

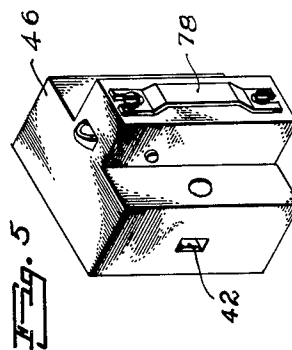
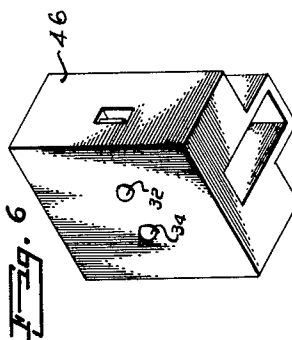
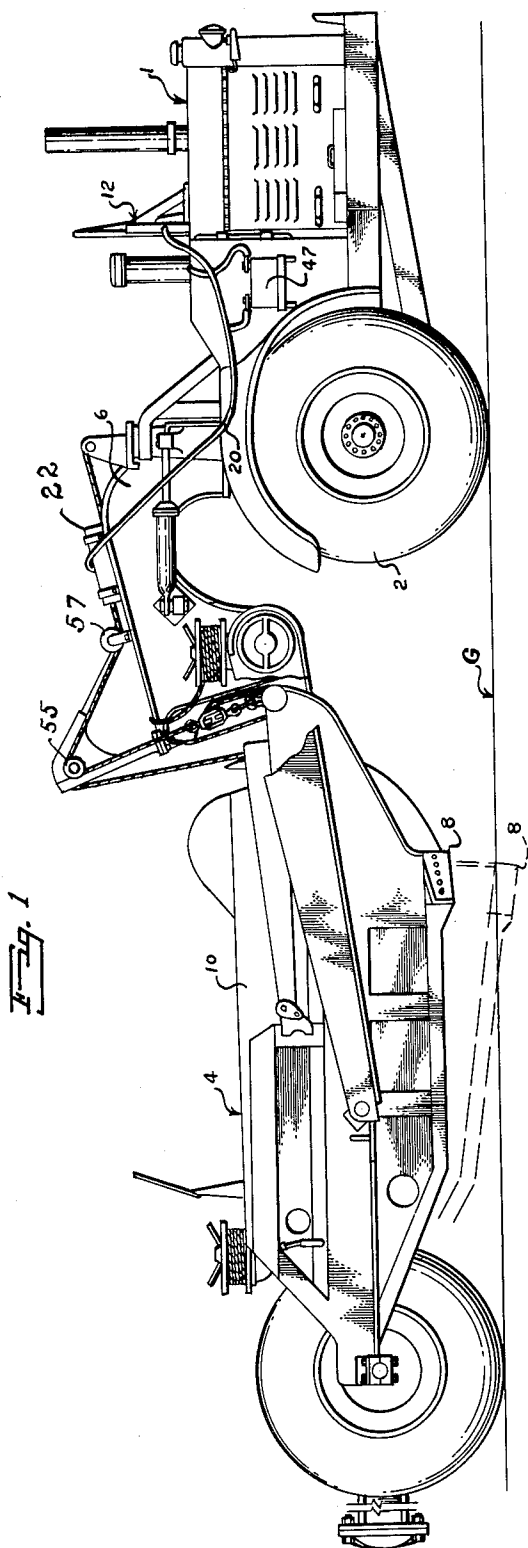
Feb. 8, 1966

W. E. BECTON
DEPTH INDICATING AND DEPTH CONTROLLING DEVICE
FOR EARTH MOVING MACHINES

3,233,349

Filed Dec. 27, 1963

4 Sheets-Sheet 1



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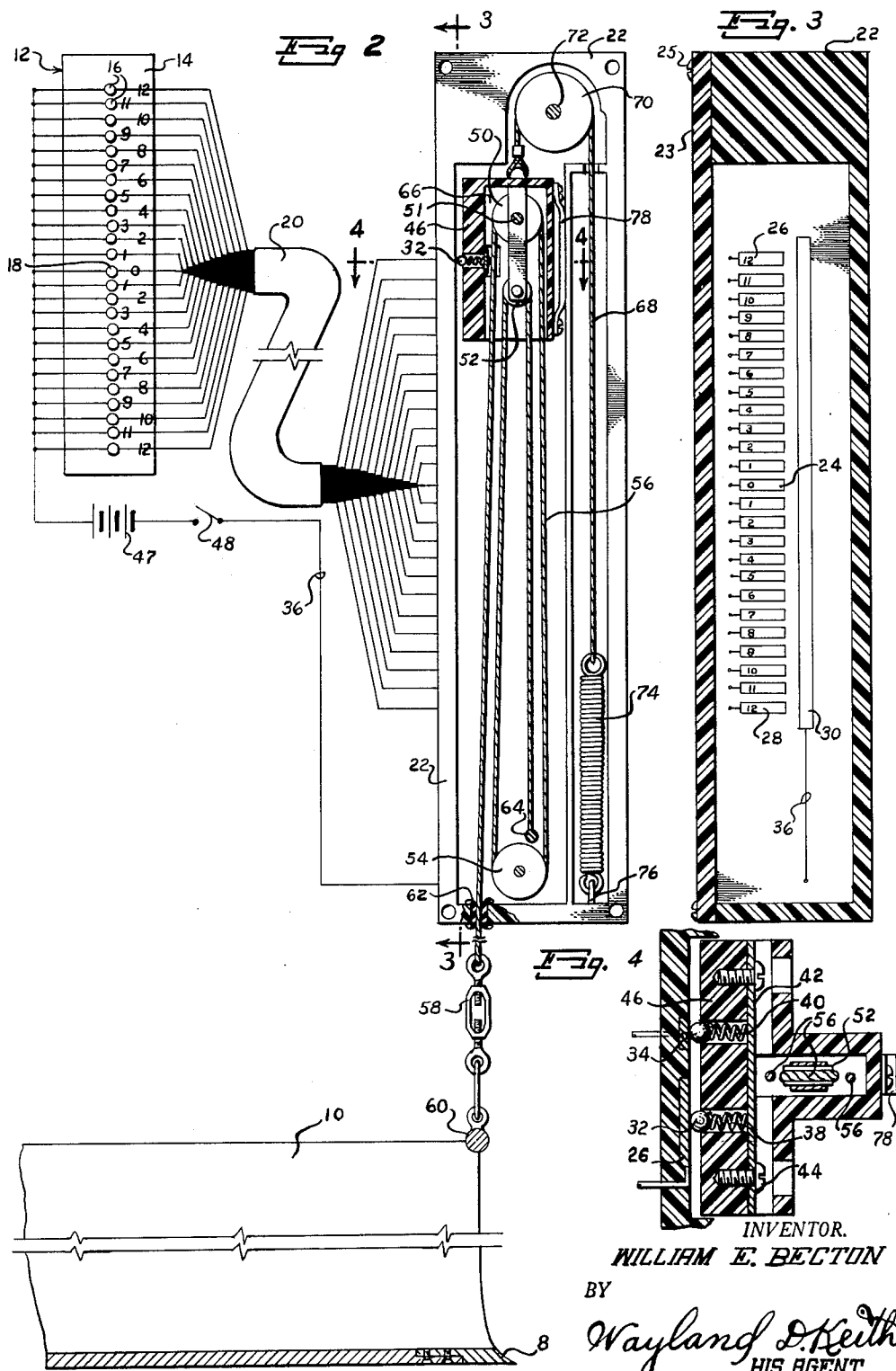
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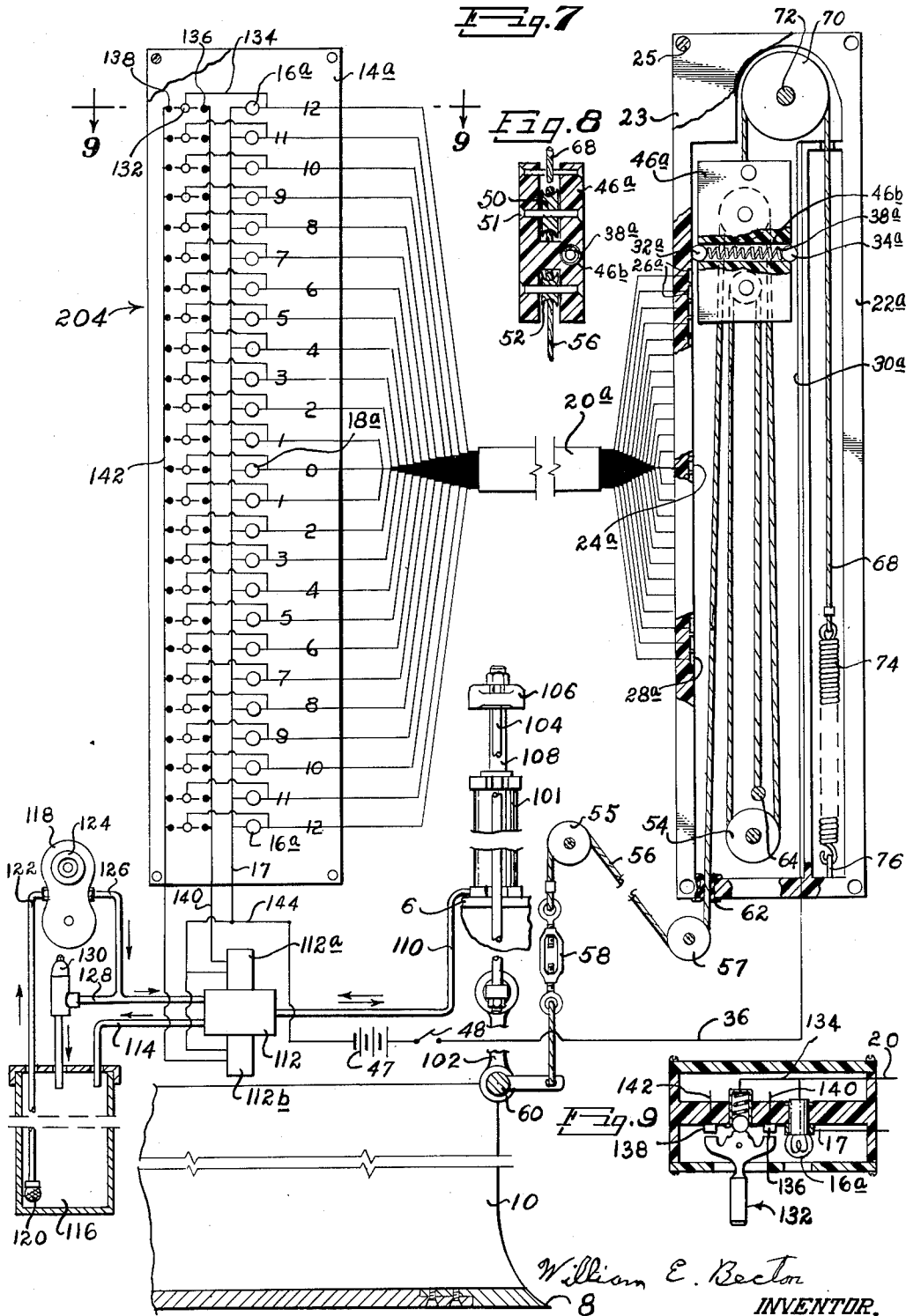
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4 Sheets-Sheet 3



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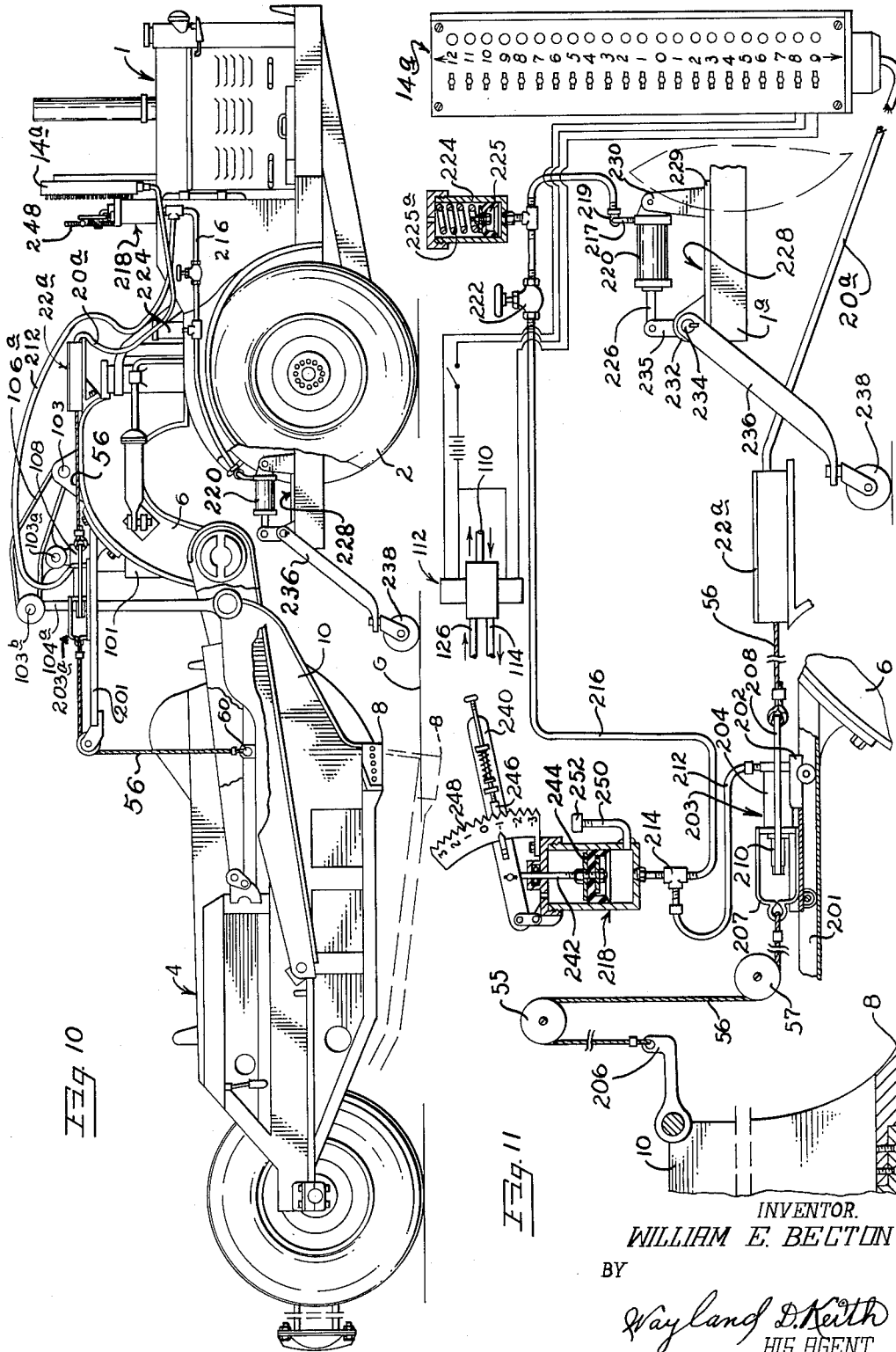
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4 Sheets-Sheet 4



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1

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DEPTH INDICATING AND DEPTH CONTROLLING DEVICE FOR EARTH MOVING MACHINES

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16 Claims. (Cl. 37-124)

This application is a continuation-in-part application of my co-pending prior application Serial No. 145,362, Depth Indicating and Depth Controlling Device for Earth Moving Machines, filed October 16, 1961, which was a continuation-in-part of my prior application Serial No. 759,676, filed September 8, 1958, for Depth Indicating Device for Earth Moving Machines, both abandoned; of which the following is a specification.

This invention relates to depth indicating and depth control device for earth moving equipment, so as to provide means for accurately gauging the depth and for controlling the depth at which the earth moving machine is engaged into the earth relative to the level of the earth on which the wheels of the equipment move.

The present device is so designed and so constructed as to enable the operator of an earth moving machine to face toward the normal line of travel of the machine and still be able to ascertain the exact depth of the ground engaging blade with respect to the level of the terrain over which the wheels of the machine pass. Furthermore, when desired, the device can be set so as to automatically control the depth or the positioning of the cutting edge of the blade of the machine with respect to the terrain over which the machine passes. In this manner, the correct amount of earth can be removed or filled in by the earth moving machine, as will be brought out in the following specification.

The present device enables an operator to expeditiously and accurately control the depth of the blade of the machine, either manually or automatically, at all times while the operator is facing in the direction of travel of the earth moving machine.

The modified form of the device makes provision for manually adjusting the zero level of the cutting edge of the blade, both with respect to the indicator and with respect to the automatic depth control, from the operator's position, and a further provision is made to automatically control the edge of the blade with respect to the surface of the terrain over which the machine operates.

An object of this invention is to provide a depth indicating device for earth moving equipment, the indicator of which device may be observed from a point remote from the ground engaging blade.

Another object of the invention is to provide a depth indicating device which may be used effectively at high speeds of the earth moving machines.

Still another object of the invention is to provide an electric signaling device, whereby the change of the relative position of the cutting edge of the blade of an earth moving machine with respect to the normal ground level, from which the earth is being moved, will be indicated.

A still further object of the invention is to provide a device for gauging the depth at which the cutting blade of an earth moving machine is cutting, which device is compact and easily installed on the earth moving machine without the necessity of materially altering the structure of the machine.

Yet another object of the invention is to provide a device which is encased within a closed housing, so as to exclude dust and other foreign matter therefrom.

Yet a further object of the invention is to provide an indicating and control device for an earth moving machine which will give an accurate indication as to the

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position of the edge of the cutting blade with respect to the terrain traversed by the traction wheels of the prime mover, and which will automatically control the position of the edge of the cutting blade of the machine within predetermined limits.

Still another object of the invention is to provide a hydraulically actuated control system for an earth moving machine which will maintain the blade thereof, within certain limits, with respect to the terrain over which the earth moving machine operates.

Another object of the invention is to provide an electrical system for actuating valves to maintain the cutting edge of the blade within given limits with respect to the terrain traversed by the traction wheels of the prime mover.

Another object of the invention is to provide means for adjusting the position of the cutting edge of the blade with respect to the indicating device to enable a correct reading, on the instrument from the operator's position, of the depth of the blade below the surface of the terrain and the correct distance above the surface of the terrain and simultaneously adjusting, in co-ordinated relation, the automatic control system.

Still another object of the invention is to provide a ground engaging wheel means to actuate a hydraulic mechanism to actuate a control mechanism to automatically adjust the cutting edge of the blade of the earth moving machine relative to the surface of the terrain over which the machine passes.

A further object of the invention is to provide a device of the character set forth herein, which is simple in construction, easy to manufacture, and which is easy to install on or remove from an earth moving machine.

With these objects in mind and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a side elevational view of an earth moving machine attached to a traction element, and showing portions of the earth moving machine as being broken away to show the details of construction of the present device, which is the subject matter of the present application;

FIG. 2 is a diagrammatic view of the wiring arrangement of the present device, showing the actuating mechanism thereof in elevation, with parts being broken away and parts being shown in section to show the details of construction, and showing the ground engaging scraper of the earth moving machine connected thereto, with parts thereof broken away and shortened and shown in section to bring out the details of construction;

FIG. 3 is a sectional view taken on the line 3-3 of FIG. 2, looking in the direction indicated by the arrows, and showing the contact segments of the electrical system;

FIG. 4 is a fragmentary sectional view taken on the line 4-4 of FIG. 2, looking in the direction indicated by the arrows and being on an enlarged scale;

FIG. 5 is a perspective view of the device taken from the top, and showing two sides thereof, and showing a brush holder for the device;

FIG. 6 is a view similar to FIG. 5, but taken from the bottom of the device and showing an opposite side thereof to show the contact brushes;

FIG. 7 is a diagrammatic view of a modified form of invention installed on an earth moving machine which utilizes a hydraulic system for raising the earth engaging scraper, with parts being broken away and other parts being shortened or shown in section to bring out the details of construction;

FIG. 8 is a longitudinal, medial sectional view through

the movable block, taken on a plane passing through the axes of the pulleys mounted in the block; and

FIG. 9 is a sectional view taken on the line 9—9 of FIG. 7, looking in the direction indicated by the arrows, but showing the control panel, switch, and signal lights pictorially.

FIG. 10 is a side elevational view of a modified form of earth moving machine attached to a traction element, portions of the earth moving machine being broken away to show the details of construction of the modified form of the machine, and showing an adjusting device to adjust the relative position of the edge of the earth engaging blade relative to the indicating device and showing the control switching mechanism, and showing a ground engaging wheel to automatically actuate the hydraulic control mechanism in accordance with the terrain engaged by the ground engaging wheel; and

FIG. 11 is an enlarged diagrammatic view, partly in section and with parts broken away and shortened, of the operating mechanism as shown in FIG. 10, but removed from the machine.

With more detailed reference to the drawings, the numeral 1 designates generally a traction element of the character embodying an internal combustion engine and two power driven wheels 2, which traction element 1 is connected to an earth moving machine, designated generally by the numeral 4, by a goose neck arrangement 6, so as to accord a pivotal movement to the traction element 1 with respect to the earth moving machine 4, and to provide a drawbar for the earth moving machine.

The earth moving machine or wheeled scraper 4 is of the character which has a ground engaging blade 8, which may be lowered from the position, as shown in full outline in FIG. 1 to that shown in dashed outline therein, to remove earth from the ground which is indicated at G. The ground engaging blade 8 may be of the type which is raised or lowered by hydraulic or cable power, or the like, so as to enable filling the body 10 of the wheeled scraper. However, it is often desirable to cut from a fraction of one-tenth of a foot to several tenths of a foot of earth from the surface, as the earth moving machine passes over the terrain.

Heretofore, it has been the practice for the operator to watch the blade engaging the earth and for him to approximate the depth at which the blade was engaging and the amount of earth that was being moved. Even the most experienced operator would often cut too deeply or not sufficiently deep to accomplish the desired results. In either event, additional time an use of the equipment would be required to correct the error, and in doing so, it was necessary for the operator to be turned to watch the blade, rather than the travel of the machine, most of the time during this operation, which did not lend to rapid handling of the traction element, and also placed considerable tension and strain on the operator, to face back to watch the blade, while the machine was being driven forward.

With the present device installed on the machine, an operator can face in a forward direction, and can observe, from the depth indicating device, designated generally at 12, the depth at which the blade of the machine is operating. The depth indicating device 12 is preferably composed of a board 14 having a series of lights 16 thereon, which indicate the relative position of the ground engaging blade 8, with respect to the normal level of the ground G. It is preferable that a given light, such as the light 18, be designated as "zero" light, with lights arranged thereabove and therebelow at definite, spaced graduations, to indicate the relative position of the blade 8 with respect to the ground level G.

The usual measurement of cuts and fills to be made, is done by surveyors in tenths of a foot, however, in accurate grading, these tenths of a foot often need to be divided into halves or, at times, into quarters. However, for the present purpose of describing the depth gauge indicating

device, the divisions will be considered in tenths of a foot, it being understood that such divisions may be varied in accordance with the particular requirements of the work being performed.

From the "zero" point or light 18, twelve lights are indicated above the "zero" light, and twelve are indicated below the "zero" light, with each of the lights being in a separate circuit. A cable 20 leads from the signal light board 14 to a contactor element housing 22, which has a "zero" contact 24, and contacts 26, numbered 1 to 12 above "zero" and contacts 28, numbered 1 to 12 below "zero," with a lineal contact bar 30 in spaced relation with respect to contacts 24, 26 and 28, so that a brush means, such as ball 32, will be in rolling contact with contactors 24, 26, and 28, and ball 34 will be in rolling contact with lineal bar 30. The contacts 24, 26 and 28 lead through respective circuit wires in cable 20 to the respective lights on signal board 14, and a wire 36 leads from lineal contactor bar 30 to a common connection with lights 16 and 18 on signal board 14.

The balls 32 and 34 are spring pressed and form brush means to press against the respective contacts by springs 38 and 40, which springs are held in place by metallic conductor strip 42, which has screws 44 passing therethrough to threadably engage in insulated block member 46.

The balls 32 and 34 are mounted in an insulated block 46, with springs 38 and 40 positioned behind the respective balls 32 and 34. A metallic conductor strip 42, for retaining the springs 38 and 40 within the block 46, which block 46 forms a brush mounting means, and is positioned behind and in contact relation with springs 38 and 40, so the current will flow from ball 32 to spring 38 into conductor strip 42, thence through spring 40 to ball 34. And since the ball 32 is adapted to be in rolling contact with contacts 24, 26 and 28 and ball 34 is adapted to be in contact relation with conductor bar 30, the electrical current will flow from the respective contacts 24, 26 and 28 to and through conductor bar 30 when the respective balls 32 and 34 are in contact therewith. A cable 20, has a plurality of wires therein, the wires of which cable are connected to contacts 24, 26 and 28 at one end and to the corresponding signal lights, as indicated at 16 and 18, at the other end. A conductor wire 36 is connected to the conductor bar 30 at one end, and is connected with switch 48 and battery 47 and the opposite sides of the signal lights 16 and 18, so as to enable the passing of electrical current therethrough, when a circuit is closed, which will light the respective lights corresponding to the respective contacts with which the balls 32 engage. The present arrangement shows twelve contacts 26, which are shown to be sub-numbered 1—12 above "zero" contact, which is numbered 24, and twelve contacts 28, sub-numbered 1—12 below "zero" contact 24.

It is preferable to have contacts 24, 26, and 28, as well as the contact bar 30 imbedded within the plastic at the time of molding, so the face of the contact elements will be in a substantially plane surface, with respect to the face of the plastic in which they are exposed. In this manner a smooth action is accorded, as the brush elements move back and forth over the contacts.

The insulated block 46 has a block and tackle arrangement of sheaves 50 and 52 mounted therein. A sheave 54 is mounted on a shaft in an end of contactor housing 22. A cable 56 has one end attached to a turnbuckle 58, which turnbuckle is attached to a bar 60 on scraper body 10 which moves as the blade 8 moves up and down, which cable passes upward through a hole formed in the lower end of contact element housing 22 which cable 56 and turnbuckle 58 form interconnecting means between the block mounting said brush and the scraper body 10. The hole within the housing 22 is surrounded by a grommet 62, so as to exclude dust and foreign matter from the interior of the housing. The cable 56 passes around the sheaves 50, 54, and 52, and is anchored, as indicated at

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64, so upon movement of the bar 60 up or down, as the scraper 10 is raised and lowered, the insulated block member 46 will move only in proportion to the geared relation of the block and tackle arrangement mentioned, which in this case is a four to one reduction. Therefore, the insulated block 46 will travel only one-fourth the distance of the up or down movement of the blade 8.

The block and tackle arrangement is arranged to slip into an opening 66 in the lower end of the block 46, and has the slide bars thereof bent to form a loop at the upper end, through which a cable 68 passes. The cable 68 passes upward over a sheave 70 which is mounted on a shaft 72 positioned in the upper portion of contactor element housing 22. The lower end of cable 68 is connected to a tension spring 74, which spring is anchored to a loop 76 in the lower end of contactor element housing 22. The spring has sufficient resilience to permit the insulated block member 46 to travel the full length of the housing 22, without impairing the elasticity of the spring. However, upon the insulated block member 46 moving upward, the spring will draw cable 68 over sheave 70 until the block 46 is at the upper-most position upon raising the blade 8 to the upper-most position.

It is preferable to make the contactor element housing 22 out of plastic or other insulating material, with the joints between the housing 22 and the cover 23 thereof being in close fitting relation, to exclude moisture and foreign matter. Screws 25 are provided to secure the cover 23 in place.

Operation of first form of invention

In event the cable 56 stretches or becomes worn, or wear in the various parts of the scraper element makes it necessary to readjust the "zero" point, this can readily be done by placing the earth moving machine on level terrain, and lowering the blade 8 until it is in contact with the ground, whereupon, the turnbuckle 58 may be adjusted until the insulated contact block 46 is moved up or down until the ball element 32 contacts the "zero" contact element 24, whereupon, the "zero" light 18 on board 14 will glow, if the switch 48 is closed.

With the turnbuckle 58 thus adjusted, the movement of the blade 8 upward or downward, will then be in co-ordinated relation with the spaced contacts 24, 26 and 28 in contactor element housing 22, so as to give the correct relative reading of the depth of the blade 8 with respect to the terrain over which the wheels of the wheeled scraper are traveling.

As the blade 8 engages the ground to a greater depth, as for instance, to a depth of four-tenths of a foot, the insulated block member 46, carrying roller contact elements 32 and 34, will move downward to contact the fourth element 28 down from the "zero" contact 24, and with the ball 34 riding on contactor bar 30, an electrical circuit will be formed from battery 47 through switch 48, conductor wire 36, contact bar 30 and through cable 20 to a light 16, which is the fourth light below the "zero" light 18.

As the blade 8 moves up and down, the respective lights will be lighted in accordance with the depth of the blade 8.

A spring 78 is positioned on the back of insulated block 46 to exert pressure against the insulated block to maintain ball contact elements 32 and 34 in contact relation with contacts 24, 26, and 28 and with contact bar 30.

It is preferable to have the block and tackle arrangement, which is fitted within insulated block member 46, to be of a character which will enable its ready removal and replacement. Therefore, the frame member thereof is made of a single piece of U-shaped metal through which a shaft 51 may be placed, which shaft is adapted to extend outward through insulated block member 46, so as to maintain the block and tackle sheaves 50 and 52 in fixed relation with respect to insulated block member 46. However, by removing the shaft 51 therefrom and by

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disconnecting the cable 68, the block and tackle member may be removed as a unit.

It is to be understood that the contactor element housing 22 may be positioned in any convenient position, so long as the cable 56 is passed thereinto in alignment with the face of sheave 50 and with the hole in which grommet 62 is positioned. The housing 22, as shown in FIG. 1, is positioned at an angle, and the cable 56 is guided thereinto by pulleys 55 and 57, however, the installation as described above may be varied to adapt to the specific requirements of various types of earth moving equipment.

Modified form of invention

The form of the invention, as shown in FIGS. 7 through 9, utilizes a traction element designated at 1, of the same general character as disclosed in FIG. 1 of the above mentioned form of the invention, which traction element has two power driven wheels 2. The traction element 2 is connected to an earth moving machine, which is designated generally by the numeral 4, by a goose neck arrangement 6, so as to accord pivotal turning movement to the traction element with respect to the earth moving machine 4, and to provide a draw bar for the earth moving machine.

The earth moving machine or wheeled scraper 4 is of the character which has a ground engaging blade 8, which blade may be lowered from the position shown in full outline in FIG. 1 to the position shown in dashed outline therein, to remove earth from the ground, indicated as G. The ground engaging blade 8 is of the type which is raised and lowered by hydraulic power so as to enable filling the body 10 of the wheeled scraper. However, it is frequently desirable to cut from the surface an amount of earth which may vary from one-tenth of one foot to several tenths of a foot, as the earth moving machine passes over the terrain. Heretofore, it has been the practice for an operator to watch the blade engaging the earth, so he could approximate the depth at which the blade was engaged and the amount of earth that was being removed. In order to watch the blade the operator had to look backward, and even the most experienced operators could miscalculated the depth of the cut, and cut too deeply or not sufficiently deep to accomplish the desired result. In either event, additional time and use of equipment would be required to compensate for the error. Since the operator in order to watch the blade, had to be turned opposite to the line of travel of the machine, this position did not lend rapid handling of the traction element, while carefully watching the blade, and furthermore, the operator was subjected to considerably tension and strain while keeping up with the cutting blade and the operation of the machine simultaneously.

With the modified form of the invention, as shown in FIGS. 7 through 9, installed on the earth moving machine, the entire operation of raising or lowering the blade can be controlled by electro-hydraulic means, which controls augment or supplement the conventional controls, if so desired.

For the sake of clarity, the present hydraulic control system is shown independently of the conventional system. In lieu of a cable being used to raise or lower the forward end of the scraper 10 with respect to the goose neck 6, a hydraulic cylinder 101 is mounted on goose neck 6 and is so connected as to raise and lower with scraper 10 by links 102 and rods 104 connected to a transverse header 106 positioned on the upper end of hydraulic plunger 108. The cylinder is shown diagrammatically and it is to be understood that it is to be pivotally mounted in a manner practiced by the various companies manufacturing earth moving equipment, including the Euclid Division of General Motors Corp.

The hydraulic system for controlling the elevation of blade 8, which is mounted on the lower, forward edge

of scraper 10, utilizes a hydraulic pump 118 which withdraws hydraulic fluid from reservoir 116 upward through filter 120 and conduit 122, with the fluid being directed outward therefrom through conduit 126, as will be brought out more in detail hereinafter.

The pump 118 is preferably connected in driven relation, by a pulley or a driven element 124, with the prime mover or engine of the traction element, or in such other manner as indicated by the particular engine on which the pump is mounted.

The valve 112 may be either a three-way valve or a four-way valve depending on whether a single acting hydraulic cylinder or a double acting hydraulic cylinder is used. Patent No. 2,702,049, Fluid Valve, to Seeloff, discloses a four-way valve to which solenoids may be connected for actuation of the valve which is suitable for use on a hydraulic cylinder of the double acting type, or, by using only three ports of the valve, the valve can be utilized to operate a single acting cylinder, in the manner as shown in FIG. 7. In using a valve of this type, inlet conduit 126 is connected with an inlet port of the valve 112 and a conduit 110 is connected with a port leading to hydraulic cylinder 101, with a conduit 114 connecting to an exhaust port of the valve to return the exhausted hydraulic fluid from cylinder 101 and valve 112 to reservoir 116.

The valve 112 is preferably of the spool type, which has a longitudinally slidable element therein, which sliding element has grooved passages formed therein to complementally register with ports and passages in the valve 112, with solenoids 112a and 112b respectively being connected to opposite ends of the sliding spool element in valve 112, so that the spool element may be shifted longitudinally in accordance with the energizing of the respective solenoids, as will be brought out more fully hereinafter.

The pump 118 is to be continuously operated to constantly supply hydraulic fluid under pressure to conduit 126 and into valve 112. However, if the port of the valve 112, with which conduit 126 is connected, is closed, or if the load on the hydraulic plunger 108 is greater than the hydraulic pressure necessary to move the hydraulic plunger, the hydraulic fluid will be by-passed through conduit 128, through relief valve 130, which relief valve is pre-set to the maximum operating pressure at which the system is designed to operate, whereupon, the hydraulic fluid will flow back to reservoir 116 for reuse.

A cable 56, FIG. 7, is connected to the scraper 10 so that the cable will be substantially in alignment with the cutting edge of the blade 8 of the scraper. The cable 56 passes over pulleys 55 and 57 which are located on the goose neck 6 of the scraper, so as to direct the cable into the housing 22a which encloses a block and tackle arrangement which is similar in construction to the block and tackle arrangement shown in FIGS. 2, 3, and 4, except contacts 24a, 26a, and 28a are disposed in opposed relation to a conductor bar 30a, with the insulated, movable block member 46a having a hole 46b formed transversely therethrough, in which hole balls 32a and 34a, which balls form brush means, which balls are positioned with a compression spring 38a positioned between and bearing against the balls to urge the ball 32a into contact relation with a side of housing 22a, and with contacts 24a and 26a and 28a, as the movable block member 46a moves within housing 22a. The spring 38a is an electrical conductor, and in urging ball 34a into rolling contact relation with conductor bar 30a an electrical circuit is formed from battery 47 through switch 48, when closed, and conductor wire 36, which wire 36 is connected in electrical relation with conductor bar 30a and with the ball 34a in contact relation therewith and the conductor spring 38a and with the ball 32a, and with the ball 32a in contact relation with one of the contact points 24a, 26a or 28a, electrical current will be conducted therethrough

and through one of the respective wires of electric cable 20a which leads to indicator and switch control panel 14a, which panel may be located remotely from housing 22a, with wire 17 connected to the opposite side of each of the light bulbs and to the opposite side of the battery to complete a circuit through the particular light bulb, which electrical circuit is closed by the brush being in contact with a particular contact, which will indicate the position of the blade relative to the surface of the terrain. The indicator and switch control panel 14a is preferably located on the prime mover forward of and in full view of the operator of the earth moving equipment. The indicating lights are numbered from one to twelve above zero and one to twelve below zero, with zero being reckoned as the surface of the terrain on which the scraper or other earth moving equipment is operating.

Grades are usually surveyed in feet or tenths of feet (English system) or in meters and the sub-division of meters (metric system), however, for purposes of illustration, feet and tenths of feet will be referred to. The contact point 24a, which is considered zero point within the housing 22a, is connected with a signal light 18a on the indicator and switch control panel 14a by the cable 20a, in the same manner as shown in FIG. 2 of the above designated form of the invention. Likewise, the respective wires of cable 20a lead from points 26a and 28a to the respective signal lights 16 on the indicating and control panel 14a, which lights indicate the relative position of the ground engaging blade 8 with respect to the normal level of the ground G. In this manner, it can be readily determined visually whether the blade 8 is above or below the level of the ground, and if below the level of the ground, the depth in tenths of feet at which the blade is cutting. If the blade is above the ground, the indicator shows the height thereabove at which the blade is being held so that earth being discharged from the scraper 10 will be filled in the number of tenths indicated above zero. However, because of the various other functions that must be performed by the operator, it is desirable that the blade be maintained between certain limits automatically by means of electro-hydraulic controls, whereby, if the circuit leading to each of the indicator lights 16a or 18a on panel 14a is also connected in parallel relation with a double throw limit switch, which is designated generally by the numeral 132, each of which switches has a conductor 134 connected to the center pole thereof, so, with the switch in an intermediate position, it is not in contact with either of the contacts 136 or 138. The contacts 136 are connected in common relation with a conductor 140 which is connected to one of the terminals of the coil of solenoid 112a. The contacts 138 are connected to a common conductor 142 which leads to one of the terminals of the solenoid 112b. The other terminal of the respective solenoids 112a and 112b connect to electrical conductor 144 which leads to and connects with the pole of battery 47 opposite the pole to which conductor 36 is connected.

In order to control the depth, within specified limits, the blade 8 is raised or lowered to a particular elevation or depth, whereupon, the ball 32a comes in contact with one of the contacts 24a, 26a, or 28a, which, with switch 48 closed, will close the circuit from battery 47 through switch 48, conductor wire 36 to conductor bar 30a, thence through metallic ball 34a, metallic conductor spring 38a and through metallic ball 32a to contact one of the contact points, for instance, 28a. If the contact point 28a should be the fourth contact point below contact point 24a, indicator light number four (below zero) on indicator and control panel 14a will be lighted, and if the handle of switch 132 is moved to the left, FIG. 9, to engage contact 138, which switch is held in position by the usual knife engagement arrangement, a circuit will be closed from contact point 28a through cable 20a and through circuit 134 and through center pole of switch 132, thence through conductor 142 and through the coil

of solenoid 112b and conductor 144 to battery 47 to energize the solenoid to move the solenoid armature and the spool valve or the like connected thereto into position to open the ports of valve 112 so that hydraulic fluid under pressure in conduit 126 will pass through valve 112 and into conduit 110 to move the hydraulic plunger 108 upward. A cross bar 106 is mounted on plunger 108 and from which cross bar 106 lifting bars 104 depend to connect with links 102 of scraper 10. It is preferable to have the contact points 24a, 26a, and 28a sufficiently close so that the ball 32a rolls off one of the contacts and onto the adjacent contact in close continuity, so upon disengagement of one point another point will be engaged so there will be no dead spots between the contact points.

With the solenoid 112b energized, the blade 8 will be lifted, however, if each switch 132 is moved to the right to allow the knife blade to engage between the friction elements of the contact 136 on the third switch below the zero switch on the indicator and the control panel 14a, the hydraulic pump will continue to deliver fluid to the cylinder until the blade is raised so that the movable block 46a is moved by the action of spring 74 which urges the block 46a upward as the cable 56 is slackened, so upon the ball 32a contacting the contact point 28a, which is electrically connected with the respective switches and indicator lights on indicator and control panel 14a, the electrical contact will be broken with the fourth contact point below 24a and, simultaneously will contact the contact point which is in electrical circuit relation with switch contact point 136 at the third tenth below zero on the indicator and control panel 14a, so upon de-energizing solenoid 112b, solenoid 112a will be energized, whereupon the solenoid armature will shift the spool valve to open the ports in valve 112 which connect conduit 110 with conduit 114, whereby hydraulic fluid will flow from cylinder 101, under the influence of the weight exerted by scraper 10 on plunger 108 until movable block 46a of the block and tackle arrangement within housing 22a is moved by cable 56 downward to contact the fourth contacting point 28a below zero contact point 24a. Whereupon, the blade will be maintained within the limits set by the two limit switches 132.

The present system preferably augments the regular control system, and is put into operation after the blade is set at a fixed location, as it will automatically maintain the desired depth or elevation until the system is switched off and the regular control system (not shown) is re-activated. The indicator, as shown in FIG. 7, functions in the same manner as the indicators shown in FIGS. 2, 3 and 4 and only the modified form of movable block and contact system is shown, however, the operating parts are the same as for the first form of invention described above, as are the indicators lights to which the circuits are connected.

Further modified form of the invention

A further modified form of the invention is shown in FIGS. 10 and 11, which form utilizes a traction element, designated generally at 1, which has power driven wheels 2 and which traction element is connected to an earth moving machine, designated generally by the numeral 4, in the same manner as set forth for the form of the invention as shown in FIG. 1, and in so far as applicable, the same numbers will designate like parts in all forms of the invention.

This particular form of the invention is so constructed that the scraper 10 may be raised and lowered by hydraulic power in the same manner as disclosed in the form of the invention as shown in FIGS. 7 through 9. A hydraulic cylinder 101 is mounted on goose neck 6 on earth moving machine 4 and extends upward therefrom and has a plunger 108 therein. A lever 106a is pivotally connected by pin 103 at one end to the goose neck 6.

The lever 106a is pivotally connected by pin 103a intermediate the length thereof to the hydraulic plunger 108. The outer end of the lever 106a has a pin 103b which pivotally interconnects rod 104a to the outer end of lever 106a. The lower end of rod 104a pivotally connects with a scraper bowl 10 so as to enable the raising and lowering of the scraper bowl 10 by hydraulic power. This arrangement enables the raising and lowering of the scraper bowl either by manual or by automatic controls, as will be more fully explained hereinafter.

The present arrangement uses a hydraulic pumping mechanism 118, as is shown diagrammatically in FIG. 7, with the solenoid actuated hydraulic valve 112 within the conduit system. However, in addition to the hydraulic mechanism, as shown in FIG. 7, and the control mechanism as shown in FIGS. 8 and 9, the present device has a channel member 201 mounted on and extending rearwardly from goose neck 6, within which channel member 201 is mounted a movable carriage 202. The movable carriage 202 has a hydraulic cylinder 204 mounted thereon for selective movement therewith, within the length of and by a wire cable 56. One end of a portion of the wire cable 56 is connected to the upper portion of scraper body 10 by a lug 206, which cable extends over pulleys 55 and 57 and is connected to a yoke 207 on cable length adjuster, designated generally by the numeral 203, which cable length adjuster comprises a hydraulic cylinder 204 which is fixed secured to the carriage 202, to which cylinder the yoke 207 is secured in fixed relation.

A second yoke 208 is connected to the plunger 210 within the hydraulic cylinder 204 and abridges the cylinder 204, which yoke 208 is connected to an end of the other portion of cable 56, which portion of the cable extends therefrom and into contactor element housing 23, which is of the character shown in FIG. 7. The cable 56 is maintained in taut relation by spring 74 which is connected through a cable 68 to a movable block assembly 46a, as has been fully explained hereinbefore.

Thy hydraulic cylinder units are designated generally by the numeral 228, which units are mounted on the rearwardly extending portions 1a of the frame, one portion 1a being on each side of the traction element 1. Each unit 228 has a base 229, each of which bases has upstanding lugs 230 thereon on which hydraulic cylinders 220 are pivotally mounted. A lug 235 is mounted on the base 229 of each unit 228 to pivotally mount the respective shafts 234 in journaled relation thereon. An arm 236 is fixedly secured to each shaft 234, which arms 236 extend downwardly and each has a caster type wheel 238 pivotally mounted thereon for turning movement about a substantially vertical axis. Each caster wheel is so positioned as to track directly behind the respective wheels 2 of the traction element 1.

A transverse pipe 217 interconnects the corresponding ends of hydraulic cylinders 220. A T connection 219 within transverse pipe 217 connects the transverse pipe 217 with the conduit 216 in fluid communication to enable the surface elevation immediately behind each of the wheels 2, on which the ground engaging wheels 238 roll, to be transmitted by hydraulic pressure through conduit 216, so as to automatically vary the effective length of the cable 56 which actuates a mechanism to initiate an electrical circuit to indicate a reading and/or to initiate an electrical circuit to actuate a mechanism to adjust the cutting edge of the blade 8 with respect to the surface of the terrain.

Each shaft 234 is also fixedly secured to the respective levers 235, to which levers hydraulic plungers 226 are pivotally connected, so, upon upward movement or downward movement of wheels 238, which are mounted on the respective arms 236, each plunger 226 will actuate a piston (not shown) in each hydraulic cylinder 220 to displace hydraulic fluid in accordance with the degree of movement of the piston within the cylinder, so fluid will

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be transmitted through transverse pipe 217, and T 219 into conduit 216 and, if valve 222 is closed, hydraulic, spring pressed plunger 225, in expansible hydraulic chamber 224, will move upward and downward to permit compensation for fluid expelled from cylinder 220 when the rest of the system is inoperative. However, the spring, designated at 225a, is sufficiently strong so as not to yield unless hydraulic valve 22 is closed.

The hydraulic pump, designated generally at 218, is operable by a hand lever 240, which hand lever pivotally connects piston rod 242 to plunger 244 so as to vary the amount of fluid pumped into hydraulic cylinder 204. As additional fluid is pumped into the system, the hydraulic plunger 210 is moved outward, which will effectively draw the ends of the cable portions 56 closer together, which in turn, will vary the positioning of the brush mounting block 46a in contactor element housing 23. When the plunger 244 is moved to the desired position, it may be locked in place by a pawl 246 engaging an arcuate rack 248. The rack is graduated from "zero plus" and from "zero minus" so as to enable the correct positioning of the edge of blade 8 above and below the surface of the terrain to enable the correct adjustment of the blade 8 with respect to the surface of the terrain. A fill pipe 250 connects with the fluid reservoir of pump 218, which reservoir is kept fluid tight by cap 252.

The present adjustment arrangement enables the zero setting of the blade with respect to the terrain without the operator moving from the operator's position on the traction element 1. Furthermore, the ground engaging wheel 238 enables the setting of the controls so that the brush mounting block 46a will be moved in accordance with the terrain to maintain an even cut or fill with respect to the terrain over which the traction element moves, if the automatic system which utilizes switches 132 is employed. In this manner, the depth of the cut may be maintained uniform with respect to the terrain over which the tractor moves, as the ground engaging wheels 238 will automatically compensate for any irregularities in high and low places between the wheels 2 on opposite sides of the traction element 1, thereby giving a definite automatic control of the depth or height of the blade 8 with respect to the normal surface of the terrain.

Having thus clearly shown and described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In combination

- (a) an earth moving machine,
 - (1) a movable scraper body on said earth moving machine,
 - (2) a ground engaging blade mounted on said movable scraper body,
- (b) a housing mounted on said earth moving machine,
 - (1) a multiplicity of electrical contacts in said housing in spaced apart relation,
 - (2) a brush mounting block movably mounted within said housing,
 - (3) electrical conductors connected to said electrical contacts in said housing,
 - (4) a metallic rolling ball forming a brush mounted within said block for sequential contact engagement with said spaced apart electrical contacts upon relative movement between said block and said housing to establish electrical circuits therethrough and through said electrical conductors,
 - (5) a metallic spring mounted on said mounting block which resiliently presses said metallic rolling ball into contact engagement with said spaced apart electrical contacts as said metallic rolling ball within said housing is rolled thereover,
- (c) pulleys and a plurality of cable reaches arranged in block and tackle relation interconnecting said

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- block in which said brush is mounted and said movable scraper body on which said blade is mounted to impart relative proportional movement therebetween to indicate the relative position of said blade with respect to the surface of the terrain being traversed by said earth moving machine,
- (d) electrically actuated depth indicating device mounted on said earth moving machine remote from the housing and being electrically connected to the respective electrical conductors to form circuits, and
- (e) a source of electricity connected to the respective electrical conductors.

2. In combination

- (A) an earth moving machine,
 - (1) a movable scraper body on said earth moving machine,
 - (2) a ground engaging blade mounted on said movable scraper body,
- (B) a depth indicating device mounted on said earth moving machine, which device comprises:
 - (1) a housing,
 - (a) a multiplicity of electrical contacts in said housing in spaced apart relation,
 - (b) a brush mounting block movably mounted within said housing,
 - (c) a brush mounted within said block for sequential engagement with said electrical contacts upon relative movement between said brush and said housing to establish electrical circuits therethrough,
 - (2) means interconnecting said block in which said brush is mounted and said movable scraper body to impart relative proportional movement therebetween to indicate the relative position of said blade with respect to the surface terrain traversed by said earth moving machine,
 - (d) a depth indicating panel mounted on said earth moving machine remote from said housing,
 - (i) electric indicating lights mounted on said panel,
 - (e) a source of electricity,
 - (i) an electrical circuit connecting said electrical contacts in said housing with said electrical indicating lights in said panel and with said source of electricity to sequentially light said indicating lights,
- (C) hydraulically actuated means on said earth moving machine and connected to said movable scraper body on which said ground engaging blade is mounted to move said scraper body and said blade with respect to the surface terrain, said hydraulically actuated means comprising:
 - (1) a hydraulic pump,
 - (a) conduit means connecting said hydraulic pump and said hydraulically actuated means in fluid communication,
 - (i) a solenoid actuated valve in said conduit for controlling the flow of fluid to said hydraulically actuated means and to control the flow of hydraulic fluid therefrom,
 - (ii) limit switches on said indicating means,
 - (iii) said switches being electrically connected to the respective solenoid actuated valves so upon movement of said brush in one direction into contact with one of said contacts, a circuit will be closed through one of said switches and one of said solenoids will be actuated to control the

movement of said blade within the limits set by said limit switches.

3. In combination

- (A) an earth moving machine,
 - (1) a movable scraper body mounted on said earth moving machine,
 - (a) a ground engaging blade mounted on said movable scraper body,
 - (B) a depth indicating and control device mounted on said earth moving machine, which device comprises:
 - (1) a housing,
 - (a) a multiplicity of electrical contacts mounted in said housing in spaced apart relation,
 - (b) a brush mounting block movably mounted within said housing for movement with respect to said electrical contacts,
 - (c) electrical conductors connected to said electrical contacts in said housing,
 - (d) a brush mounted on said movable block for sequential engagement with said contacts upon relative movement between said brush and said housing to establish electrical circuits therethrough and through said electrical conductors,
 - (2) mechanical means interconnecting said brush moving block, in which said brush is mounted and said movable scraper body on which said blade is mounted to impart relative proportional movement therebetween,
 - (3) an electrically actuated depth indicating device mounted on said earth moving machine remote from said housing,
 - (a) electrically actuated means connected to the respective electrical conductors to form circuits to indicate the relative position of said blade with respect to the surface of the terrain being traversed by said earth moving machine,
 - (b) a source of electricity connected to the respective electrical conductors within said circuits,
 - (C) a hydraulic system comprising,
 - (1) a hydraulically actuated cylinder connected intermediate said earth moving machine and said movable scraper body,
 - (2) a source of hydraulic pressure,
 - (3) a hydraulic conduit system extending between said source of hydraulic pressure and said hydraulic cylinder,
 - (4) electrically actuated control valves within said conduits,
 - (a) electrical conductors of said depth indicating device leading from said electrical contacts to said electrically actuated means connected to the respective electrical conductors,
 - (b) electrical switches within said electrical circuits to form limit switches and connected within circuits with said electrically actuated control valves to cause said hydraulic system to maintain said ground engaging blade within predetermined limits with respect to the surface of the terrain.
4. In combination, an earth moving machine as defined in claim 3; wherein
- (a) said electrical switches, which form limit switches, are double throw switches to selectively connect said electrically actuated control valve with said respective conductors.

5. In combination

- (A) an earth moving machine,
 - (1) a wheeled frame,
 - (2) a movable scraper body mounted on said wheeled frame,
 - (3) a ground engaging blade mounted on said movable scraper body,
 - (4) yieldable control means interconnected between said movable scraper body and said wheeled frame,
 - (B) a hydraulic system,
 - (1) hydraulically actuated means connected between said wheeled frame and said movable scraper body to move said scraper body carrying said ground engaging blade with respect to the surface of the terrain,
 - (2) a hydraulic pump,
 - (3) a hydraulic fluid reservoir,
 - (4) a conduit connecting said hydraulically actuated means in fluid communication with said hydraulic pump,
 - (5) an electrically actuated valve within said conduit leading to said hydraulically actuated means connected to said movable scraper body,
 - (C) an electrical system,
 - (1) electrical circuits on said wheeled frame,
 - (2) limit switches mounted on said wheeled frame and connected within said electrical circuits and operably connected to said movable scraper body by said yieldable control means,
 - (3) an electrically actuated valve within said circuits to enable hydraulic fluid to be selectively directed from said pump to said hydraulic actuating means to maintain said ground engaging blade within predetermined limits relative to the surface of the terrain, and
 - (4) a source of electricity connected within said circuits,
6. A depth control device for an earth moving machine in the combination defined in claim 5, wherein
- (1) a further conduit extends between said hydraulically actuated means and said hydraulic fluid reservoir to return hydraulic fluid to said reservoir from said hydraulically actuated means when said electrically actuated valve is in one position.
7. A depth control device for an earth moving machine in the combination defined in claim 5, wherein
- (1) the yieldable means interconnecting said movable scraper body with said wheeled frame is
 - (a) a cable and pulley arrangement to form a block and tackle,
 - (i) one of the blocks thereof being movable,
 - (ii) electrical contact points within each of said circuits, and
 - (iii) brush means on said movable block to move said brush over said contacts proportionate to the raising and lowering of said ground engaging blade to selectively close certain of said circuits to electrically energize said electrically actuated valve to control the flow of hydraulic fluid to and from said hydraulically actuated means.
8. A depth control device for an earth moving machine in the combination defined in claim 7, wherein
- (1) double throw switches are connected within circuits leading to said electrically actuated valve to control the maximum upward movement of said movable scraper body when one of said switches is in one position and to control the maximum downward movement of said movable scraper body when another of said switches is in another position, to close the respective circuits leading to said hydraulically actuated valve so as to maintain said ground engaging blade within predetermined limits.
9. In combination
- (a) an earth moving machine,

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- (1) a movable scraper body on said earth moving machine,
 - (2) a ground engaging blade mounted on said movable scraper body,
 - (b) a housing mounted on said earth moving machine,
 - (1) an electrical transmitting device within said housing,
 - (2) an electrical conductor circuit connected to said electrical transmitting device in said housing,
 - (c) means interconnecting said electrical transmitting device in said housing with said movable scraper body on which said blade is mounted to impart proportional movement therebetween to indicate the relative position of said blade with respect to the surface of the terrain being traversed by said earth moving machine,
 - (d) electrically actuated depth indicating device mounted on said earth moving machine remote from said housing and being electrically connected with said electrical transmitting device,
 - (e) a source of electricity connected within said circuit extending between said electrical transmitting device and said electrically actuated depth indicating device,
 - (f) remotely controlled, fluid actuated adjusting means mounted intermediate said means interconnecting said electrical transmitting device and said movable scraper body,
 - (g) fluid actuated remote control means associated with said earth moving machine, and
 - (h) conduit means interconnecting said adjusting means and said remote control means to enable the adjusting of said means interconnecting said electrical transmitting device and said movable scraper body.
10. The combination of an earth moving machine and a depth indicating and depth controlling device as defined in claim 9; wherein
- (a) said remote control means is a manually operated cylinder, and
 - (b) a trackway,
 - (c) a wheeled carriage mounted on said trackway,
 - (1) said fluid actuated adjusting means mounted on said wheeled carriage and being movable therewith, and
 - (2) said fluid actuated adjusting means being a fluid cylinder and plunger.
11. The combination of an earth moving machine and a depth indicating and depth controlling device as defined in claim 10; wherein
- (a) a lever is operatively connected to said plunger in said fluid cylinder of said remote control means to selectively vary the adjustment of said plunger, and
 - (b) said means to selectively maintain said remote control means in adjusted position is a rack and pawl.
12. The combination of an earth moving machine and a depth indicating and depth controlling device as defined in claim 9; wherein
- (a) said means interconnecting said electrical transmitting device in said housing and said movable scraper body is a cable,
 - (b) said adjusting means being a hydraulic cylinder mounted on said movable carriage,
 - (1) said cable being attached to said carriage,
 - (2) a plunger in said hydraulic cylinder,
 - (3) one portion of said cable being attached to said plunger in biased relation,
 - (4) the other portion of said cable being connected to said electrical transmitting device,
 - (c) said remote control means being a hydraulic cylinder,
 - (d) said means interconnecting said adjusting means

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- and said remote control means being a hydraulic conduit.
13. An attachment for an earth moving machine having a ground engaging blade and a hydraulic system for raising and lowering the ground engaging blade, which attachment comprises;
- (A) an electrical indicating device associated with said ground engaging blade to transmit an electrical impulse to an indicator to indicate the position of the ground engaging blade with respect to the surface of the terrain,
 - (1) an electrical circuit including said electrical indicator operatively associated with said ground engaging blade,
 - (B) an electrically controlled valve associated with the hydraulic system to control the flow of hydraulic fluid within said hydraulic system to control the raising and lowering of the ground engaging blade,
 - (1) limit switches within said electrical circuit which are operatively associated with said indicator to initiate an electrical impulse when a certain one of said switches is in one position,
 - (a) a certain other of said limit switches adapted to initiate an electrical impulse when in another position,
 - (b) said limit switches being operatively associated with said electrically actuated valve to selectively admit hydraulic fluid therethrough in direct co-ordination to the positioning of said certain limit switches to initiate electrical impulses in direct co-ordination with said electrical indicator.
14. An attachment for an earth moving machine having a ground engaging blade and a hydraulic system for raising and lowering the ground engaging blade, as defined in claim 13; wherein
- (a) said electrical indicator and said limit switches are electrically connected at graduated points of indication so by moving one of said limit switches, a circuit will be closed when said point of indication is reached to actuate said electrically controlled valve to direct hydraulic fluid into the hydraulic system to arrest upward movement of the ground engaging blade, and
 - (b) another of said limit switches being associated with an indicating point on said indicator to close a circuit to said electrically operated valve to direct hydraulic fluid within the hydraulic system to arrest the downward movement of said ground engaging blade.
15. An attachment for an earth moving machine having a ground engaging blade and a hydraulic system for raising and lowering the ground engaging blade, as defined in claim 13; wherein
- (a) said electrical indicator has a plurality of circuits leading thereto,
 - (1) certain of said circuits being energizable to provide a signal on said indicator in direct proportion to the movement of the ground engaging blade with respect to the terrain,
 - (b) two circuits associated with said electrically controlled valve,
 - (1) a set of switch contacts associated with each said circuit at each point of indication on said indicator so as to close one of said circuits on said indicator and one of said circuit leading to said control valve, and
 - (2) the other set of said switch points associated with said electrical circuit through said indicating means and said electrically controlled valve to open said valve to direct hydraulic fluid through said control valve to control the position of the ground engaging blade with respect to the terrain.
16. In combination
- (a) an earth moving machine,

- (1) a movable scraper body on said earth moving machine,
- (2) a ground engaging blade mounted on said movable scraper body,
- (b) a housing mounted on said earth moving machine, 5
 - (1) a multiplicity of electrical contacts in said housing in spaced apart relation,
 - (2) a brush mounting block movably mounted within said housing,
 - (i) pulleys associated with said brush mounting block, 10
 - (ii) a pulley associated with said housing,
 - (iii) a plurality of reaches of cable surrounding said pulleys, the terminal end of said cable being anchored to said housing to form a block and tackle, 15
 - (3) said brush mounting block being the movable block of said block and tackle,
 - (4) one reach of said cable being connected to said movable scraper on which said ground engaging blade is mounted to impart relative, proportional movement between said scraper body and said brush mounting block to indicate the relative position of said ground engaging blade with respect to the surface of the terrain being traversed by said earth moving machine, 20 25
 - (5) electrical conductors connected to said electrical contacts in said housing,
- (c) a pair of metallic rolling balls forming brushes, mounted within said block, for sequential engagement with said respective spaced apart electrical contacts, upon relative movement between said block 30

- mounting said ball of metallic rolling balls and said housing to establish electrical currents therethrough and through said electrical conductors,
- (d) a metallic coiled spring associated with said block and interposed between said balls to press said balls into contact engagement with the respective contacts within said housing as said balls are moved thereover,
- (e) electrically actuated depth indicating device mounted on said earth moving machine remote from the housing and being electrically connected to the respective electrical conductors to form circuits,
- (f) a source of electricity connected to the respective electrical conductors.

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