Aug. 15, 1939. H. A. HUTCHINS ET AL. 2,169,606

BULLDOZER ATTACHMENT FOR TRACTORS

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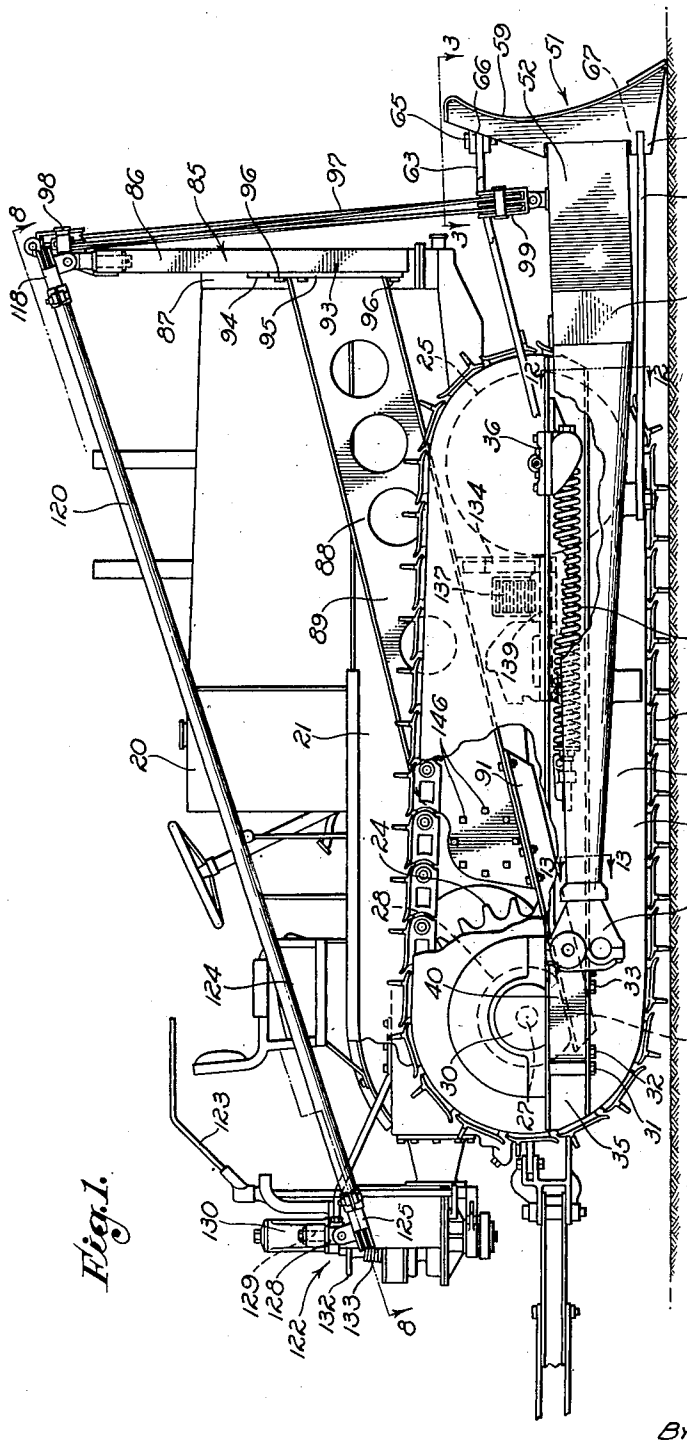


Fig. 1.

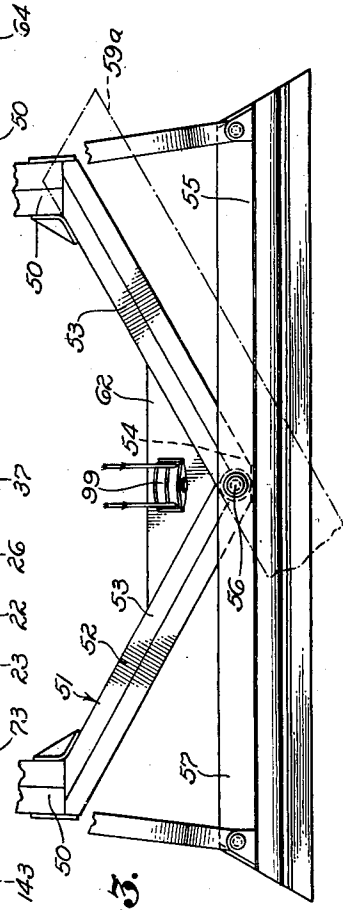


Fig. 3.

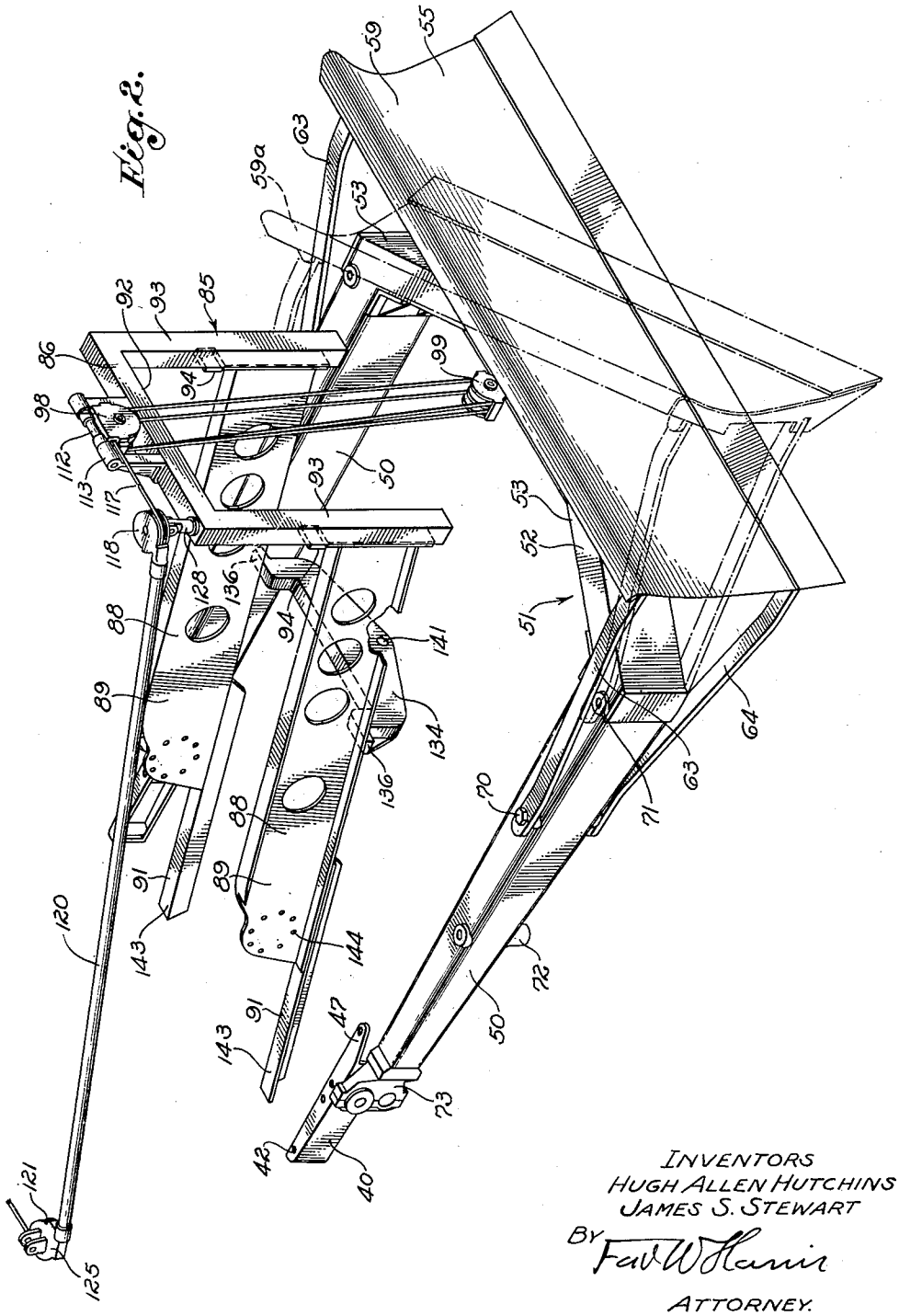
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BULLDOZER ATTACHMENT FOR TRACTORS

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Fig. 2.



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Fig. 4.

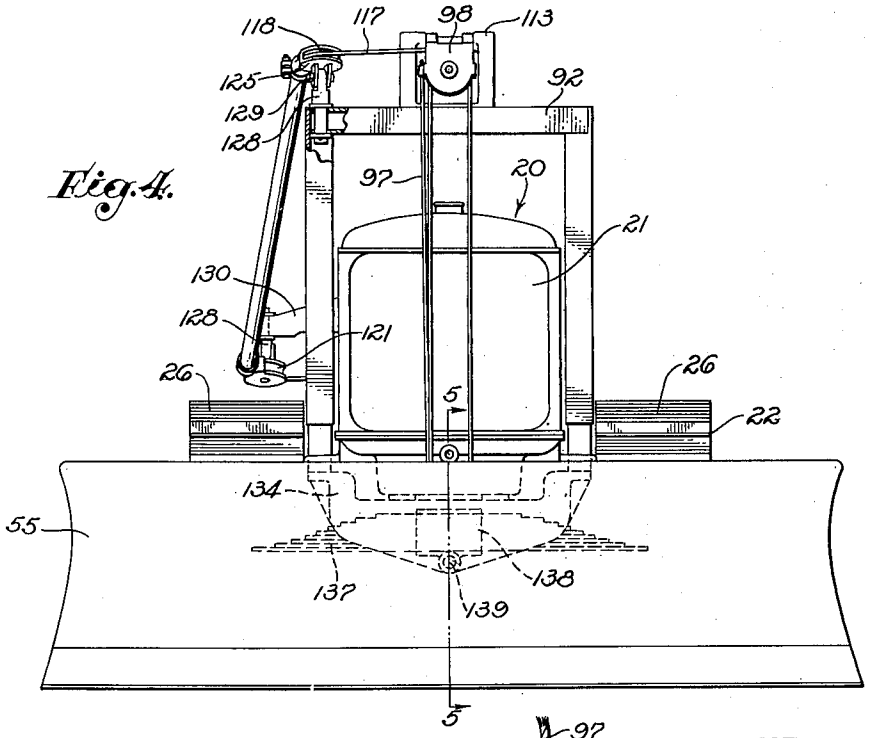


Fig. 5.

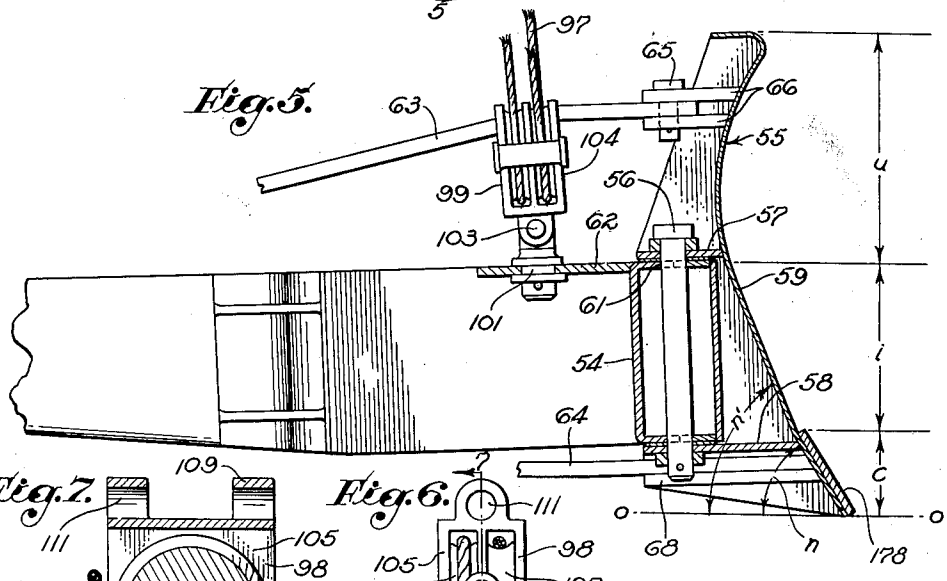


Fig. 7.

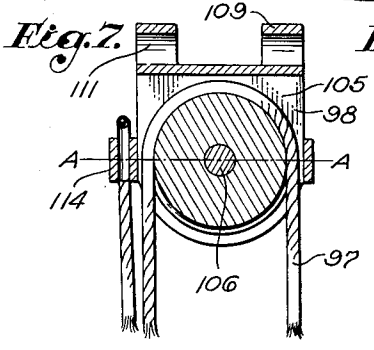
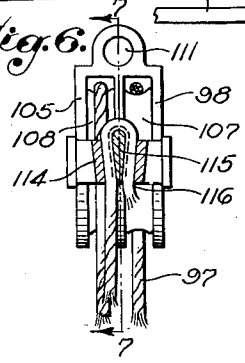


Fig. 6.



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Fig. 9.

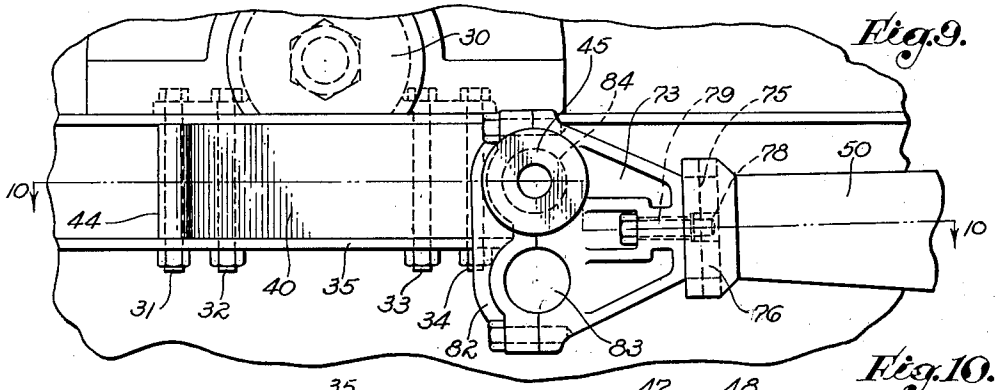


Fig. 10.

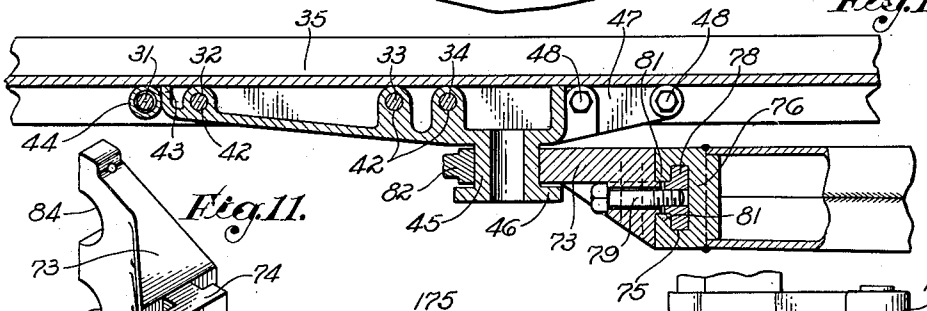


Fig. 11.

Fig. 12.

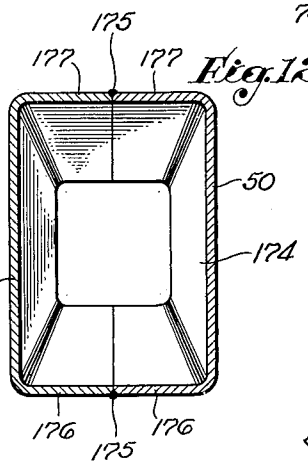
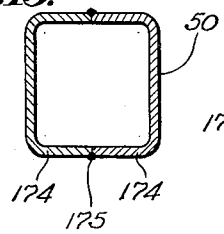


Fig. 13.



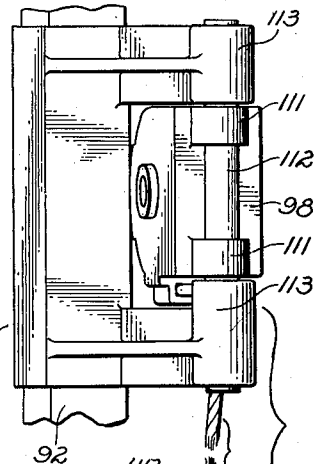
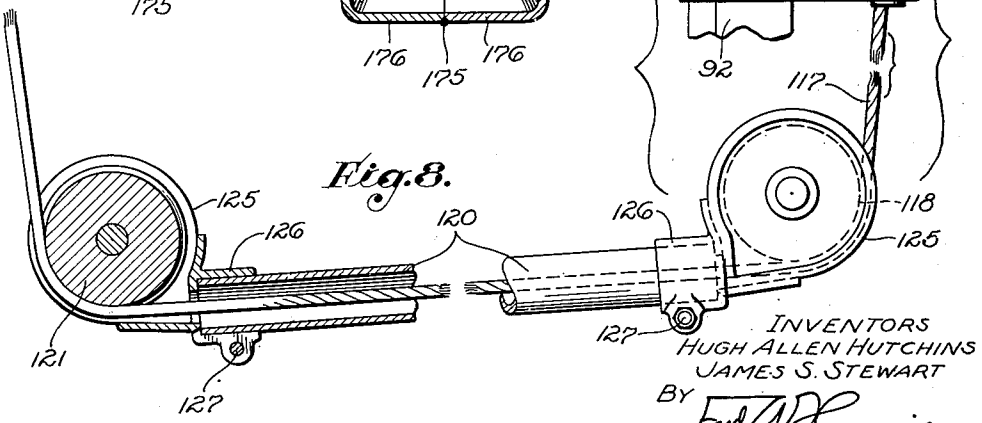


Fig. 8.



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BULLDOZER ATTACHMENT FOR TRACTORS

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Fig. 14.

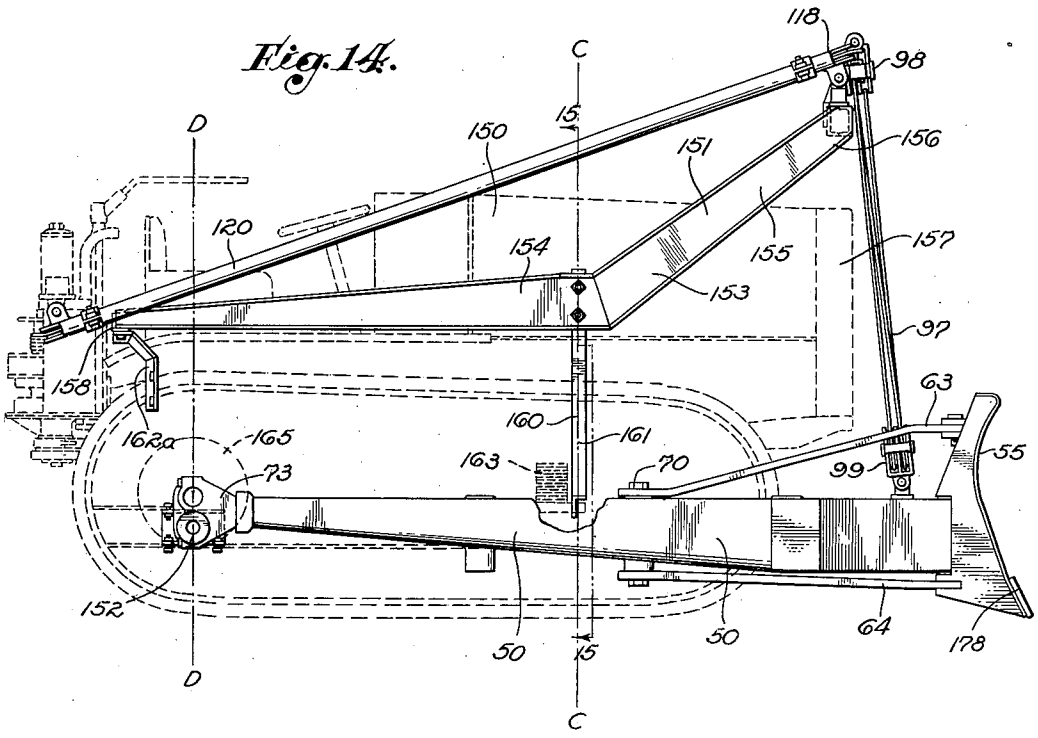
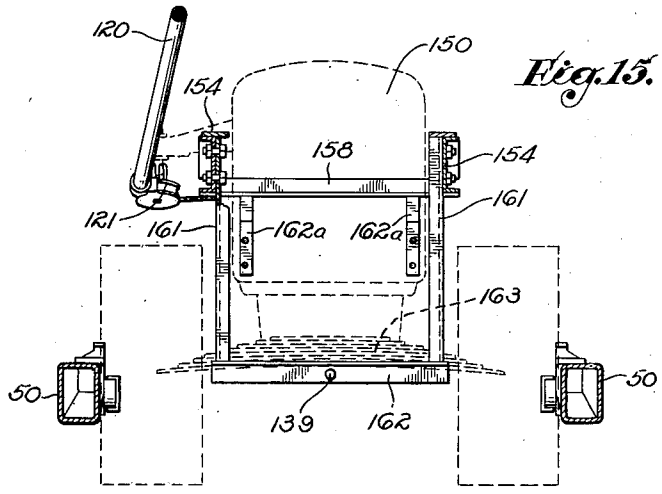


Fig. 15.



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BULLDOZER ATTACHMENT FOR TRACTORS

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Fig. 16.

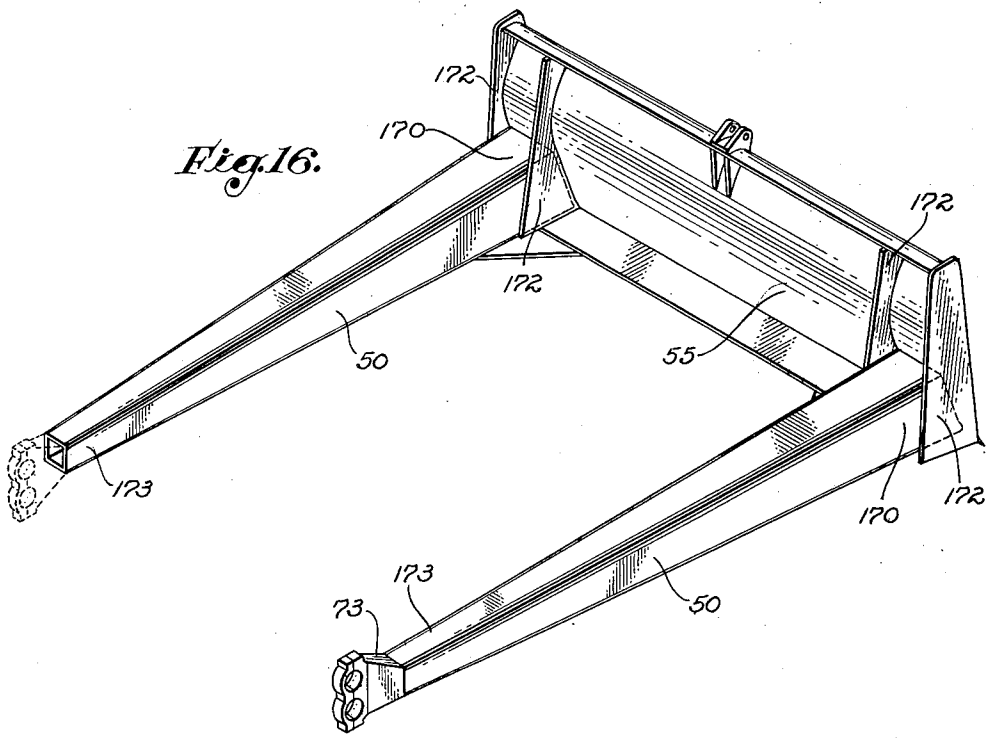


Fig. 17.

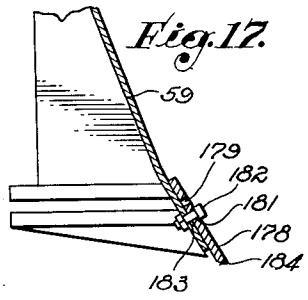


Fig. 18.

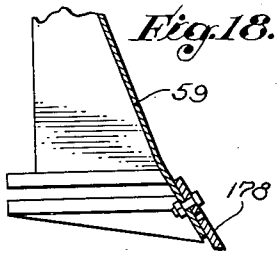


Fig. 19.

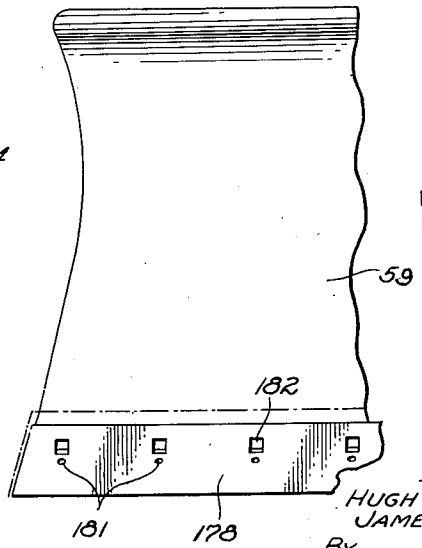
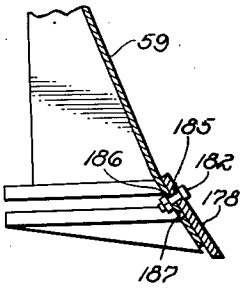


Fig. 20.



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Patented Aug. 15, 1939

2,169,606

UNITED STATES PATENT OFFICE

2,169,606

BULLDOZER ATTACHMENT FOR TRACTORS

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Application February 15, 1936, Serial No. 64,091

20 Claims. (Cl. 37—144)

Our invention relates to ground working attachments for vehicles, and relates in particular to improvements in means for securing such attachments to tractors of the track laying type.

Our invention is best represented in a bulldozer attachment for tractors of this character, and therefore the invention will be explained with particular relation to this type of attachment. These bulldozer attachments have a pusher element and parts for securing the pusher element to the tractor so that it may be raised or lowered, such pusher element ordinarily having a plate at the forward end thereof, called the "moldboard", which is adapted to engage materials lying on the ground, such, for example, as earth, gravel, or rock, so as to push the same ahead of the tractor from one position to another. Such bulldozers may be also used in the same manner as scrapers for the purpose of cutting down the surface of the ground to a desired level, filling trenches, etc.

Tractors, like other vehicles, include a body carrying the engine and the engine transmission and control means therefor, and an undercarriage for supporting the body, such undercarriage having wheels or the linked track which runs over the wheels so as to engage the ground. Considerable difficulty has been found in connecting to these tractors ground working devices which operate on the front ends or heads of the tractors, and it is found that in many instances the attachment of bulldozers so that they will operate in front of the tractors results in strains being placed in the tractor body resulting in breakage of the parts of the body. For example, in one form of tractor the body consists of the engine casting, a cast clutch housing connected to the rear of the engine casting, and a transmission housing connected to the rear end of the clutch housing. In many instances the strains incurred by the attachment of bulldozers have caused either the clutch housing or the forward part of the transmission housing to break. Repairs for such breakages are ordinarily quite expensive.

It is an object of our invention to provide an attachment for ground working devices to operate ahead of a tractor, in which the principal lateral and vertical forces produced by the ground working attachment will be carried directly to the undercarriage of the tractor, thereby avoiding the placing of strains in the tractor body which might result in breakages such as hereinabove discussed.

It is also found in the use of bulldozer attachments on tractors that there is a constant danger of the tractor riding forwardly over the bulldozer attachment and overturning upon the driver of the tractor, this having resulted fatally in a number of instances. It is an object of our invention to provide a bulldozer attachment having a pusher element with thrust arms extending rearwardly along the sides of the tractor and connecting to the extremities of the rear axle of the tractor so that the thrust from the tractor to the bulldozer is applied in such a manner that the tractive action of the tractor treads cannot result in the tractor overturning forwardly over the bulldozer.

Further objects of the invention are: to provide novel attachment members for connecting the rearward ends of the thrust arms to bearing castings disposed at the ends of the rear axle to provide a means of vertical adjustment between the foregoing attachment members and the rearward ends of the thrust arms so that the angle of approach of a ground working tool carried at the forward end of the thrust arms may be varied by swinging the rearward portions of the thrust arms vertically; to provide a simple and effective means for adjustably connecting a moldboard to the forward end of the pusher element; to provide a cable and sheave means for raising and lowering the forward part of the pusher element, and simple means for running the cable from the forward end of the tractor to a cable winch or power take-off disposed at the rearward end of the tractor; to provide a sheave member having a cable anchor to which an end of the cable may be secured, this anchor being placed at the side of the frame of the sheave means so that the forces applied to the sheave means will be substantially balanced; to provide a rigid and durable pusher element having rearwardly extending arms for connection to the undercarriage of the tractor, said arms converging rearwardly so as to serve as cantilever beams; and to provide a moldboard which is so formed that the cutting edge thereof will act with a slicing action instead of a scraping action with the tendency for the moldboard to dig downwardly.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawings, which are for illustrative purposes only,

Fig. 1 is a partly sectioned side view showing a preferred form of bulldozer attachment secured to a tractor.

Fig. 2 is a perspective view of the bulldozer attachment.

Fig. 3 is a fragmentary plan view looking downwardly from the plane 3—3 of Fig. 1.

Fig. 4 is a front view corresponding to Fig. 1.

Fig. 5 is an enlarged fragmentary section on a plane represented by the line 5—5 of Fig. 4.

Fig. 6 is an enlarged side view of the balanced sheave shown in Figs. 1, 2 and 4.

Fig. 7 is a cross section on a plane indicated by the line 7—7 of Fig. 6.

Fig. 8 is an enlarged fragmentary section taken as indicated by the line 8—8 of Fig. 1.

Fig. 9 is an enlarged fragmentary view showing the adjustable means for connecting the thrust arms to the rear axle casting.

Fig. 10 is a section taken as indicated by the line 10—10 of Fig. 9.

Fig. 11 is a perspective view of the adjustable pivot block shown in Figs. 9 and 10.

Fig. 12 is an enlarged cross section taken as indicated by the line 12—12 of Fig. 1.

Fig. 13 is an enlarged cross section taken as indicated by the line 13—13 of Fig. 1.

Fig. 14 is a side view showing an alternative form of bulldozer attachment connected to the tractor.

Fig. 15 is a cross section taken as indicated by the line 15—15 of Fig. 14.

Fig. 16 is a perspective view showing a non-angling type of bulldozer pusher element made in accordance with the principles of our invention.

Fig. 17 is a fragmentary sectional view showing a manner of adjustably securing the cutting blade to the moldboard.

Fig. 18 is a view similar to Fig. 17, showing the cutting blade in lowered position.

Fig. 19 is a face view corresponding to Fig. 18.

Fig. 20 is a fragmentary view similar to Fig. 17, showing an alternative manner of adjustably securing the cutting blade.

In Fig. 1 we show a tractor 20 comprising a tractor body 21 and an undercarriage 22. The undercarriage 22 includes a pair of track frames 23, one on each side of the tractor undercarriage. Each one of these track frames has a sprocket wheel 24 at its rearward end and an idler wheel 25 at its forward end over which the linked tracks or treads 26 of the tractor travel. The sprocket wheels 24 are mounted upon the opposite end portions of rear axles 27 which project laterally from an axle housing 28 under the rearward portion of the tractor body 21. On the outer extremities of the axles 27, axle castings 30 are mounted, each of which castings 30, as shown in Figs. 1 and 9, is connected by means of four bolts 31, 32, 33, and 34 to the rearward end of a spreader link 35 consisting of a structural channel which extends forwardly to the front ends of the track frames 23 where it is slidably engaged by a block or body 36 connected to the axle of the associated idler wheel 25. A heavy spring 37 carried by each member 35 exerts a forward thrust on its associated block 36, tending to move the idler wheel 25 forwardly and thereby hold the track 26 taut. Should the four bolts 31 to 34 inclusive be removed, the reaction of the spring 37 against the channel 35 will cause the same to move rearwardly, or leftwardly, and to again replace the bolts 31 to 34 inclusive would require the use of a jack sufficiently heavy to compress the spring 37 so as to permit the movement of the member 35 forwardly.

In the practice of our invention we provide a pair of supporting pivot members 40, one on each side of the tractor, adapted to be connected to the rear axle bearing castings 30 by use of bolts. It is a feature of the construction of the supporting pivot members that they shall be connected to the castings 30 by use of a part of the group of bolts 31 to 34 inclusive. For example, the supporting pivot members may be made of such length that they may be engaged by three bolts 32, 33, and 34 without necessity for removing the bolt 31. Each member 40 is of such width or vertical dimension that it will fit into the space between the upper and lower flanges of the channel 35, and has three openings 42 extending vertically therein in such position that the bolts 32, 33, and 34 may be passed therethrough. The rearward or leftward end of each member 40 is provided with a wall 43 which will rest against a spacing sleeve 44 surrounding the intermediate portion of the first bolt 31, as shown in Fig. 10. Each member 40 is attached to the casting 30 by use of bolts 32, 33 and 34 forming a part of the original tractor structure, without entirely disconnecting the casting 30 from its associated spreader member 35. Therefore, the compression on the spring 37 is not released, owing to the fact that the bolt 31 remains in place at all times. The bolts 32, 33, and 34 are ordinarily equipped with spacing sleeves, such as the sleeve 44, but these sleeves are moved when the members 40 are secured in place as shown.

As clearly shown in Figs. 9 and 10, each supporting pivot member has an outwardly projecting trunnion 45 which preferably has an integrally formed flange 46 at its outer extremity.

The pivot members 40 may be provided with additional securing means consisting of forwardly extending tongues 47 through which cap screws 48 are passed into engagement with the flanges of the members 35. The members 40 serve as supports for the rearward ends of thrust arms 50, which, as best shown in Fig. 2, form a part of a pusher element 51 which is of U-shaped form and has a front member 52 adapted to extend across the front of the tractor.

As shown in Fig. 3, this front member 52 consists of a pair of cooperating members 53 disposed in angular relation so as to form a nose or horn 54 to which a ground engaging element 55 may be secured so as to swing on a vertical axis defined by a pivot pin 56. This pivot pin 56, as shown in Fig. 5, extends through plates 57 and 58 which project rearwardly from the front plate 59 of the ground engaging member 55, such front plate 59 constituting the moldboard of the bulldozer which has the function of shoving materials ahead of the tractor when the pusher element is in lowered position as shown in Figs. 1 and 4. The pin 56 likewise extends vertically through the nose or horn 54, as clearly shown in Fig. 5, and to compensate for the removal of metals in forming the holes 61 through which the pin 56 passes, the front member 52 is reinforced by means of a gusset plate 62. The moldboard 59 may be held in a position extending laterally at an angle of 90° relative to the line of forward movement of travel, in which position it is shown in Figs. 1 and 2, or the moldboard 59 may be swung into an angled position such as indicated by dotted lines 59a in Figs. 2 and 3. When in the position indicated by the dotted lines 59a, the moldboard will shove materials to the left of the forward line of travel of the tractor and bulldozer. Should it be desired to shove materials to the right of this line of travel, the moldboard 59 may be angled rightwardly. Secured to the moldboard 59 near the

ends thereof are pairs of links 63 and 64, the links 63 being connected at their forward ends to pivot pins 65 supported in brackets 66 near the upper edge of the moldboard 59, and the links 64 having their forward ends pivotally secured to pins 67 carried by brackets 68 near the lower edge of the moldboard 59. As clearly shown in Fig. 2, the rearward ends of each pair of links 63 and 64 engage a bolt 70 adapted to pass vertically through a thrust arm 50. The links 63 and 64 occupy positions above and below the thrust arms 50, and when the moldboard 59 is in laterally extended position the bolts 70 will be in the position indicated in full lines in Fig. 2. In each of the thrust arms 50 forward and rearward bolt-receiving tubes 71 and 72 are placed. When it is desired to angle the moldboard 59, the bolts 70, of which there is one on each side of the pusher element, will be moved forwardly to the tube 71 or rearwardly so as to be extended through the tube 72, depending upon whether the moldboard 59 is to be angled to the right or to the left. It will be noted that the links 63 and 64 are at all times connected to the ends of the moldboard 59, and accordingly at all times transmit the thrust from the ends of the moldboard 59 rearwardly through the bolts 70 to the thrust members 50. Likewise, these links 63 and 64, being disposed above and below the thrust arms 50, do not increase the overall width of the pusher element 51.

In our invention we provide a means for changing the angle of approach or the cutting angle of the moldboard 59 by raising or lowering the rearward or leftward ends of the thrust arms 50. This is accomplished by the use of pivot blocks 73 which are adjustably connected to the rearward ends of the arms 50 and are likewise adapted to adjustably engage the trunnions 45 of the supporting pivot members 40. As shown in Figs. 9, 10, and 11, the pivot blocks 73 are provided at their forward ends with tongues 74 adapted to pass into vertical grooves 75 in companion blocks 76 which are secured by welding to the rearward ends of the thrust arms 50. Each tongue 74 has a laterally positioned gap 77 intermediate its ends in which a clamping block 78 is placed, this clamping block being engaged by a screw 79 by which it may be caused to clamp against flanges 81 along the edges of a groove 75 so as to prevent relative vertical movement of the members 73 and 76. The members 76 may be adjusted vertically through short distances relative to the pivot block 73. Each pivot block 73 is provided with a removable cap 82, and between each block 73 and its cap 82 laterally directed, but vertically spaced, openings 83 and 84 are provided for selective engagement with a trunnion 45. Accordingly the pivot blocks 73 may be raised or lowered through major distances represented by the openings 83 and 84 so that the rearward ends of the thrust arms 50 may be correspondingly moved through these major distances, intermediate adjustments being accomplished by movement of the companion blocks 76 relative to the pivot blocks 73.

As part of an actuating means for the pusher element 51 we provide a superstructure 85 which includes a front member in the form of an A-frame 86 which is held in vertical position substantially in alignment with the radiator 87 of the tractor by means of side beams 88 consisting preferably of structural channels 89 with angle iron extensions 91 projecting rearwardly therefrom. The A-frame 86 consists of a top member 92 which extends horizontally above the radiator 87 of the tractor 20 and a pair of downwardly projecting leg members 93 which are preferably made of hollow tubes of square cross section and are provided with abutments 94 intermediate the ends thereof. The side beams 88 slope rearwardly and downwardly, as clearly shown in Fig. 1, and have flange forming plates 95 welded to the forward ends thereof. The upper ends of the flanges 95 rest against the abutments 94 when the flanges 95 are bolted against the leg members 93 by means of bolts 96. The operating or actuating element of the elevator means shown in Figs. 1 and 2 consists of a cable 97 which is run over upper and lower sheave or pulley devices 98 and 99. As shown in Fig. 5, the lower sheave device 99 is secured to the plate 62 at the forward end of the pusher element 51 so as to have the capacity for universal alignment, this being accomplished by use of a post 101 mounted in the plate 62 so that it may rotate on an upright axis, and a hinge 103 connecting the upper end of the post 101 with the frame 104 of the lower sheave device 99. As best shown in Figs. 2, 4, 6, 7, and 8, the upper sheave device 98 includes a frame 105 carrying an axle 106 on which sheaves 107 and 108 are turnable. This frame 105 has lugs 109 on the upper portion thereof with laterally extending openings 111 therethrough to receive a pin 112 which is mounted above the center of the cross member 92 of the A-fame 86 by means of upwardly extending brackets 113. As shown, the sheave devices 98 and 99, each have two sheaves, so that the cable 97 forms four lines between these sheave members 98 and 99. As shown in Figs. 6 and 7, the upper sheave device 98 has a cable anchor 114 disposed at the side thereof in a horizontal plane A—A extending through the axle 106 and in a vertical plane such as represented by the line 7—7 of Fig. 6 which extends through the pin openings 111. The cable anchor 114 includes a wedge block 115 around which the end 116 of the cable is carried. The anchoring of the end 116 of the cable at one side of the frame 105 in the manner shown, balances the forces which the cable applies to the sheave device 98 in view of the fact that two lines of the cable 97 are disposed on each side of the frame 105.

From the sheave 107 of the upper sheave device 98, the cable 97 is run leftwardly along or above the cross member 92, as indicated at 117, to a guide sheave 118 mounted on the left-hand upper corner of the A-frame 86. From the sheave 118 the cable then runs rearwardly through a pipe 120 to a sheave 121 disposed at the rearward end of the tractor in a position to one side of a power take-off 122 having levers 123 enabling its control by the operator of the tractor occupying the seat 124 shown in Fig. 1. The pipe 120 is disposed along one side of the tractor and slopes downwardly and rearwardly as clearly shown in Fig. 1. This pipe 120 serves not only as a guide for the cable 97 but also holds the sheaves 118 and 121 in operative alignment. Each of the sheaves 118 and 121 includes a supporting frame 125 adapted to be adjustably mounted in position. Each of the frames 125 has a tubular split socket 126 adapted to receive an end of the pipe 120, as shown in Fig. 8, and clamping bolts 127 are provided for locking the split socket 126 on the ends of the pipe 120 so as to firmly attach the frames 125 to the ends of the pipe 120, whereupon the pipe 120 will then serve as a means for determining the positions

of the sheaves 118 and 121. The adjustable or universal supporting means for each sheave frame 125 includes, as shown in Fig. 4, a post 128 and hinge means 129 for connecting such post 128 to the frame 125. As shown in Fig. 4, the post 128 associated with the forward frame 125 is rotatably mounted at the leftward end of the A-frame cross member 92. As shown in Fig. 1, the post 128 associated with the rearward frame 125 is rotatably mounted at 129 in the end of a supporting arm 130 which projects leftwardly from the power take-off 122. The power take-off 122 has a cable drum 132 on which the cable 97 is wound as indicated at 133. In accordance with the right-hand and left-hand rotation of the cable drum 132, the cable 97 may be spooled or unspooled, with the result of raising or lowering the forward end of the pusher element 51 relative to the ground.

Although the side beams 88 of the superstructure 85 extend along the sides of the tractor body 21, the loads or forces transmitted from the superstructure 85 are carried directly to the undercarriage of the tractor in such a manner that these loads or forces, although they might be quite large, will not result in breaking any part of the tractor, especially the interconnecting castings of the tractor body. As shown in Fig. 2, and also in Figs. 1 and 4, we provide a yoke 134 having the ends 136 thereof resting against and secured to the lower faces of the I-beams 89 in a plane intermediate the ends of the I-beams 89. This yoke 134 is of such form that it will extend under the engine of the tractor and has means for engaging the part of the tractor undercarriage which extends under and supports the forward part of the tractor. In the form of tractor shown in the illustrations, this lateral supporting member of the undercarriage consists of a heavy leaf spring 137, the central portion of which is received in a box-like spring clamp 138 having a pin 139 extending horizontally through the lower part thereof. It is through this pin 139 that the load at the front end of the tractor is transmitted to the spring 137. The spring 137, being pivotally mounted as described, is enabled to operate as an equalizer, since this spring may swing on a longitudinal axis in accordance with the raising or lowering of the track frames 23 disposed on opposite sides of the tractor undercarriage 22. The lower part of the yoke 134 has a longitudinal and horizontal opening 141 adapted to receive or engage one end of the pin 139, for example, the forward end thereof, as shown. In order to place the yoke 134 in engagement with the forward end of the pin 139, as described, it is generally necessary to remove a cast bracket which connects the forward end of the pin 139 to the under part of the engine casting of the tractor; but, since the yoke 134 is made of steel instead of cast iron, its use in replacing the aforementioned casting adds to the strength of the supporting structure and at the same time provides a means whereby vertical and lateral loads from the side beams 88 of the superstructure 85 may be transmitted directly to the tractor undercarriage. The rearward ends 143 of the angles 91 extend under the opposite sides of the axle housing 28, as shown in dotted lines in Fig. 1, so that when a downward force is applied to the front end of the superstructure 85 with the result that the beams 88 tend to fulcrum in clockwise direction around the yoke 134, the upward thrust of the rearward ends of the side beams 88, namely, the ends 143 of the angles 91, will be applied directly to the axle housing 28 constituting a rearward part of the tractor undercarriage. In order to further tie the side beams 88 to the tractor structure in such a manner that these side beams will be held in proper alignment, we provide at the rearward ends of the channels 89, openings 144, as shown in Fig. 2, through which studs or screws 146, Fig. 1, existing as part of the tractor structure for the holding in place of cover plates, extend. Preferably the holes 144 are materially larger in diameter than the studs 146 so that vertical forces will not be transmitted from the rearward ends of the I-beams 89 to the studs.

In Figs. 14 and 15 we show in dotted lines a tractor 150 having a bulldozer attachment secured thereto which is essentially the same as the bulldozer attachment previously described with the exception that an alternative form of superstructure 151 is employed, and the trunnions or pivots 152 for supporting the rearward ends of the thrust arms 50 are in vertical alignment with the sprocket wheels at the rearward end of the tractor 150. The alternative form of superstructure 151 includes side beams 153 each of which consists of a horizontal rearward portion 154 and an upwardly sloping forward portion 155 disposed at such an angle that the forward ends 156 thereof will stop in a plane above the front end of the tractor body 157. In this alternative form, the superstructure 151 includes a yoke 160 having vertical side members 161 which lead upwardly from a horizontal member 162 adapted to engage the previously mentioned pin 139, so that forces will be transmitted through the yoke 161 and the pin 139 directly to the spring member 163 of the tractor 150. The rearward ends of the members 154 connect to a laterally extending channel 158 which is in turn connected to the rearward part of the tractor by means of brackets 162*a*. The superstructure 151 has two means of connection with the tractor on which it is mounted. One of these means consists of the yoke 160 which is placed so as to transmit forces to the tractor in a vertical and lateral plane C—C which coincides with the forward tractor body supporting means, or spring 163, of the tractor undercarriage. The rearward or second connecting means consists of the brackets 162*a* which lie close to a plane D—D extending vertically and laterally through the rearward body supporting portion of the tractor undercarriage, or, namely, the rear axle housing indicated by dotted lines 165. Otherwise, the parts of the bulldozer attachment shown in Figs. 14 and 15 are the same as those shown in Fig. 1 and have been described.

In the preceding part of the specification we have described the form of our invention in which the moldboard or ground engaging element is secured in such a manner that it may be adjusted into angular relation. In some forms of the invention the bulldozer is made of non-angling type, and, as shown in Fig. 16, the thrust arms 50 are connected rigidly to the moldboard 55. In this manner of securing the thrust arms 50, the forward ends 170 thereof may extend between vertical side plates 172 which vertically reinforce the moldboard 55. Regardless of whether the moldboard is rigidly or adjustably secured to the arms 50, such arms have the same characteristic form; that is, they are each formed from tubes of rectangular cross section which converge in both vertical and lateral dimension

from the forward ends 170 thereof to the rearward ends 173.

In Figs. 12 and 13, this rearward tapering of the arms 50 is clearly shown, and likewise Figs. 12 and 13 show the simple manner in which the tubes employed in the making of the arms 50 are produced from a pair of channels 174 with welds 175 connecting their flanges 176 and 177 in abutting relation.

The moldboard 59 with which we have equipped the bulldozer has three longitudinal portions as follows: The lower or cutting edge portion indicated by *c* in Fig. 5, the intermediate or pushing portion indicated by *i*, and the upper or earth rolling portion indicated by *u*. It will be perceived that the cutting edge portion *c* is disposed at an angle *n* relative to a horizontal plane indicated by a line *o—o*, this angle *n* being sufficiently sharp to cause the cutting edge portion to enter the ground with a cutting action rather than with a mere scraping action. The intermediate portion *i*, however, continues upwardly from the upper edge of the cutting portion *c* at an angle which approaches nearer to vertical, the reason for this being that were the angle *n* of the cutting portion *c* used in the intermediate portion *i*, the downward reaction of the material being pushed would force the moldboard downwardly, causing it to dig into the ground; whereas, where the placing of the cutting and intermediate portion *c* and *i* is maintained substantially as shown in Fig. 5, the bulldozer will cut in forward direction without digging in. As the material, such, for example, as earth, builds up in front of the moldboard 59, it is engaged by the upper section *u* which curves forwardly from the upper edge of the intermediate section *i* so as to pass through a vertical plane and then curve forwardly of this vertical plane.

We have found that the best results in the moving of materials are obtained where the cutting angle *n* is approximately 60° and the angle of the intermediate section, indicated by *n'*, is approximately 70°. This difference of slope of approximately 10° between the portions *c* and *i* gives a satisfactory cutting action of the moldboard without its being caused to dig in; whereas, the maintaining of the lower or cutting portion *c* as a continuation of the intermediate portion *i* does not give the proper cutting effect, but more the scraping effect, and the continuing of the intermediate portion *i* upwardly at the same angle as the lower or cutting portion *c*, namely, approximately 60°, gives a good cutting action but causes the moldboard to dig into the ground. We have found that satisfactory results may be had where the cutting angle *n* is maintained between the limits of 55° and 65° and the angle *n'* is maintained within the limits of 67° to 74°. It is found that where the intermediate portion *i* is brought too close to vertical, the desired rolling action of the materials being pushed is not attained, but the entire mass is shoved forwardly bodily.

The knife blade 178, which is mounted on the lower portion of the moldboard 59 and forms a part of the cutting portion *c*, is of adjustable character; that is, when the lower cutting edge thereof has worn, the blade 178 may be moved downwardly into a new position as best shown in Figs. 17 to 19 inclusive. As shown in Fig. 17, the blade 178 has two rows of holes 179 and 181 therein. Bolts 182 are passed through the lower row of holes 181 to initially secure the blade 178 in place, these bolts passing through holes 183 formed in the moldboard 59 near the lower edge thereof. After a portion of the cutting edge 184 of the blade 178 has been worn away, the bolts 182 may be removed from the positions in which they are shown in Fig. 17 and then replaced as shown in Fig. 18 through the upper row of holes 179 and the holes 183, thereby holding the blade 178 in a lowered position relative to the lower edge of the moldboard 59. In this way a double length of life of a single cutting blade 178 is obtained. As shown in Fig. 20, the cutting blade 178 may be provided with a single row of holes 185, and two rows of holes 186 and 187 may be provided near the lower edge of the moldboard 59. In readjusting the blade 178 downwardly when the construction of Fig. 20 is employed, the bolts 182 are moved downwardly from the row of holes 186 to the row of holes 187.

Although we have herein shown and described our invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

We claim as our invention:

1. In a bulldozer attachment for use with a tractor having a body and an undercarriage, the combination of: a pusher element of U-shaped form comprising a front member extending across the front of the tractor, a pair of thrust arms extending rearwardly from said front member along opposite sides of said tractor, and pivot means at the rear ends of said arms connecting said rear ends of said arms to the undercarriage of said tractor; and an elevator element for producing vertical movement of said pusher element, comprising a front post member to project upwardly at the front end of said tractor body, supporting means for said post member, said supporting means carrying said post on the forward end thereof and extending rearwardly along the sides of said tractor body, there being a cross-member tying said supporting means together in a rigid structure, means for transmitting vertical and lateral forces directly from said supporting means to said undercarriage of said tractor, and lifting means connecting said post member to the forward portion of said pusher element and being operative to raise and lower the front end of said pusher element relative to the ground.

2. A ground working attachment for use with a tractor having a body and an undercarriage supporting said body, including: a ground working element comprising a front member extending across the front end of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, and pivot means at the rear ends of said arms connecting the same to the rearward portion of said undercarriage; and an elevator element for producing vertical movement of said ground working element, comprising a rigid superstructure having a pair of side beams extending rearwardly on opposite sides of said tractor body, means positioned between the ends of said beams for transmitting vertical and lateral forces directly from said side beams to said undercarriage of said tractor, and lifting means connecting said superstructure to the forward part of said ground working element and being

operative to raise and lower the same relative to the ground.

3. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, and pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

4. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage, and adjustable means connecting the rearward ends of said arms to said pivot means whereby said rearward ends of said arms may be raised and lowered so as to change the angle of said arms relative to the horizontal; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

5. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, each of said thrust arms consisting of a tubular member enlarging both vertically and laterally in cross section from its rearward end to its forward end and having its forward end rigidly secured to said front member, and pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

6. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, each of said thrust arms consisting of a tubular member enlarging both vertically and laterally in cross section from its rearward end to its forward end and having its forward end rigidly secured to said front member, pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage, and adjustable means connecting the rearward ends of said arms to said pivot means whereby said rearward ends of said arms may be raised and lowered so as to change the angle of said arms relative to the horizontal; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

7. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, and a cable winch at the rearward end of said tractor, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, and pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage; an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said under-carriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device; a longitudinally extending cable tube placed so as to extend from the rearward end of said tractor to the forward end thereof; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; and a sheave at the forward end of said tube for directing said cable from said forward end of

said tube to said actuating means of said operating device.

8. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, and a cable winch at the rearward end of said tractor, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, each of said thrust arms consisting of a tubular member enlarging both vertically and laterally in cross section from its rearward end to its forward end and having its forward end rigidly secured to said front member, pivot means at the rearward ends of said arms connecting the same to the rearward portion of said undercarriage, and adjustable means connecting the rearward ends of said arms to said pivot means whereby said rearward ends of said arms may be raised and lowered so as to change the angle of said arms relative to the horizontal; an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device; a longitudinally extending cable tube placed so as to extend from the rearward end of said tractor to the forward end thereof; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; and a sheave at the forward end of said tube for directing said cable from said forward end of said tube to said actuating means of said operating device.

9. In a ground working attachment for use with a tractor having a body and an undercarriage, and a cable winch at the rearward end of said tractor, the combination of: a ground working device disposed at the forward end of said tractor; means for connecting said ground working device to said tractor; a supporting structure having means for mounting it on said tractor; an adjusting means connecting the forward end of said supporting structure and said ground working device; a cable tube extending from the rear of said tractor to the front thereof; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; and a sheave at the forward end of said tube for directing said cable from the forward end of said tube to said adjusting means.

10. In a bulldozer attachment for use with a tractor having a body and an undercarriage including a track frame having longitudinal spreader links on the opposite sides thereof, a rear axle casting, and a plurality of bolt members connecting the rearward ends of said links to said axle casting, the combination of: a pusher element of U-shaped form comprising a front member extending across the front of the tractor, a pair of thrust arms extending rearwardly from said front member along opposite sides of said tractor, and pivot means at the rear ends of said arms connecting said rear ends of said arms to the undercarriage of said tractor, said pivot means each comprising a pivot block having bolt openings to receive a part of said bolt members of said rear axle casting and adapted to be mounted in place on one of said spreader links without the removal of all of said bolt members; and an elevator element for producing vertical movement of said pusher element, comprising a front post member to project upwardly at the front end of said tractor body, supporting means for said post member extending rearwardly along the sides of said tractor body, means for transmitting vertical and lateral forces directly from said supporting means to said undercarriage of said tractor, and lifting means connecting said post member to the forward portion of said pusher element and being operative to raise and lower the front end of said pusher element relative to the ground.

11. In a bulldozer attachment for use with a tractor having a body and an undercarriage including a track frame having longitudinal spreader links on the opposite sides thereof, a rear axle casting, and a plurality of bolt members connecting the rearward ends of said links to said axle casting, the combination of: a pusher element of U-shaped form comprising a front member extending across the front of the tractor, a pair of thrust arms extending rearwardly from said front member along opposite sides of said tractor, pivot means at the rear end of said arms connecting said rear ends of said arms to the undercarriage of said tractor, said pivot means each comprising a pivot block having bolt openings to receive a part of said bolt members of said rear axle casting and adapted to be mounted in place on one of said spreader links without the removal of all of said bolt members, and means connecting said blocks to the rear ends of said arms so that said rear ends of said arms may be raised and lowered relative to said blocks; and an elevator element for producing vertical movement of said pusher element, comprising a front post member to project upwardly at the front end of said tractor body, supporting means for said post member extending rearwardly along the sides of said tractor body, means for transmitting vertical and lateral forces directly from said supporting means to said undercarriage of said tractor, and lifting means connecting said post member to the forward portion of said pusher element and being operative to raise and lower the front end of said pusher element relative to the ground.

12. In a ground working attachment for use with a tractor having a body and an under carriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, and a drive axle at the rear end thereof, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, and pivot means at the rearward ends of said arms connecting the same to the ends of said drive axle of said undercarriage; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, said beams having means engaging the rearward portions of said undercarriage, a yoke having its ends connected to said beams and having its inter-

mediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

13. In a ground working attachment for use with a tractor having a body and an undercarriage with a lateral member extending across the front portion thereof under the forward part of said body to support the same, and a drive axle at the rear end thereof enclosed by an axle housing, the combination of: a ground working device comprising a front member extending across the front of said tractor, a pair of thrust arms extending rearwardly from said front member and along opposite sides of said tractor, and pivot means at the rearward ends of said arms connecting the same to the ends of said drive axle of said undercarriage; and an operating device for said ground working device comprising a superstructure having a pair of side beams extending from the front of said tractor and along opposite sides of the tractor body, the rearward ends of said beams engaging said axle housing so that forces carried to the rearward ends of said beams will be thereby transmitted directly to said undercarriage, a yoke having its ends connected to said beams and having its intermediate portion extending under said body of said tractor and engaging said lateral member of said undercarriage, and actuating means operatively connecting said superstructure with said ground working device.

14. In a device of the character described for use with a tractor, the combination of: a working element disposed at the forward end of said tractor; a post projecting upwardly at the forward end of said tractor; a cable winch disposed at the rearward end of said tractor; means connecting said winch to the drive mechanism of said tractor; a tubular member sloping upwardly from the rearward end of said tractor to the forward end thereof and having its forward end engaging said post; a cable connected to said winch; and means for guiding said cable through said tubular member and to said working element at the forward end of said tractor.

15. In a ground working attachment for use with a tractor having a body and an undercarriage, and a cable winch on the rearward portion of said tractor, the combination of: a ground working device secured at the forward end of said tractor, said ground working device having a part supported so as to be raised and lowered; a superstructure having means for mounting it on the front portion of said tractor; a cable tube extending forwardly from the rearward portion and along a side of said tractor and having the front thereof connected to said superstructure; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; a sheave at the forward end of said tube over which a cable may run as it leaves the forward end of said tube; and a cable extending from said winch over said first named sheave, through said tube, over said last named sheave, and having the forward end thereof connected to said part of said ground working device which is adapted to be raised and lowered.

16. In a ground working attachment for use with a tractor having a body and an undercarriage, and a cable winch on the rearward portion of said tractor, the combination of: a ground working device connected to the forward end of said tractor, said ground working device having a part supported so as to be raised and lowered; a supporting structure having means for mounting it on the front portion of said tractor; a cable tube extending forwardly from the rearward portion and along a side of said tractor and having the front thereof carried by said supporting structure; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; a sheave at the forward end of said tube over which a cable may run as it leaves the forward end of said tube; brackets for supporting said sheaves, said brackets being connected to the ends of said tube and having means for pivotally mounting them in their respective positions of operation; and a cable extending from said winch over said first named sheave, through said tube, over said last named sheave, and having the forward end thereof connected to said part of said ground working device which is adapted to be raised and lowered.

17. In a ground working attachment for use with a tractor having a body and an undercarriage, and cable winch means on the rearward portion of said tractor, the combination of: a ground working device disposed forwardly on said tractor; means for connecting said ground working device to said tractor so that it may be raised and lowered; a supporting means secured to the forward part of the tractor in elevated relation to said ground working device; a cable tube extending lengthwise of said tractor, the rear end of said tube being disposed adjacent said winch means and the front end thereof terminating at said supporting means; a sheave at the rearward end of said tube for directing a cable from said winch into the rearward end of said tube; a sheave at the forward end of said tube; and a cable extending from said winch, over said first named sheave, through said tube, and over said second named sheave to said ground working device to actuate the latter.

18. In a ground working means for use with a tractor of the character described, the combination of: a ground working device; means for connecting said ground working device to said tractor so that it may be raised and lowered at the front end thereof; cable winch means on the rearward portion of said tractor; a cable tube extending along one side of said tractor, the rear end of said tube being disposed adjacent said winch means and the front end of said tube terminating at a point near the front end of said tractor; a support secured to the tractor and supporting the front end of said tube; a cable extending from said winch means through said cable tube; a sheave disposed at the rear end of said tube for guiding said cable into said tube; and a sheave disposed at the front end of said tube for guiding said cable from said front end of said tube to said ground working device.

19. In a device of the character described for use with a tractor, the combination of: a ground working element mounted at the forward end of said tractor, and being movable from active to inactive relation to the ground; cable winch means mounted at the rearward end of said tractor, said winch means including an arm which extends to the side of the tractor; a cable tube extending forwardly from said arm along one side of the tractor; supporting means mounted at the forward end of the tractor for supporting the forward end of said cable tube; a cable extending from said winch means through said cable tube; a sheave at the rear end of said cable tube for guiding said cable into the rear end of said tube; and a sheave at the front end of said

cable tube for guiding said cable from said tube to said ground working element.

20. In a device of the character described for use with a tractor, the combination of: a working element mounted at the forward end of the tractor; a support mounted on the forward part of the tractor; a cable winch disposed rearwardly on the tractor; an arm extending from the cable winch; a tubular member having its forward end connected to said support and its rearward end pivotally connected to said arm; and a cable extending from said winch through said tube and to said working element at the forward end of said tractor to actuate said element.

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