United States Patent [19]

Lucero

[11] **3,744,260**

[45] **July 10, 1973**

[54] **CABLE LAYING APPARATUS WITH OFF-CENTER INCLINED EARTH-PENETRATING BLADE**

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[22] Filed: **Oct. 29, 1971**

[21] Appl. No.: **193,835**

[52] **U.S. Cl.** **61/72.6,** 37/193, 172/65, 172/699

[51] **Int. Cl.** **F16l 1/00,** E02f 5/02, A01b 49/02

[58] **Field of Search** 61/72.6, 72.5, 72.1, 61/72.7, 72.2; 37/193; 172/699, 700, 65, 66

[56] **References Cited**

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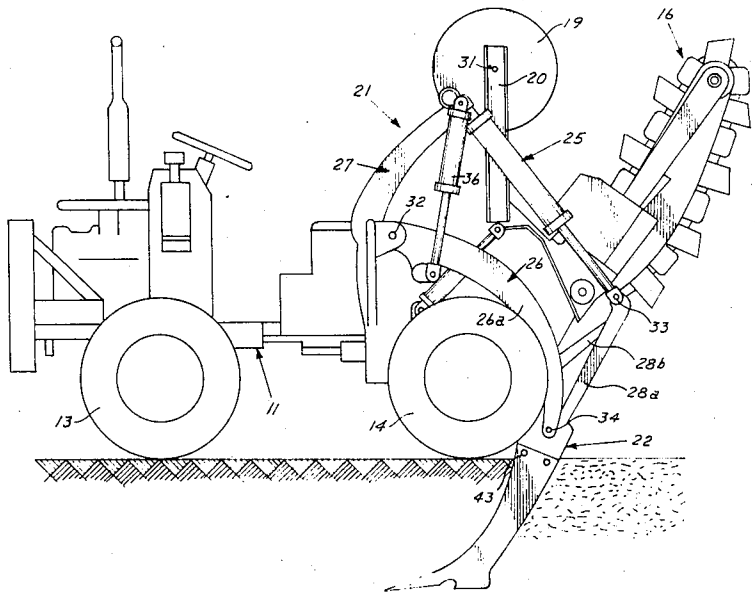
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[57] **ABSTRACT**

An earth-penetrating blade is mounted to one side of the longitudinal axis of a vehicle chassis and out of the way of other auxiliary equipment on the chassis for alternate operation of blade or the equipment on the same chassis. The blade is mounted at the rear of the parallelogram-type support frame for movement between an elevated position above the soil and an earth-penetrating position wherein the blade extends downwardly and laterally from one side of the longitudinal axis of the vehicle chassis at an angle to the vertical axis of the chassis to make an angular cut in the soil with a reduction in drag and the blade also extends downwardly and forwardly from the rear of the chassis at an angle to the vertical axis of the vehicle chassis with a forwardly extending lower digger tooth extending substantially forwardly of the rear wheels to distribute the pull-down forces of the blade on the vehicle more evenly between each of the vehicle wheels. Hydraulic cylinders are operatively associated with the support frame to move the blade between the elevated position and earth-penetrating position and to adjust the angle the toe section of the digger tooth makes with the horizontal.

19 Claims, 8 Drawing Figures



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SHEET 1 OF 2

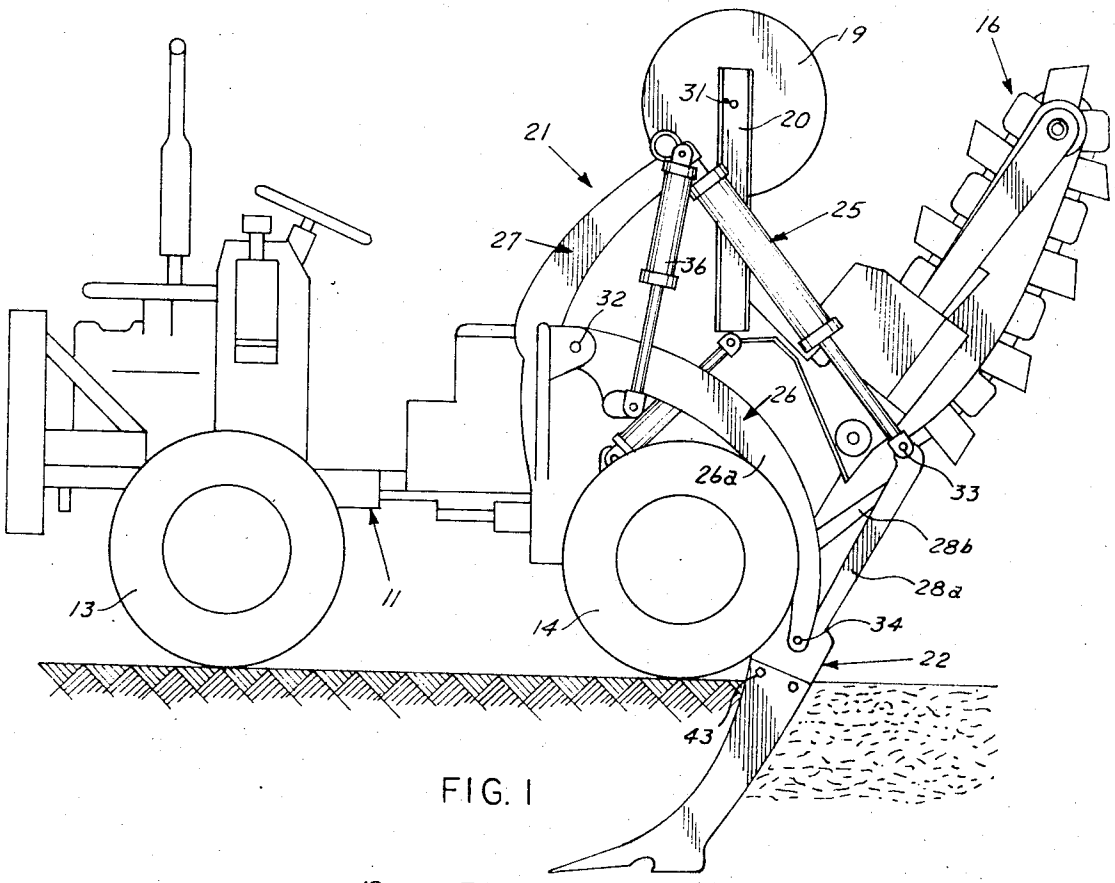


FIG. 1

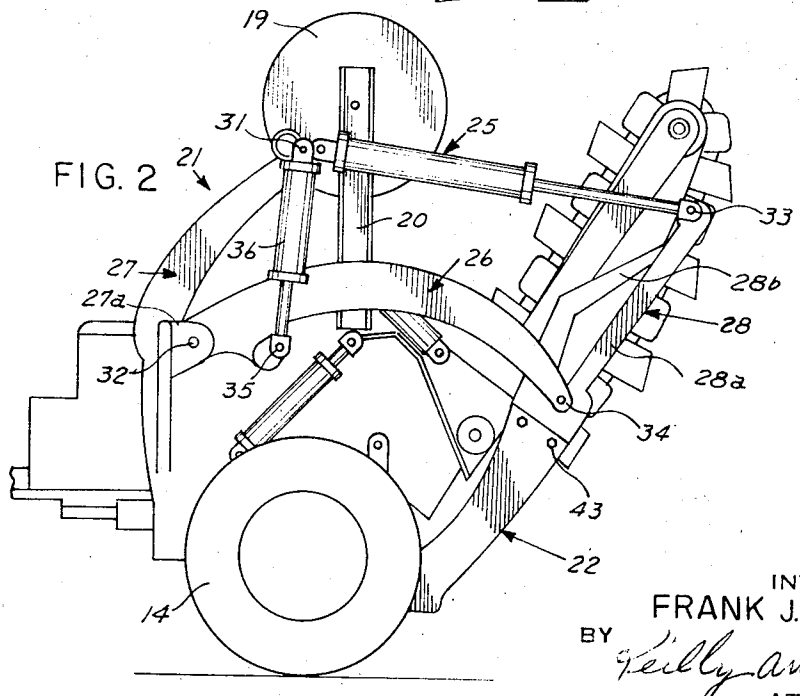


FIG. 2

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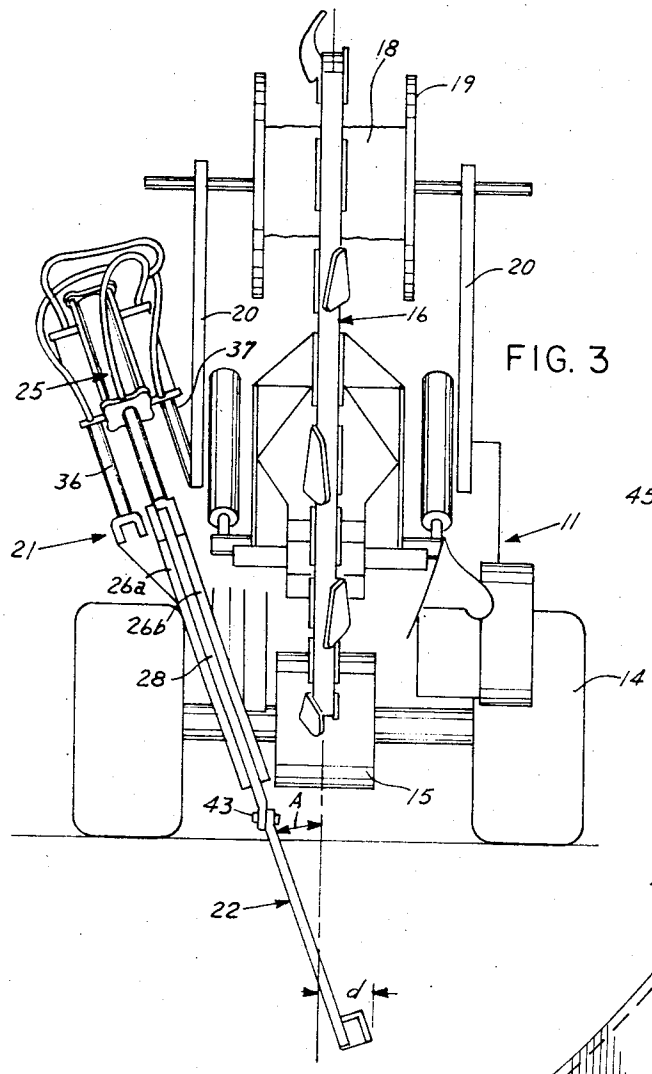


FIG. 3

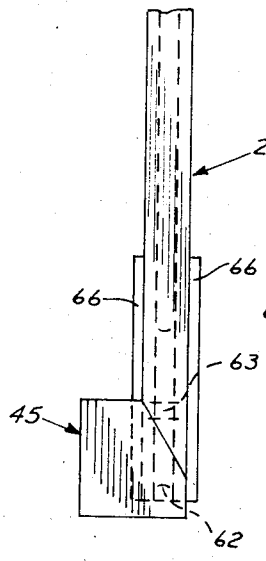


FIG. 4

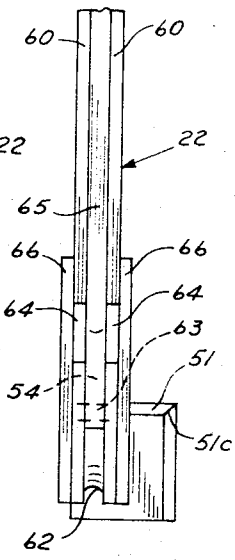


FIG. 5

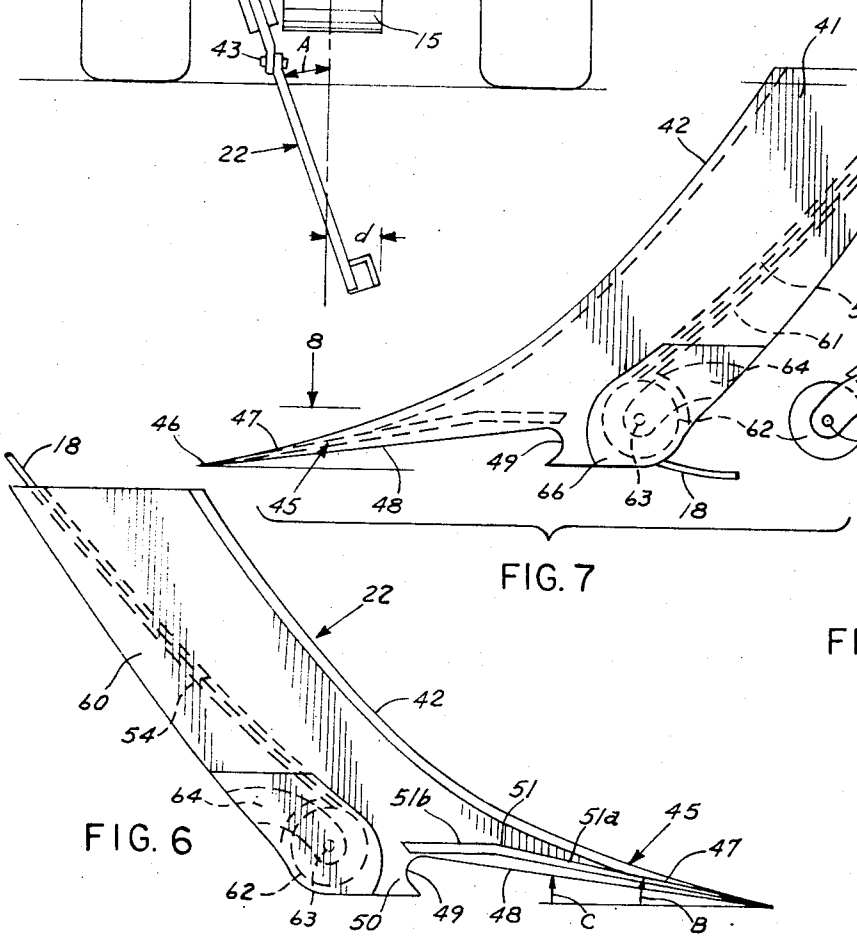


FIG. 7

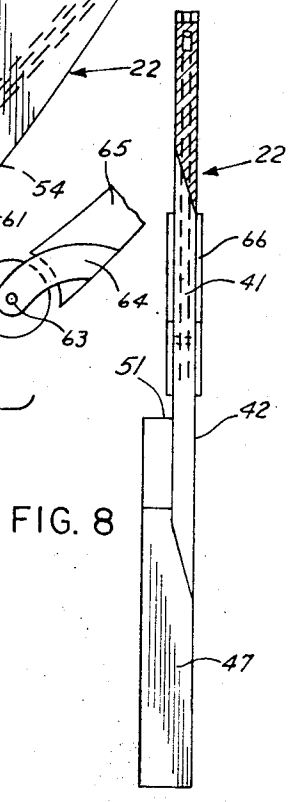


FIG. 8

FIG. 6

CABLE LAYING APPARATUS WITH OFF-CENTER INCLINED EARTH-PENETRATING BLADE

This invention generally relates to cable laying apparatus and more particularly to improvements in earth-penetrating blade apparatus and the mounting thereof on a vehicle chassis.

A variety of trenching plow arrangements have been devised to dig a trench into the ground and deposit a cable into the trench. Trenching blades have usually been mounted in a centered, vertically disposed position on the chassis and between the wheels and either in a forward or trailing position on the chassis. Some attempts have been made to position vertically mounted blades on either or both sides of the vehicle or to incline the blade from the center position at the rear of the vehicle chassis. In my copending application entitled Apparatus For Laying Cable And The Like, there is described an earth-penetrating blade having efficient soil lift and minimum drag characteristics.

Accordingly, it is an object of this invention to provide a novel mount for an earth-penetrating blade which disposes the blade out of the way of other auxiliary equipment on a vehicle chassis for alternate operation of the blade or auxiliary equipment.

A further object of this invention is to provide a novel trenching blade which serves to cut through the soil with reduced frictional drag.

Another object of this invention is to provide an earth-penetrating blade having improved distribution of pull-down forces between the vehicle wheels.

Another object of this invention is to provide a novel mount for a trenching blade which supports the blade for movement between a laterally offset elevated position with relation to the vehicle chassis and an angular earth-penetrating position extending downwardly and inwardly from the one side to make an angular cut in the soil.

Still a further object of this invention is to provide a novel cable laying apparatus characterized by an offset mount for an earth-penetrating blade which extends downwardly and laterally toward the vertical axis of the vehicle chassis having a sharp-edged shank, a toe section at the lower forward end of the shank located substantially forwardly of the rear wheels, and a heel section at the rear to dig into the soil and elevate same in forming a trench.

In accordance with the present invention in a preferred embodiment shown there is provided an earth-penetrating blade and means mounting the blade on a vehicle chassis for movement between and extending downwardly and inwardly from one side toward the center of the vehicle chassis. The blade has a flat-sided shank portion with a sharp forward cutting edge and a forwardly and downwardly extending digger tooth at the lower front end of the shank including a toe section and a heel section rearwardly of the toe section with a cable dispensing portion in the blade rearwardly of the heel section. The mounting means is a parallelogram-shaped structure with pivotal corner connections which is powered by hydraulic cylinders, the blade being pivotally connected to and depending from the rear of the frame where it is raised and lowered or the blade angle is altered by selective actuation of hydraulic drive means operatively associated with the frame.

Other objects, advantages and capabilities of the present invention will become more apparent as the description proceeds taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevational view of cable laying apparatus embodying features of the present invention with the novel trenching blade shown in an extended earth-penetrating position;

FIG. 2 is a side elevation view showing the rear portion of the cable laying apparatus of FIG. 1 with the blade shown in a raised or retracted position;

FIG. 3 is a rear end elevation view of the cable laying apparatus shown in FIGS 1 FIGS. 2;

FIG. 4 is a front end elevation view of a lower portion of the blade;

FIG. 5 is a rear end elevation view of the lower portion of the blade shown in FIG. 4;

FIG. 6 is a right side elevational view of a lower portion of the blade;

FIG. 7 is a left side elevational view of a lower portion of the blade with the pulley assembly also shown in a removed position; and

FIG. 8 is a sectional view of the blade taken along lines 8—8 of FIG. 7.

Referring now to the drawings, FIGS. 1–3 show a four-wheel drive trencher vehicle having a chassis **11** with a pair of front wheels **13** and a pair of rear wheels **14** and a rear axle **15**, the vehicle illustrated being a Vermeer Model No. M460 equipped with an endless chain bucket-type digging assembly **16** mounted in a centered trailing position at the rear end of the vehicle chassis. A cable **18** is mounted on a drum **19** supported for rotation by spaced uprights **20** on each side of the vehicle chassis to pay out the cable as required. Briefly, the apparatus shown comprises an adjustable, parallelogram-type, power-actuated support frame **21** secured to one side of the vehicle chassis on which there is carried the earth-penetrating blade **22**. The blade **22** is disposed by the frame **21** at selected elevations between a fully extended position as shown in FIG. 1 or an elevated or retracted position for transport as shown in FIG. 2.

The support frame **21** includes upper and lower frame members **25** and **26**, respectively, and front and rear frame members **27** and **28**, respectively, arranged in an open, parallelogram assembly with four pivot or pin connections **31, 32, 33** and **34**, respectively, joining the frame members at four corners, the upper and lower frame members **25** and **26** being arranged parallel to one another and the forward and rear frame members **27** and **28** being parallel to one another. The upper frame member **25** preferably is a hydraulic cylinder, as shown, to provide for some adjustment in the angle which the lower forwardly extending toe section of the blade makes with the horizontal, as is described more fully hereinafter. In the event no blade angle adjustment is necessary it is understood that the hydraulic cylinder may be replaced by a rigid frame or structural member.

The lower frame member **26** is rigid, generally upwardly bowed, and is bifurcated at the rear end providing spaced arm portions **26a** and **26b** adapted to slidably receive the rear frame member **28**. The front frame member **27** is rigid and has a lower rearwardly extending ear portion **27*a*** arranged for supporting the associated pivot pin **32** pivotally connecting frame members **26** and **27**. The rear frame member **28** is rigid and forms an upper extension or continuation of the shank of the blade. As shown, the rear frame member

has a straight back section **28***a* and a dog-leg shaped forward section **28***b* for greater strength. The blade depends from the lower end of the rear frame member **28** and is mounted for movement between an elevated position behind the rear axle and an angular earth-penetrating position at an angle to the verticle axis of the chassis. In the earth-penetrating position, the forward lower tip of the blade is below and substantially forwardly of the rear wheels and axle and this has been found to distribute the pull-down forces of the blade between each of the wheels. Although thevertical axis of the chassis will vary according to the auxiliary equipment mounted thereon, the vertical axis of the chassis shown is only slightly forwardly of the forward tip of the blade.

A pair of hydraulic cylinders **36** and **37** are mounted on opposite sides of the support frame **21** and are selectively actuated by suitable controls accessible to the driver to raise or lower the blade. These hydraulic cylinders **36** and **37** are pivotally connected at the forward upper connection **31** of the frame and at a point on the lower frame member rearwardly of the lower forward pivot pin **32** at a pivotal connection **35.** In this way the extension of the associated piston rods in the cylinders **36** and **37** lowers the blade and retraction of the associated piston rods raises the blade. The digging angle of the forward lower toe end of the blade is changed by the extension and retraction of the piston rod in the upper frame cylinder **25** with an extension reducing the angle and a retraction increasing the angle.

The blade is also supported by the frame to one side of the longitudinal axis of the vehicle chassis and extends downwardly and inwardly from the one side at an angle to the vertical axis of the vehicle chassis represented at A. The blade preferably extends past a longitudinal plane passing through the vertical axis of the chassis a distance represented at *d*. This angularly inclined mounting for the blade produces an angular cut in the soil as the blade is drawn therethrough which has been found to greatly reduce friction and thereby reduces the amount of pulling force required for the blade. Further, the blade is carried to one side of the auxiliary equipment **16** so as not to interfere with the operation thereof.

The blade **22** includes an elongated shank **41** which is generally flat-sided, relatively narrow and is provided with a sharp forward cutting edge **42** so as to cut through the soil in a knife-like action. The shank **41** is formed of a single piece of hardened steel or the like. The upper end of the shank is shown as being inclined or bent at a right angle to the shank and is removably fastened to the rear frame member **28,** the upper end of which is similarly bent at right angles so that both ends extend substantially vertical as best seen in FIG. **3.** The shank and frame member **28** are releasably fastened by spaced bolts **43,** it being understood that the shank and rear frame member could be made as an integral part or unit but the total weight of the two makes separate parts preferable.

The blade **22** also includes a digger tooth **45** extending forwardly and downwardly from the lower forward end of the shank **41** which terminates at its forward end in a sharp cutting edge forward of tip **46.** The digger tooth **45** has a forward generally wedge-shaped toe section **47** providing an upper lifting surface to lift or elevate the soil. The top surface of the toe forms the blade angle inclined to the horizontal represented at B. The digger tooth of the blade is contoured with a forwardly and downwardly inclined bottom edge **48,** an intermediate C-shaped slot section **49** and a depending heel section **50** at the lower rear end. The bottom edge **48** is inclined to the horizontal at an angle represented at C which affords relief for the soil. The bottom edge **48** of the blade is shown slightly below that of the bottom of inclined lateral wedge member **51** but it is understood that these surfaces may be in the same plane. The toe section of the blade is formed by affixing the lateral wedge member **51** which projects from the side of a forwardly and downwardly directed lower extension of the blade shank and includes an inclined forward portion **51***a* and a horizontal rear portion **51***b*. The top of the forward portion **51***a* merges with the top of the shank to afford a substantial top lifting surface at the forward end of the blade. The forward end of the lateral wedge member **51** terminates in a beveled front edge. The lateral blade section is provided with an outer beveled edge **51***c* for added relief for the soil.

For the dispensing of the cable **18** into the trench formed by the blade the back of the blade is provided with a cable dispenser which includes a pair of spaced parallel trailing guide plates **60** which butt against the back side of the shank represented at **54** and are fixedly secured thereto as by welding. The outer surfaces of the guide plates are flush with the side faces of the shank and the inner surfaces are spaced apart to form a trough or passage **61** through which the cable slides. For the supporting of a pulley **62** on an axle **63,** a pair of arcuate cut-out sections **64** are taken from the guide plates to form correspondingly shaped slots in the guide plates to form correspondingly shaped slots in the guide plates which open along the back side. These sections **64** are mounted on an insert member **65** which releasably inserts between the guide plates leaving enough space for the cable to slide in the passage. A pair of additional cover plates **66** are secured over the guide plates to cover the slots which receive the pulley support sections **64.** The insert member **65** is suitably releasably secured to the back of the shank preferably at its upper end by a suitable fastener (not shown).

The pulley **62** is readily removed from the blade by sliding the support sections rearwardly up and out of the arcuate slots in plates **60** to a removed position, as best seen in FIG. **7.** This removable arrangement for the pulley allows the cable to be readily inserted into the passage **61** anywhere along the length of the cable and eliminates the necessity of threading the cable through a top opening.

In the full sequence of operation of the above-described apparatus the blade is normally carried in a raised position as shown in FIG. **2.** In this position the lower end of the blade is above the ground and to one side of the center of the vehicle chassis so that it does not interfere with the normal operation of the vehicle or other equipment mounted at the rear thereof such as the digging assembly **16** or at the front thereof.

When it is desired to lay a cable the trenching blade is generally lowered into the earth as the vehicle is moved along the ground by the extension of the piston rods in the cylinders **36** and **37.** To adjust the blade angle B the cylinder **25** is actuated. In the lowered operating position for the blade the forward end thereof is substantially forwardly of the rear wheels and rear axle and at approximately the center of the vehicle as viewed from the side. The blade extends downwardly

and inwardly from the side of the vehicle toward the center and slightly beyond the center a distance d as viewed from the rear end thereof. As the blade is moved forwardly by the vehicle a trench is made in the soil into which the cable is dispensed.

The off-center or offset mounting for the blade which extends downwardly and forwardly to a point forwardly of the rear wheels has been found to require a less pulling force and is highly effective in distributing the pull-down forces on the vehicle more uniformly between all four wheels. Further a side-mounted unit as shown places the blade in an out-of-the-way position so as not to interfere with other equipment carried on the vehicle.

The angles for the blade above-described may vary but optimum results have been obtained in angle A on the order of 20°, angle B between 10° and 20°, preferably 15°, and angle C on the order of 6°.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.

What is claimed is:

1. In vehicle-mounted apparatus for laying cable and the like in the soil having a vehicle chassis and front and rear ground-engaging wheels on front and rear axles, respectively, the combination comprising:

an earth-penetrating blade having a forwardly and downwardly projecting digger tooth at the lower front end of said blade and cable-dispensing means rearwardly of the digger tooth, and

blade mounting means mounting said blade on said chassis for movement between an elevated position and an angular earth-penetrating position in which said blade inclines downwardly and forwardly from behind the rear axle to a point forwardly of the rear axle with the digger tooth projecting into the ground forwardly of the rear axle to distribute the pull-down forces of the blade between the front and rear axles and form a trench for laying the cable as the blade is advanced through the soil.

2. In vehicle-mounted apparatus as set forth in claim **1** wherein said blade includes a shank and said digger tooth has a forwardly and downwardly inclined toe section at the lower end of shank providing an upper lifting surface and a lower relief surface, each of said upper and lower surfaces being inclined rearwardly and upwardly with respect to the horizontal.

3. In vehicle-mounted apparatus as set forth in claim **2** wherein said toe section includes a laterally extending wedge-like member on one side of a forward and downwardly directed lower extension of the shank.

4. In vehicle-mounted apparatus as set forth in claim **2** wherein said shank has a relatively thin cross section and a forward cutting edge.

5. In vehicle-mounted apparatus as set forth in claim **2** wherein said upper lifting surface of the toe section is inclined at an angle of about 15° with respect to the horizontal.

6. In vehicle-mounted apparatus as set forth in claim **2** wherein said lower surface of the toe section is inclined with respect to the horizontal at an angle of about 6°.

7. In vehicle-mounted apparatus as set forth in claim **2** wherein said blade has a substantially C-shaped slot rearwardly of the toe section along the bottom edge thereof and a depending heel section rearwardly of the slot for forming the trench.

8. In vehicle-mounted apparatus as set forth in claim **2** wherein said cable-dispensing means for the cable includes a pulley supported at the lower end of a cable guide passage at the back of the blade, said pulley being disposed rearwardly of said heel section.

9. In vehicle-mounted apparatus as set forth in claim **8** wherein said pulley is releasably mounted at the rear of the blade to facilitate the positioning of the cable in the cable guide passage.

10. In apparatus as set forth in claim **1** wherein said mounting means for the blade includes parallelogram-type support frame having spaced upper and lower frame members and spaced front and rear frame members and drive means operatively associated with said frame members to raise and lower said support frame to adjust the depth of the blade in the soil.

11. In apparatus as set forth in claim **10** wherein said upper frame mender is in the form of a hydraulic cylinder adapted to change the angle of the blade as it inclines downwardly and forwardly from behind the rear axle.

12. In apparatus as set forth in claim **10** wherein said drive means includes hydraulic cylinder means connected between the forward end of the upper frame member and between the forward and rear ends of the lower frame member to raise and lower the blade.

13. In vehicle-mounted apparatus as set forth in claim **10** wherein said blade depends from said rear frame member.

14. In vehicle-mounted apparatus for laying cable and the like in the soil having a vehicle chassis and ground-engaging wheels, the combination comprising;

an earth-penetrating blade having a forwardly and downwardly projecting digger tooth at the lower end of said blade, and

blade mounting means mounting said blade on said chassis for movement between an elevated position to one side of the central longitudinal axis of the chassis and an angular earth-penetrating position extending downwardly and laterally from the one side at an angle to vertical to a position underlying the central longitudinal axis and with the digger tooth being disposed below and in approximate vertical alignment with said central longitudinal axis to make an angular cut and form a trench in the soil for the cable as the blade is advanced through the soil.

15. In vehicle-mounted apparatus as set forth in claim **14** wherein said blade extends downwardly and laterally from the one side to an extent whereby the digger tooth extends past a vertical plane passing through the central longitudinal axis of the chassis.

16. In vehicle-mounted apparatus for laying cable and the like in the soil having a vehicle chassis with ground-engaging wheels and auxiliary earth-working apparatus mounted on the vehicle chassis in alignment with the central longitudinal axis thereof, the combination comprising:

an earth-penetrating blade having a trailing cable dispenser, and

means mounting said blade on said chassis for movement between an elevated position to one side of said auxiliary apparatus and an angular earth-penetrating position extending downwardly and laterally under the chassis and under said wheels

whereby the blade extends laterally at least to a vertical plane containing said central longitudinal axis to make an angular cut in the form of a trench in the soil for the cable as the blade is advanced through the soil.

17. In vehicle-mounted apparatus as set forth in claim 16 wherein said mounting means includes a parallelogram support frame on the side of the vehicle and inclined at a selected downwardly and laterally projecting angle for in-line angular movement of the blade between the elevated and earth-penetrating positions.

18. In vehicle-mounted apparatus for laying cable and the like in soil, having a vehicle chassis and ground-engaging front and rear wheels on front and rear axles respectively, the combination comprising:

an earth-penetrating blade having a forwardly and downwardly projecting digger tooth at the lower front end of said blade and cable dispensing means rearwardly of the digger tooth, and

blade mounting means mounting said blade on said chassis for movement of the blade between an elevated position to one side of the central longitudinal axis of the chassis and rearwardly of the rear axle and an angular earth-penetrating position extending downwardly and both laterally and forwardly from the one side and behind the rear axle to a point wherein the digger tooth extends below and forwardly of the rear axle to make an angular cut in the soil and to distribute the pull-down forces of the blade between each of the wheels as the blade makes an angular cut and forms a trench in the soil for the cable as the blade is advanced through the soil.

19. In vehicle-mounted trenching apparatus for laying cable in the soil having a vehicle chassis with front and rear ground-engaging wheels on front and rear axles respectively and auxiliary earth-working apparatus mounted on the vehicle chassis in alignment with the central longitudinal axis thereof, the combination comprising:

an earth-penetrating blade having a shank with a sharp forward edge and a digger tooth projecting forwardly and downwardly from the lower front end of the shank, said blade having a wedge-shaped member to one side of a forwardly and downwardly directed lower extension of the shank to form a toe section with an upper lifting surface and a lower relief surface, said surfaces being inclined upwardly and rearwardly and a heel section rearwardly of the toe section,

a cable dispenser mounted at the back of the blade including a cable guide passage and a removable pulley disposed rearwardly of the heel section,

a support frame mounting the blade for in-line, angular movement between an elevated position to one side of the auxiliary earth-working apparatus extending downwardly and both laterally and forwardly from the one side and from behind the rear axle at angles to the vertical axis of the chassis to a position wherein the digger tooth is disposed below and forwardly of the rear axle to make an angular cut in the soil and to distribute the pull-down forces of the blade between each of the wheels as the blade makes an angular cut and forms a trench in the soil for the cable while being advanced through the soil, said frame including upper and lower frame members and forward and rear frame members pivotally connected at the corners in a parallelogram configuration, said blade being releasably fastened to the lower end of said rear frame member and extending downwardly and forwardly therefrom, and

hydraulic drive means for the frame to advance and retract the blade into the soil and adjust the angle the toe section makes with the horizontal.

* * * * *