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Codlin

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[54] **RIPPER PLOW WITH COMBUSTION CHAMBER IN TIP TO EFFECT FRACTURING OF SOIL**

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Related U.S. Application Data

[63] Continuation of Ser. No. 25, Jan. 2, 1970, abandoned.

[52] **U.S. Cl.** **172/699,** 37/1, 37/193, 102/22, 299/13

[51] **Int. Cl.** **A01b 13/08**

[58] **Field of Search** 31/1, 18, 193; 172/40, 699; 102/22, 23; 111/6, 7; 175/4.5; 299/13

[56] **References Cited**

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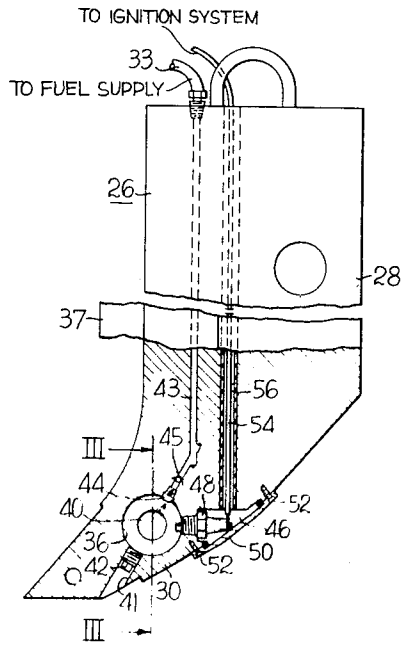
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[57] **ABSTRACT**

A tractor drawn ripper for fracturing earth is provided in its tip with a combustion chamber which vents to both sides of the ripper tip. A passage in the ripper communicates with the chamber and intermittently supplies a combustible fuel mixture thereto from an outside source. A spark plug projects into the chamber and is adapted to fire the combustible fuel mixture to cause repetitive explosions which loosen the earth adjacent the ripper as the latter moves along and permits it to be more easily drawn through the earth.

4 Claims, 3 Drawing Figures



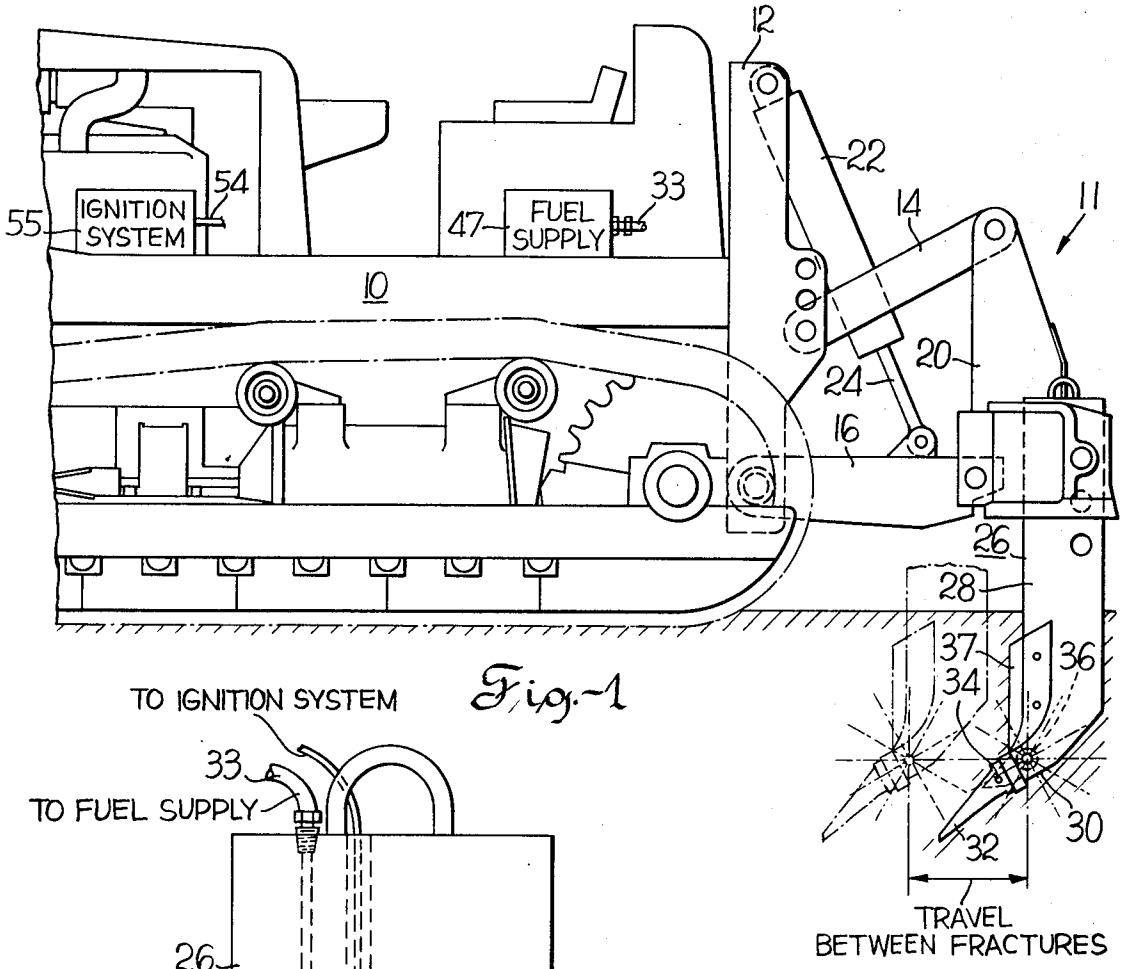


Fig.-1

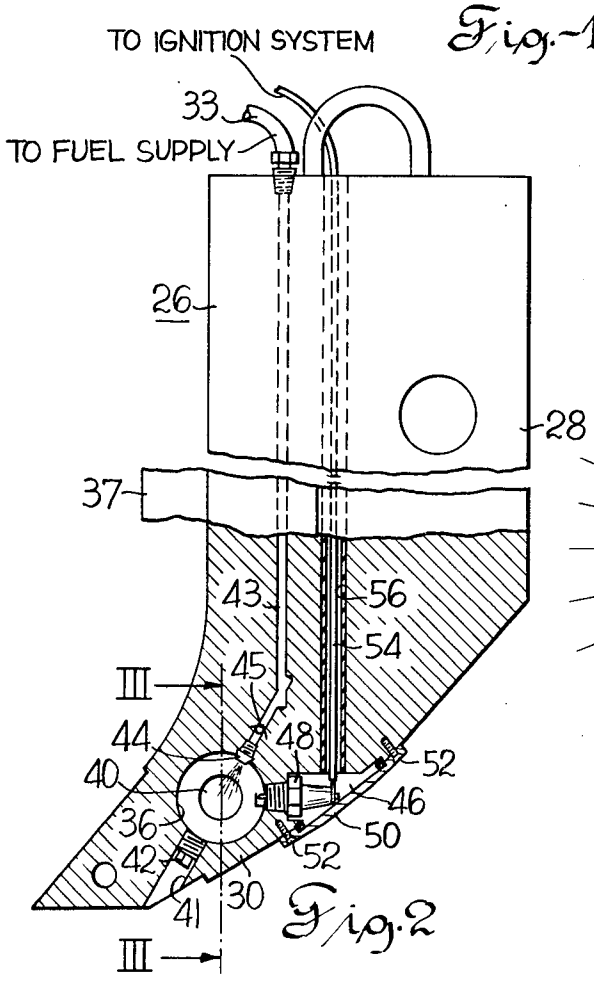


Fig.2

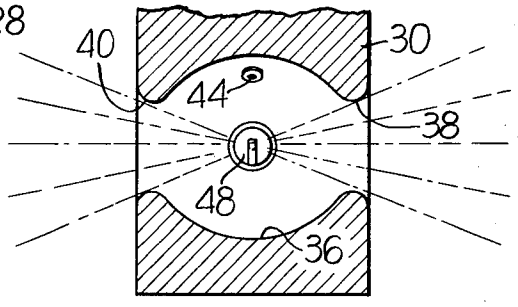


Fig. 3

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RIPPER PLOW WITH COMBUSTION CHAMBER IN TIP TO EFFECT FRACTURING OF SOIL

This is a continuation of Ser. No. 25, filed Jan. 2, 1970, and now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to implements for fracturing earth. More particularly, it relates to rippers which penetrate the terrain and are drawn or otherwise moved therethrough by suitable traction means to cause fracturing and loosening of the soil.

2. Description of the Prior Art

Conventional tractor drawn rippers require that a great deal of force be concentrated at the tip of the ripper shank in order to cause fracturing of the soil or other material being ripped. In effect, ripping is accomplished by brute force. It has been proposed to reduce the amount of force required by providing means which effect vibration of the ripper shank and contribute to fracturing of the material. However, this solution would impose unacceptable vibration levels on associated equipment which would need to be prevented by costly and cumbersome means.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided an implement for dynamic fracturing of material such as earth which comprises a ripper having a shank and a tip. A chamber is provided in the ripper wherein bursts of expanding gas are produced at repetitive intervals as the ripper is moved through the material being ripped. Vent means are provided to discharge the expanding gas from the chamber and take the form of a pair of openings located on laterally opposite sides of the ripper tip from which the gas is expelled to fracture material adjacent thereto. Means are provided to produce bursts of expanding gas at repetitive intervals and comprise a passage in the ripper through which a combustible or explosive substance, such as a mixture of fuel and oxidant, is introduced periodically into the chamber from a suitable source. Means are also provided to ignite or explode the substance in the chamber at the said periodic intervals and such means comprise a spark plug. A passage is provided in the ripper for a conductor which connects the spark plug to an ignition system.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide improved implements for the dynamic fracturing of soil and other materials.

Another object is to provide improved rippers which employ explosive forces to assist in fracturing the material being ripped thereby allowing the ripper to make faster progress in the direction it is being moved with less expenditure of power and with fewer adverse effects on the ripper and associated equipment than is presently obtainable.

Another object is to provide an improved ripper having means whereby expanding gases from explosions are discharged through one or more openings or vents in the sides of a ripper shank near the tip to assist in fracturing the material through which the ripper moves.

Another object is to provide improved rippers of the aforesaid character wherein explosive forces and by-products are repetitively produced and released as the ripper moves along.

Another object is to provide improved rippers which have higher production rates and lower maintainence and operating costs than conventional rippers.

Other objects and advantages of the invention will hereinafter appear.

DESCRIPTION OF THE DRAWING

The accompanying drawing illustrates a preferred embodiment of the invention but it is to be understood that the embodiment illustrated is susceptible of modifications with respect to details thereof without departing from the scope of the appended claims.

In the drawing:

FIG. 1 is a side elevational view of a crawler tractor to which is attached a ripper in accordance with the present invention;

FIG. 2 is an enlarged view, partly in cross section, of a portion of the ripper shown in FIG. 1; and

FIG. 3 is a view taken along line III—III of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawing, the numeral **10** designates a tractor which has a ripper assembly **11** suitably secured to the rear end thereof. Ripper assembly **11** comprises a rigid frame element **12** to which are provided upper and lower arms **14** and **16** of a trapezoidal linkage. The arms **14** and **16** are pivotally connected to the ripper frame **20**. A hydraulic cylinder **22** is pivotably secured to frame element **12** and its piston rod **24** is pivotably secured to lower arm **16**. Ripper assembly **11** further comprises a ripper **26** in accordance with the invention which is removably mounted on the frame **20** and which is hereinafter more fully described. Cylinder **22** and piston rod **24** are understood to be adapted to lower and raise the ripper frame **20** to thereby move ripper **26** into or out of the soil or other material to be ripped.

As FIGS. **1** and **2** shows, ripper **26** comprises a shank **28** which terminates in a ripper tip **30**. A replaceable ripper tooth **32** is secured to ripper tip **30** by suitable means, such as a pin **34**, as FIG. **1** shows. The front portion of ripper **26** is also provided with a rigidly attached replaceable cutting edge **37**, as FIG. **1** shows.

In accordance with the present invention, walls in shank **28** define a combustion chamber **36** near ripper tip **30**, as FIGS. **1**, **2** and **3** show, and in which explosive forces and by-products are repetitively produced, as hereinafter explained. Chamber **36** is provided with means for venting the explosive by-products, such as rapidly expanding gases, and such means comprise vents, ports or exhaust openings **38** and **40** which are located at the opposite lateral sides of ripper tip **30**. Preferably, chamber **36** is further provided with an access hole **41** which is used for manufacturing purposes and also for servicing the nozzle **44**. Hole **41** is normally closed by a removable plug **42**.

Chamber **36** is adapted to be supplied with a combustible explosion producing substance through a supply passage **43** located in and extending through shank **28** of ripper **26**. Since chamber **36** is cut off from

usable amounts of atmospheric oxygen when ripper **26** is in the ground, it is necessary that the explosion producing substance supplied thereto contain an explosive fuel, such as gasoline, and an oxidant necessary to effect an explosion when the mixture of fuel and oxidant is ignited. Preferably, passage **43** is provided with a suitable injection nozzle **44** at the point where the passage meets combustion chamber **36**. Supply passage **43** is connected as by hose **33** to supply means **47** for the combustible substance which, for example, is carried on tractor **10**. Supply means **47** is adapted to meter the correct amount of explosive substance to chamber **36** at preselected adjustable intervals. Preferably, passage **43** is provided with means such as a check valve **45** which prevents the effects and by-products of an explosion in chamber **36** from proceeding up the passage.

Means are provided to effect ignition and explosion of the substance supplied to chamber **36**. Thus, for example, the rear side of tip **30** of ripper **26** is provided with a recess or cavity **46** in which an ignition device such as a conventional spark plug **48** is mounted. The electrodes of spark plug **48** project into chamber **36**, or at least are exposed to the explosive substance therein, so as to effect ignition when the plug is fired or when the explosive substance is introduced into the chamber. Cavity **46** is closed by a removable protective plate **50** which is secured to ripper **26** by bolts **52**. An ignition wire or conductor **54**, suitably insulated, is connected to one of the electrodes of spark plug **48** and extends through a passage **56** in ripper **26** to a suitable ignition system **55** which, for example, is located on tractor **10** and energizes the plug. It is to be understood that the other electrode of spark plug **48** is grounded to ripper **26** and that the latter is in electrical connection through various mechanical connections to the grounded side of ignition system **55**. Ignition system **55** is adapted to effect firing of spark plug **48** as is necessary to produce the repetitive explosions in chamber **36**.

The invention operates as follows. Assume that ripper **26** is disposed in material to be ripped, as shown at the right-hand side in FIG. **1**, and is being drawn or moved leftward with respect to FIG. **1** by tractor **10**. Further assume that while ripper **26** is at the right-hand position shown in FIG. **1**, an appropriate amount of explosive substance is introduced into chamber **36** and is ignited by spark plug **48**. The explosion which results in chamber **36** generates a burst of expanding gas or gases which are directed out of the chamber through the vents **38** and **40** with great force and cause fracturing of the material adjacent the vents and in the immediate vicinity of tip **30** of ripper **26**. When the material is thus fractured, ripper **26** can more easily continue its leftward movement. When ripper **26** reaches another position, such as the position shown in phantom in FIG. **1**, a suitable amount of explosive substance is again introduced into chamber **36** and ignited to provide another explosion which fractures the surrounding material. This procedure is repeated at desired intervals as ripper **26** moves along. The intervals between explosions are variable, as desired, in accordance with the nature of the material, the rate of travel desired, and other relevent factors.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination,
- a ripper adapted to penetrate to substantial depths and be surrounded by material through which it is moved,
- said ripper having a downwardly extending shank with a replaceable tooth on its lower end,
- walls in said ripper forming a chamber in the lower end of said shank rearwardly of said tooth with an exhaust opening at each of the two laterally opposite sides of said shank, and
- means for producing explosions in said chamber at repetitive intervals causing discharge of rapidly expanding gas from said chamber through said openings to effect fracturing of material on laterally opposite sides of said ripper including
  - a source of combustible substance,
  - a passage in said ripper communicating between said source and said chamber,
  - ignition means to effect combustion of said substance in said chamber, and
  - check valve means in said shank preventing expanding gases of combustion from proceeding through said passage from said chamber.

2. A combination according to claim **1** wherein said ignition means comprises a spark plug mounted in said shank with its igniting end in said chamber and further comprises an ignition system for firing said spark plug.

3. A combination according to claim **2** wherein said ripper comprises a passage for accommodating a conductor connected between said spark plug and said ignition system.

4. The combination of claim **1** wherein said openings are aligned and equal in size so that lateral forces imposed on said ripper shank by said explosions are substantially balanced.

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