Aug. 15, 1961 R. N. WHEELER 2,995,902

PLOW MACHINE FOR LAYING MATERIAL UNDERGROUND

Filed Nov. 6, 1958 2 Sheets-Sheet 1

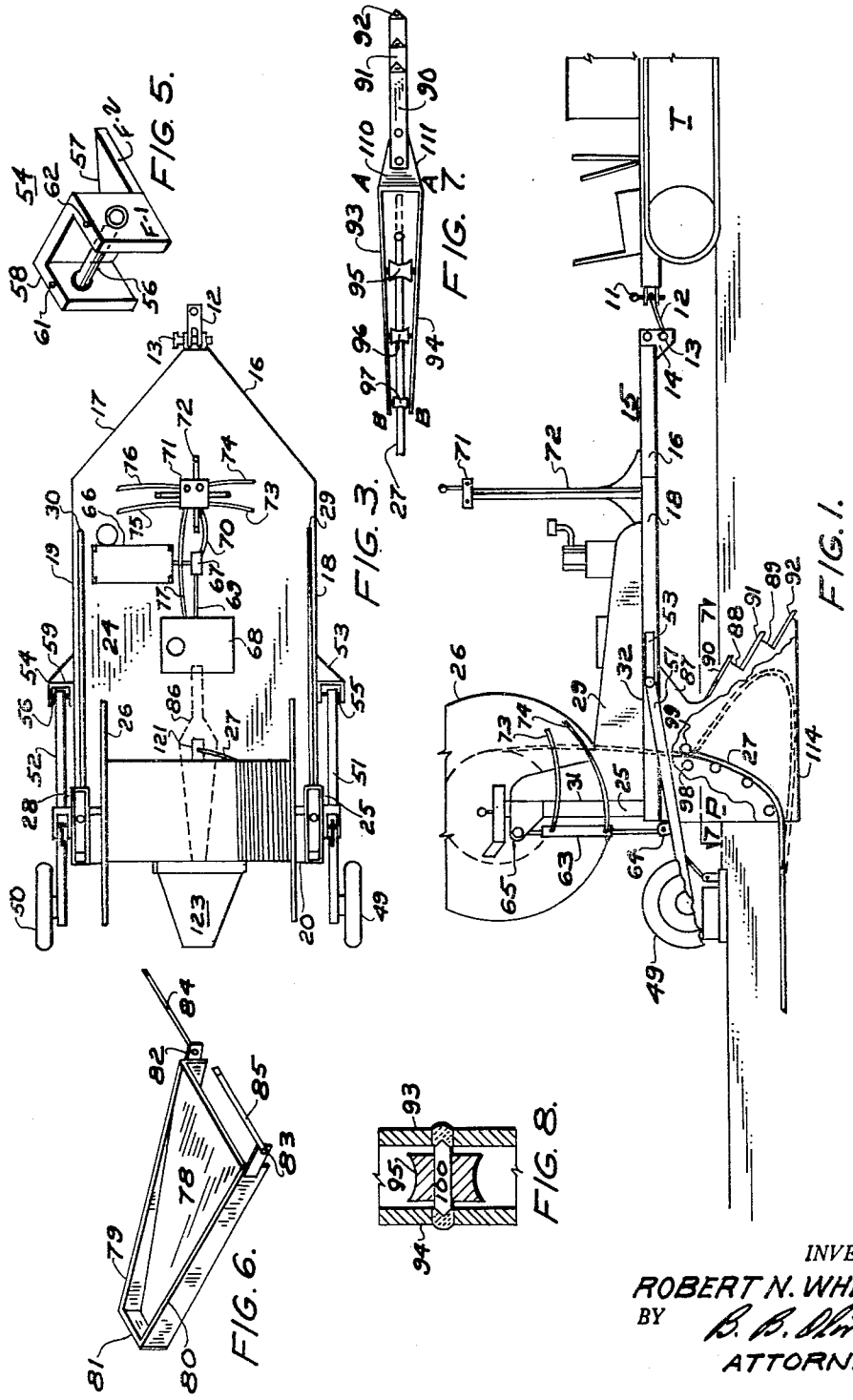

FIG. 1.

FIG. 3.

FIG. 5.

FIG. 7.

FIG. 6.

FIG. 8.

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PLOW MACHINE FOR LAYING MATERIAL UNDERGROUND

Filed Nov. 6, 1958 2 Sheets-Sheet 2

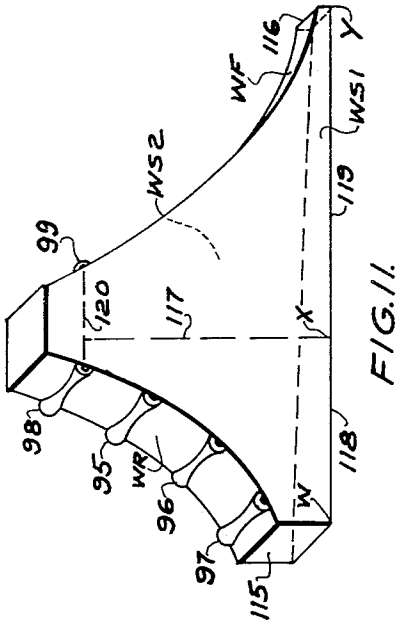

FIG. 11.

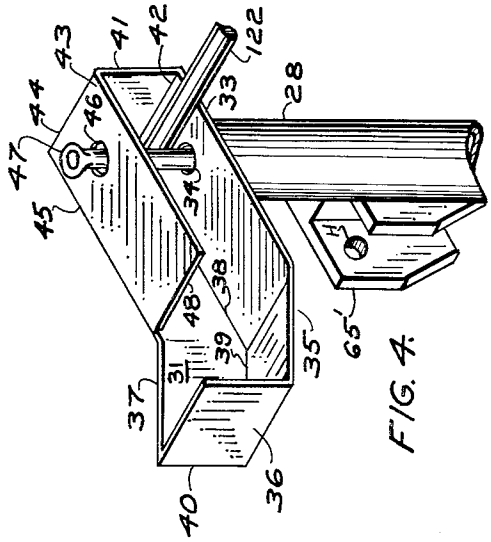

FIG. 4.

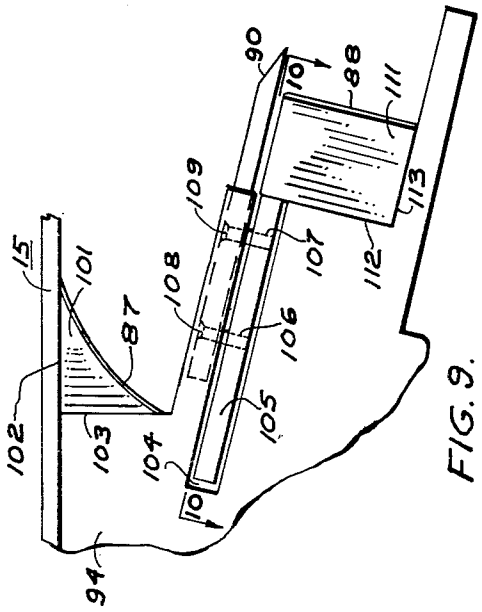

FIG. 9.

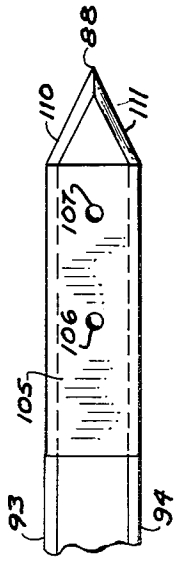

FIG. 10.

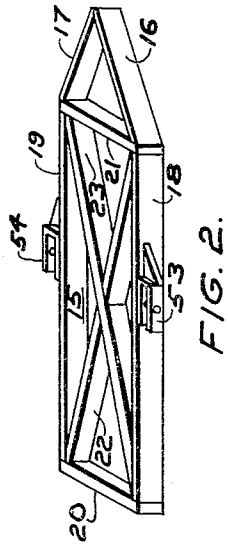

FIG. 2.

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United States Patent Office 2,995,902
Patented Aug. 15, 1961

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PLOW MACHINE FOR LAYING MATERIAL UNDERGROUND

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Filed Nov. 6, 1958, Ser. No. 772,301
1 Claim. (Cl. 61—72.6)

This invention relates to improvements in a machine equipped with a plow for laying underground materials such as cables, pipe and conduit in which the operations of trenching, laying and covering are performed in one operation and, more specifically, to improvements in the machine in respect to the plow and the means for regulating the position of the plow with respect to the ground.

Machines of this kind are generally supported and pulled by a tractor at the front and at the rear are provided with some means of running support, such as wheels. With such an arrangement, the depth of trenching and the angle of the plow have been regulated either by mechanically adjusting one or both of the supporting wheels, or by leaving the wheels in a fixed position and moving the plow structure with respect to the frame of the machine. In either case, it has been necessary to stop the machine and make adjustments in various mechanical linkages either on the wheels, or the plow and, since a change in ground condition such as from sand-rock to soft sand, or a change in slope such as from a flat surface to a hilly surface frequently requires a change either in plow depth or in the angle at which the plow lies with respect to the ground, considerable working time has been lost during such changes, both during normal cable laying as well as during the occasional reversing and cable retrieving operation discussed below.

By way of explanation, the term "plow depth" is taken to mean the physical distance below ground level at which cable is being laid. The term "angle of the plow" is intended to refer to the relation of the plow relative to a horizontal plane as a reference. The plow is usually rigidly attached in a vertical position to the frame of the machine so that when the bed of the frame is maintained substantially level or horizontal during normal plowing, the angle referred to will be substantially vertical. However, when plowing around the side of a hill, for example, it will be appreciated that, unless steps are taken to raise the downhill side of the frame, the frame will not remain level and the angle referred to will not remain vertical. Consequently, the wheel or other means used for raising and lowering the frame are important in the machine both for controlling depth, as well as the angle of the plow.

As mentioned above, a machine of this type occasionally needs to be reversed. When the plow, for example, unexpectedly strikes a bed of hidden rock, it may be necessary to reverse and retrieve a short section of the previously laid cable. In the ordinary plow structure, the passageway provided within the plow for the cable has generally taken either exactly or substantially the form of a curved hollow tube, having an inside diameter only slightly in excess of the diameter of the cable and, when attempts have been made to retrieve the cable through such a passageway, it has been found that the cable will often wedge itself or bend or become lodged at the lower entrance to the passageway, causing damage to the cable. That is, in reversing a machine having a plow equipped with the type of cable passageway described, the cable is forced to follow a substantially fixed path as it moves from the bottom of the trench to the reel on which it is rewound. As a practical matter, it is difficult to reverse a large machine of this kind and take the cable up at exactly the same rate at which it is

being forced back into the plow, which often results in damage to the cable for the reasons stated. Furthermore, it has been found that the difficulty of adjusting plow depth and angle has hampered the reversing operation, since cable removal is sometimes greatly facilitated by a slight change in the working depth or angle of the plow.

So far as the plow structure is concerned, it is also obviously desirable that the structure have good trenching characteristics in addition to the retrieving characteristics and, in operation, the plow should penetrate quickly to its desired depth, maintain this depth, be rugged, present a minimum of running friction and be adaptable to various hard, soft and intermediate soils and soft rock.

With the above in mind, it is an object of this invention to provide in a machine of the type described, frame supporting members such as wheels capable of being raised and lowered in finite or substantial amounts, either individually or together, while in transit or at standstill, while going forward or in reverse, and requiring a minimum of manual effort on the part of the machine operator to produce such changes.

Another object is to provide in such a machine an improved plow to facilitate both the laying of cable as well as the retrieving of cable during a reversing operation.

A further object is to provide an improved machine of this kind in which both the normal cable laying and the occasional cable retrieving operations are facilitated through a combined improved plow and improved means for raising and lowering the frame supporting members as the cable is laid in or removed from the ground.

Other and further objects of the invention will appear as the description proceeds and in the drawings, in which:

FIG. 1 represents a side elevation view of the machine, showing the machine coupled to a tractor, with a cut-away section of the improved plow showing in dotted lines how the cable is free to flex within the plow during reversing and showing the improved lever arrangement for the wheels and individual hydraulic control means for regulating the position of the wheels.

FIG. 2 shows the arrangement of the structural members making up the frame of the machine.

FIG. 3 represents an overall plan view of the machine showing a mounted reel feeding cable through the frame towards the plow, in dotted lines, and a self-contained motor and pump for a hydraulic system used in raising and lowering the frame supporting wheels.

FIG. 4 is an enlargement of the details associated with the post mounting for the reel shaft.

FIG. 5 is a detail of the bracket which furnishes a pivotal support for one end of the lever arm on which each wheel is mounted.

FIG. 6 is an enlargement of the pan that is pulled behind the machine to assist in tamping the disturbed surface soil.

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 1 and showing the arrangement of the rollers, the tapering design of the plow and, in dotted lines, the position which the cable is free to assume during reversing.

FIG. 8 is an enlargement showing how a cable roller is mounted within the plow.

FIG. 9 is an enlargement of a portion of the plow showing how the individual plow points are mounted and how the front of the plow is given a streamlined effect.

FIG. 10 is a sectional view of a portion of FIG. 9 taken along the lines 10—10.

FIG. 11 is a somewhat schematic representation of the general shape of the passageway or chamber provided

within the plow and in which the cable is free to move and play.

Referring first to FIG. 1, there is shown a prime mover, generally represented by the tractor T, having a vertical drawbar pin **11** passing through one end of a link **12**, the other end of link **12** being connected with a horizontal pin **13** mounted in bracket **14** fixed to the machine frame structure, designated generally as **15**. The connection made by pins **11** and **13** and link **12** is such that the prime mover and the machine frame structure can rotate in a horizontal plane around pin **11** and in a vertical plane around pin **13**. That is, as is customary with connections of this kind, pins **11** and **13** and link **12** are loosely fitted together, allowing free play at the connection in both horizontal and vertical directions, which play is highly desirable during raising and lowering of the plow and for negotiating hills, ravines and the like.

As is known, frame structures as such for a plow machine may take many forms, such as being cast or fabricated and bolted, welded or otherwise fastened together. For the purpose of this invention, a welded I-beam structure arranged as in FIG. 2 has been found satisfactory. In FIG. 2, **16**, **17**, **18**, **19** and **20** represent I-beam side members and **21**, **22** and **23** represent I-beam bracing members, all being of suitable strength and welded together as required. For the purposes of additional strength and for providing a walking surface above the frame, the entire frame **15** is covered by a deckplate **24** (FIG. 3) welded to the frame **15**. Since plow frames are, as stated above, old in the art and because the frame, per se, is a part of the invention only as the same is necessary in the combinations herein claimed, the frame is not otherwise described in detail.

Referring again to FIG. 1, there is shown attached to a rear corner of the frame proper a reel supporting post **25** whose principal purpose is to furnish a support for the shaft of the reel **26** on which the cable **27** is stored prior to being laid underground. A similar post **28** is attached to the opposite rear corner of the frame (FIG. 3). Posts **25** and **28** are tubular steel posts and are welded at their base to the deckplate **24** (FIG. 3) and are further reinforced and braced by members **29**, **30** (FIG. 3). Members **29**, **30** are made of metal plate cut in a somewhat L-shaped section and are welded, in the case of plate **29** to post **25** along line **31** and to the deckplate **24** along line **32**. Plate **30** (FIG. 3) is welded in a similar manner to post **28** and deckplate **24**. Any form of suitable bracing for posts **25**, **28** could be used. However, by forming the members **29**, **30** out of plate in the manner described, a minimum of room is used widthwise of the frame, thus minimizing obstruction placed in the path of the rotating reel **26**.

Mounted on the top of reel posts **25** and **28** are reel shaft supporting structures, the details of which may be seen by reference to FIG. 4, in which the shaft supporting structure mounted on post **28** is represented. A fabricated welded metal plate construction has been found suitable for this purpose. In FIG. 4, the reel shaft support is shown as made up of a number of plate sections, including a base section **33** welded directly to the top of post **28** and having a hole **34** aligned with the hollow interior of post **28**. Joined to one end of section **33** is a somewhat upwardly sloping section **35** and joined to section **35** is vertical section **36**. Joined to sections **33**, **35** and **36** is a further section **37**, shaped generally as shown, joined to section **33** along the line **38**, to section **35** along the line **39** and to section **36** along the line **40**. Also joined to section **33** along the line **42** is a vertical section **41**. To complete the reel shaft supporting structure, there is provided a horizontal section **43** joined to section **41** along line **44** and to section **37** along line **45**. Section **43**, similar to section **33**, is provided with a hole **46**, axially aligned with hole **34** and of substantially the same diameter. Arranged to drop through holes **46** and **34** into the hollow interior of post **28**, there is provided a pin **47** which can be removed from holes **46** and **34** at will and, as later explained, is dropped in the position shown after the reel has been loaded on the machine to maintain the reel shaft in place during operation.

Reference is now made to FIG. 1 and FIG. 3 in which the running support for the rear of the frame during plowing is shown as comprising two wheels **49**, **50**, whose axes are attached to the free ends of two levers **51**, **52**. The opposite ends of the levers **51**, **52** are pivotally mounted on brackets **53**, **54** fixed to the sides of frame **15**, the brackets having fixed pins **55**, **56** around which the levers **51**, **52** are enabled to pivot. That is, **51** and **52**, in effect, comprise levers pivoted on one end and whose pivot points are found in pins **55**, **56**. It will be seen that the position of levers **51**, **52** controls the sidewise tilt of frame **15** as well as the height of the frame above the ground. Consequently, the depth and angle of the plow are controlled by the position of levers **51**, **52**.

The fabricated welded construction utilized in brackets **53**, **54** is illustrated in FIG. 5, in which bracket **54** is shown as comprising a triangular shaped member **57** and a U-shaped member **58**, the members **57** and **58** being formed of metal plate and joined together along the line **59** (FIG. 3), after which the complete bracket is joined to frame member **19** (FIG. 2) along the faces F–1, F–2, the method of welding having been found satisfactory for the joining of the bracket to the frame. As previously mentioned, the purpose of the bracket **54** is to provide a pivoting support for one end of lever **52** (FIG. 3) which, in the illustration shown, takes the form of a pin **56**, fixed in bracket **54** and held in position by set screws **61**, **62**, bracket **53** being similarly arranged. It should be understood that the area of contact between pin **56** and lever **52** should preferably take the form of a suitable bearing, not otherwise shown.

Each of the levers **51**, **52** is arranged to be raised and lowered and held in given positions by hydraulic cylinders. Explanation of this arrangement is now made in reference to lever **51**. In FIG. 1 there is seen hydraulic cylinder **63** attached to lever **51** through bracket **64** and further attached at its opposite end to an I-shaped bracket **65** welded to post **25**, the bracket **65** being of the general configuration of the bracket **65'** shown in FIG. 4 welded to post **28** slightly below the reel shaft supporting structure. The hole H shown in bracket **65'** provides means for supporting a pin, not shown, connecting the cylinder and the bracket.

The bracket **64** is made similar to the U-shaped member **58** shown in FIG. 5 as a part of bracket **54** and is, therefore, not shown in further detail. The connections made at brackets **64** and **65** preferably include bearings, not shown, and are such as to allow a pivoting action at the connections.

For the purpose of operating the hydraulic cylinder **63**, there can be seen in FIG. 3 a hydraulic system on the frame comprising a gasoline motor represented at **66**, driving a pump **67** drawing oil from a supply tank **68** through line **69** and feeding pressurized oil through line **70** to a hydraulic hand control **71** mounted on a suitably braced stand **72** to facilitate operation of the control. Leading from the hydraulic control **71** are pressure lines **73**, **74** leading to cylinder **63** and, similarly, pressure lines **75**, **76** are provided for a cylinder, not shown, on the opposite side of the machine. An oil return line **77** leads back from the control **71** to the oil tank **68**.

While hydraulic systems as such are old, the system employed herein is believed to be novel in the relation disclosed. As will be understood, the purpose of the motor **67** is to develop sufficient pressure in the line **70** such that, by proper manipulation of hand control **71**, this pressure may be directed to certain of the lines **73**, **74**, **75** or **76** and relieved in others of the same lines, to cause the cylinders to raise or lower the levers to which they are attached, thus raising or lowering the wheels and raising or lowering the particular sides of the frame on which the wheels are mounted and, consequently, raising

or lowering the plow in depth or changing the angle of the plow.

The hydraulic system shown will be recognized as a complete, self-contained system on the machine. Such a system offers many advantages in operation. However, where the tractor or other prime mover provides a source of pressure, the motor **66**, pump **67**, tank **68** and lines **69**, **70** and **77** could be eliminated and suitable line connections made between the control **71** and the pressure source located at the tractor. Furthermore, while an oil hydraulic system is preferred, systems employing air or other suitable pressure media could be employed for the purposes stated.

Referring now to FIG. 6, there is shown a type of pan whose purpose is to tamp the surface soil that may be disturbed during cable laying operations. The pan follows a simple but effective construction in which four sections of plate material are joined by welding. **78** is a trapezoidal shaped section having joined thereto side sections **79** and **80** and rear section **81**. It will be noticed that section **78** is attached to sections **79**, **80** and **81** so as to provide a surface that slopes downward from front to rear of the pan, such that the disturbed soil will be gathered in and compressed as the pan moves forward. Further attention is directed to the fact that, by having the configuration shown in FIG. 6, a somewhat 3-sided receptacle is provided at the rear of the pan, having a bottom formed of section **78** and sides formed of the insides walls of sections **79**, **80** and **81**. As will be described later, such a receptacle provides a convenient location for storing heavy articles to weight the pan. In order to pull the pan behind the frame of the machine, brackets **82**, **83** are attached to sections **79** and **80** respectively and through links **84**, **85** may be connected to frame **15** (FIG. 1) by suitable means, not shown, the connection between **85** and **83** and between **84** and **82** being a somewhat loose connection to allow the pan to rise and fall according to the ground conditions encountered.

The description thus far has dealt with the frame proper, the reel supporting posts and the pan used to tamp the soil and has further dealt with the wheel supports for the frame and the hydraulic system devised to regulate the wheels during operation of the machine. The description will now proceed to describing the construction of the plow which, in FIG. 1, is generally represented as a structure P, attached to the underside of the frame **15**.

Looking at the plow P lengthwise in FIG. 1, the rear of the plow can be seen to be substantially in a line with the rear of the frame and, looking at the plow structure widthwise and, particularly at the dotted line **86** representing the plow in FIG. 3, the plow can be seen to be located in the middle, widthwise, of the frame. Referring further to FIG. 1, it can be seen that the plow includes leading edges **87**, **88** and **89** and a plurality of points **90**, **91** and **92**.

Particular attention is directed to the presence of a plurality of points, all pointed downwardly, and further, to the fact that the points are mounted so that in trenching, the bottommost point is the leading point and the uppermost point is the trailing point. That is, in the construction shown in Fig. 1, there are three points **90**, **91** and **92**, point **92** being the leading point and point **90** being the trailing point. By having a plurality of points and having the points so staggered, it has been found that the plow has an inherent tendency to dig in quickly and remain at whatever depth the plow is fixed and, particularly, in situations where different soil conditions are encountered. For example, as the tractor proceeds, the soil may change from firm to soft or only a layer of soil, such as the layer acting on the bottommost point, may change from say, firm to soft. In either case, the plow exhibits an inherent tendency to remain in the ground at the depth originally chosen.

Referring to FIG. 7, there is shown a sectional view taken along the line **7—7** (FIG. 1) in which the general plow construction can be seen to comprise main side plates **93**, **94** separated by cable rollers **95**, **96** and **97**, the purpose of the rollers being to reduce the amount of friction encountered during the normal cable laying operations. In addition to the rollers **95**, **96** and **97**, two additional rollers **98** and **99** are provided as illustrated in FIG. 1. It will be noticed that this section has a somewhat tapering effect in that dimension A—A is greater than the dimension B—B. As is explained later, the taper greatly facilitates placing of the cable. It will also be noticed that, ahead of roller **95**, the interior of the plow provides considerable free room in which the cable may play, the purpose for this being more fully explained below.

Referring next to FIG. 8, a preferred method of mounting the rollers is shown in which it is assumed, for example, that a vertical sectional view through roller **95** has been taken. As illustrated in FIG. 8, roller **95** is mounted so as to rotate around pin **100**. The ends of the pin **100** are fixed by being shaped to facilitate the use of an inverted V-weld between the ends of the pin and the plate members **93**, **94** in which suitable holes are provided for the purpose. Such a construction gives a rugged mounting for the pins and minimizes the amount of running friction, since no bolts, nuts or the like appear on the exposed surface of the plates **93**, **94**.

Referring next to FIG. 9, there is shown a detail of the area in and around plow point **90**. This section of the plow comprises a somewhat triangular shaped plate **101**, having a sharpened edge **87** and which is welded to frame **15** along line **102** and to plate **94** along line **103**, it being understood that such welding is preferably built up where needed to fill in voids so as to provide a relatively streamlined surface for the leading edge of the plow and, further, that plate **101** is similarly connected with plate **93**, not shown in FIG. 9. Plate **93** and plate **94** are slotted as shown at **104** to receive a rectangular shaped plate **105** having two bolt receiving holes **106**, **107** matched with similar holes **108**, **109** in plow point **90**. Once mounted in slot **104**, plate **105** is secured to plates **93** and **94** by welding along all of the edges in contact between **93**, **94** and **105** and, once so fixed in position, plow point **90** is then bolted to **105** by suitable bolts, not shown. Plow point **90** is not otherwise fastened to the plow structure proper, which arrangement facilitates replacement of points as needed.

FIG. 10 represents a section taken generally along the lines **10—10** shown in FIG. 9 to illustrate how streamlining is obtained on the leading edge immediately below plow point **90**. In FIG. 10 it can be seen that there are two plates **110** and **111**, suitably beveled so as to be capable of being welded in a sharp edge at their leading ends and the same being attached at their trailing ends to plates **93** and **94**, respectively, by welding which, in the instance of plate **111**, is shown in FIG. 9 as being along lines **112** and **113**.

A principal feature of the invention is illustrated in FIG. 1 in which the dotted line **114** represents the position the cable may take during reversing of the machine. That is, rather than maintain the position indicated by cable **27**, shown in solid lines the cable may, when overrun during laying or reversing, flex a substantial amount within the plow proper and assume a position such as that indicated at **114**. To understand better how this additional flexing is made possible, reference is made to FIG. 11.

In FIG. 11 there is shown a somewhat schematic representation of the shape of the passageway or chamber provided within the plow. That is, FIG. 11 represents the approximate shape of the chamber provided within the plow and in which the cable is free to flex and move whenever more cable is being forced into the plow than is being taken out, as may occur particularly during a reversing operation and sometimes during a laying opera-

tion. So far as the rear wall WR of this chamber is concerned, its boundaries are established principally by the rollers **95**, **96**, **97** and **98**, since the cable cannot travel rearwardly beyond these rollers. At the front of the chamber on the other hand, the front wall WF is, in effect, established by the interior wall area immediately behind the points **90**, **91**, **92** located on the front of the plow. Because of the particular staggered mounting chosen for the points and the use of plate as sidewalls for the plow, the front wall WF of the chamber takes on the sloping appearance illustrated in Fig. 11. Having established the front wall WF and the rear wall WR, it will be noticed that the side WS–**1** and the side WS–**2**, hidden from view are formed by the inner walls of the plates **93** and **94** in somewhat of a trapezoidal shape. Looking at the entire chamber formed by the walls WR, WF, WS–**1** and WS–**2** shown in FIG. 11, it will be immediately recognized that such a passageway is not either exactly or substantially in the form of a tube and, therefore, restrictive of movement, but rather such a chamber has a trapezoidal shaped cross-section and provides a considerable amount of room in which the cable may at least temporarily flex as may be necessary during operation of the machine.

While it is not desired to be limited to any particular dimensions, it has been found that when using a cable of a diameter of approximately two inches, that satisfactory results are obtained when the reference lines indicated in FIG. 11 and in the table below are of approximately the dimensions stated.

Reference line:	Dimension, inches
115 (width of WR)	2½
116 (width of WF) at base	3
117 (height of WS–**1** and WS–**2**)	31
118 (width WX on base of WS–**1** and WS–**2**)	15
119 (width XY on base of WS–**1** and WS–**2**)	30
120 (space between rollers **98** and **99**)	2½

In reviewing the dimensions given, it will be appreciated that the width of the chamber is controlled by the width of the cable being laid, since the plow must necessarily be wide enough internally to allow the particular size cable to pass freely. This invention, therefore, relates principally to the manner in which the interior of the plow is shaped lengthwise. In the representative dimensions given, it can be seen that with a two inch cable, there is approximately thirty inches, or fifteen times the cable diameter, of room in front of the cable along the base of the chamber in which the cable may move whenever the cable overfeeds into the plow on laying or retrieving.

In operation, a fully loaded reel **26** is mounted on the reeling carrying posts **25**, **28** as pictured in FIG. 3 and in which the cable **27** is shown feeding through a hole **121** in the floor of the frame **15**. The cable is entwined on rollers **95**, **96**, **97** and **98** and is directed to the rear of the machine where a suitable weight or other object, not shown, is placed on the cable until the plowing operation has gotten under way.

In loading the reel **26** on the post **28**, for example, the reel shaft **122** shown in FIG. 4 is first lowered through the space above section **35** and is then, with pin **47** raised, moved into the position shown in FIG. 4, after which pin **47** is placed in the position shown in FIG. 4 which, in effect, locks shaft **122** in its running position. A suitable grease or other lubricant is normally used on section **35** and **33** to facilitate movement and rotation of shaft **122**.

With the reel loaded as above and the tractor T connected to frame **15**, the machine operator, not shown, assumes a position between reel **26** and stand **72** so as to be available to operate the hydraulic control **71**, as well as turn reel **26** to cause cable **27** to unwind. To commence the actual operation, the motor **66** is started, causing pressure to build up in the line **70** and, at this time, tractor T may start forward. Assuming that it is desired to lay cable underground immediately, the operator manipulates such of the control levers on control **71** as are necessary to raise or lower wheels **49**, **50** into running position. Normally, the wheels **49**, **50** would be raised until the levers **51**, **52** are substantially parallel with the members **18**, **19**. As the tractor moves forward under this condition, the plow points **90**, **91**, **92** will begin to dig into the soil and normally will be completely submerged at proper operating depth after running about ten feet or less. With the tractor proceeding and the machine following, the operator continues to unwind the reel **26** as required, which condition is maintained as long as the cable supply lasts, or until a new condition is encountered, such as moving from hilly to level terrain. In the event of change of terrain, such as having to plow on the side of a hill, it may be necessary for the operator to adjust the control **71** so as either to raise or lower either or both of the wheels **49**, **50**. It should be particularly noticed that this change in wheel position can be accomplished very easily and with a minimum of manual effort, since the operator has control of both wheels through the hydraulic control **71**. Therefore, such changes can be accomplished while the machine is running and with little effort. It will also be noticed that, if the operator attempts to force the cable **27** into the plow at a faster rate than it is being laid, the cable may flex and move out of its normal path as best shown in the cutaway section in FIG. 1.

In the event a hidden rock is encountered and it becomes necessary to reverse the machine, the operator is required to reverse the reel and take up cable at substantially the same rate that the cable is being forced back into the plow. Such an operation is difficult of performance because of the uncertain nature of soil and because of the uncertain nature in which the cable **27** is apt to act. If the tractor T, for example, temporarily backs too fast, the cable must either be taken up at a more rapid rate or be subject to damage because of bending at the plow. However, as best illustrated in the cutaway section of FIG. 1 and as shown by the shape of the chamber shown in FIG. 11, room is available within the plow for a substantial amount of such temporary flexing as may be required in these conditions. Therefore, the operator is able to prevent cable damage because of the fact that the excess cable is allowed to store itself temporarily within the plow chamber. Furthermore, if a slight change in plow depth is necessary to retrieve the cable, this slight change can be accomplished by manipulation of the control **71**.

In order to carry out the covering of the disturbed surface soil, the pan **123** shown in FIG. 3 is carried behind the frame **15**. In use, a heavy object such as a rock is placed on the plate **78** shown in FIG. 6 so as to reside in the previously mentioned receptacle formed by the inner walls of sections **79**, **80** and **81**, also shown in FIG. 6. Thus, as the machine proceeds, the soil will be automatically gathered under section **78** and compressed or tamped as the machine proceeds.

In summary, it will be noticed that the invention provides a system by which the plow can be adjusted both in depth or in angle, in slight or large amounts, through the provision of the wheel levers and the hydraulic system operating on the wheels as described. Further, whenever the cable attempts to overrun within the plow, whether during laying or retrieving of cable, ample provision is made for the excess cable to store itself temporarily within the plow so as to prevent damage. It will also be seen that the arrangement of trenching points on the front of the plow provides a plurality of relatively narrow and downwardly inclined beveled working faces for breaching the soil immediately ahead of the material being laid, which arrangement has been found helpful in holding the plow at a given depth. While simple in structure and thus adaptable to manufacture, the invention provides a machine capable of carrying out the com-

bined operations of transporting a reel of material, trenching the soil, laying the material in the trench and tamping the surface of the soil over the material.

One feature of the invention not previously covered in the description concerns the ability of the machine to raise the plow without the necessity of backing the tractor and, in raising, giving the plow both a lifting as well as a backward motion. Thus, the plow points may be raised from a hidden obstruction by being moved along a somewhat arcuate path without being forced to lift the soil resting directly over the points. In prior apparatus, so far as is known, the lifting force applied to the plow has been in a vertical direction and the entire machine, including the tractor, has had to be backed out of any hidden obstruction and, in raising, the plow points have had to lift the soil above the points. Since many such hidden obstructions are encountered in operation, the advantage of this feature may be readily seen.

Having shown a specific embodiment of the invention, it will be apparent that many modifications may be made by those skilled in the art in carrying out the invention. The wheels, for example, could be replaced by runners or other forms of running ground support. The reel, as a further example, could be mounted on a separate carrier drawn by the tractor, either behind or in front of the machine of this invention, and the cable fed from such a carrier to the machine as described herein. The plow, for example, could be cast or otherwise formed in the shape described so as to make available a chamber substantially in the form disclosed. As such changes could be made within the scope of the present invention, it is intended that the matter mentioned in the description shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

In a machine for making a trench and laying in flexible, relatively stiff strand material and of the type having the strand material wound on a reel mounted above an elongated machine frame and including a strand passage through the frame below the reel: an improved trenching plow including a pair of narrowly and laterally spaced, vertical plate walls extending parallel to the longitudinal axis of said frame and rigidly attached to said frame below said passage and constituting the sides of said plow; trench opening means joining said walls at the front thereof; a plurality of friction reducing guide means arranged between said sides within and at the rear of said plow and spaced along a downwardly and rearwardly curved path, said guide means being aligned at the upper end with said passage and terminating in an opening at the lower end of said plow for the transfer of said strand material into the said trench; said plow being provided ahead of said guide means and below said passage with an unobstructed, substantially large chamber whereby said strand material may be normally carried along said path but will be free on reverse operation of said machine to leave said guide means and be accommodated in substantially bent form in said chamber.

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