support arm and slidably mounted in said guide member, means on said guide member for relatively moving the bucket chain line supporting frame member and said guide member, and means for supporting an endless chain bucket line on said bucket chain line supporting member, and positive latch means on said guide member operable by the driver of said tractor for positively engaging and locating said bucket chain line support member in predetermined positions on said guide member, and means on said tractor frame for positively limiting downward swinging movement of said second support arm on said tractor frame, and power means interconnected between said tractor frame and said second support arm for swinging both of said arms to and from said predetermined limited position of movement.

7. In a trenching machine structure including a tractor having, a tractor frame, an upper support arm pivotally mounted at one end on said tractor frame, a lower support arm pivotally mounted at one end on said tractor frame below said upper support arm, a guide member pivotally mounted on the other end of said lower support arm, a bucket chain line supporting frame pivotally mounted on the outer end of said upper support arm and slidably mounted in said guide member pivotally mounted on said lower support arm, a fluid pressure cylinder carried on said tractor frame and connected to activate said lower support arm in pivotal movement on said tractor frame, a second fluid pressure cylinder carried on and interconnected between said bucket chain line support frame and said guide member, and a common source of fluid pressure on said tractor frame connectable to both of said cylinders through a common single control valve on said tractor frame.

8. In a trenching machine structure including a tractor having, a tractor frame, an upper support arm pivotally mounted at one end on said tractor frame, a lower support arm pivotally mounted at one end on said tractor frame below said upper support arm, a guide member pivotally mounted on the other end of said lower support arm, a bucket chain line supporting frame pivotally mounted on the outer end of said upper support arm and slidably mounted in said guide member pivotally mounted on said lower support arm, a fluid pressure cylinder carried on said tractor frame and connected to actuate said lower support arm in pivotal movement on said tractor frame, a second fluid pressure cylinder carried on and interconnected between said bucket chain line support frame and said guide member, a common source of fluid pressure on said tractor frame connectable to both of said cylinders through a common single control valve on said tractor frame, and stop means on said tractor frame interconnected between said lower support arm and said tractor frame to limit downward

swinging movement of the outer end of said lower support arm to a predetermined position.

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