A ripper employs a repetitive exploding device whereby a gaseous fuel mixture is introduced into fissures created in material being ripped, and is ignited to provide repetitive explosions which create high energy release for rock breaking and fracturing.

4 Claims, 2 Drawing Figures
3,887,237

1

RIPPER WITH REPEATED EXPLOSIVE DEVICE
FOR ROCK BREAKING

BACKGROUND OF THE INVENTION

The present invention relates to earth working and pertains more particularly to methods and apparatus to rip rock and hard earth formations.

In the ripping of materials such as hard soil or rock, conventional rippers are limited in their application by available tractive force and the strength of the material being ripped. It is not uncommon to increase the ripping capability by applying more than one track-type tractor to a single shank ripper. This practice results in extreme wear on the ripper tip with consequent high maintenance and replacement cost.

When the strength of the material being ripped exceeds the ripping capacity of the applied multi-tractive force, it is common practice to blast with dynamite or similar explosives. Although blasting has evolved into a highly sophisticated art, it is not a continuous operation and is therefore time consuming and expensive. Blasting is also an extremely hazardous operation.

Other more sophisticated methods proposed for ripping or fracturing rock and hard soil formations have met with some success, however, they are prohibitory due to high cost.


SUMMARY OF THE INVENTION

It is the primary object of the present invention to provide a method and apparatus for breaking up or fracturing rock and/or hard soil formations.

Another object of the present invention is to provide a ripper employing explosive blasts for breaking up rock and hard soil formations.

A further object of the present invention is to provide a ripper designed to supply a reactive gaseous fuel mixture to fissures created in material being ripped and capable of igniting said mixture to provide explosive blasts within the fissures that result in the breaking of rock and hard soil formations.

Still another object of the present invention is to provide a ripper having at its upper end a combustion chamber communicating with a passage-way extending through the shank and out the tip, which chamber and passage-way are periodically charged with a pressurized gaseous fuel mixture which is introduced into fissures and ignited by a detonation shock wave which propagates through the passage-way when the fuel mixture in the combustion chamber is fired.

A still further object of the present invention is to provide a ripper equipped with control means for repeatedly supplying and detonating, at predetermined intervals, a reactive gaseous fuel mixture introduced in fissures created by the ripper being pulled through the ground.

In accordance with the present invention there is provided a ripper comprising at least one ground engaging ripper shank in combination with a repetitive gas exploding device, the ripper being capable of injecting gas into fissures and igniting it for fracturing and breaking rock and hard soil formations in a safe and economical manner.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and further objects, features and advantages of the present invention will be apparent in the following description taken in conjunction with the accompanying drawings.

FIG. 1 is a perspective view of a preferred embodiment of the present invention mounted on a tractor.

FIG. 2 is a schematic view with portions in cross-section to show the components of the system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and more particularly to FIG. 1, there is illustrated a suitable tractor 6 of the crawler type supporting by linkages of conventional construction 8, a ripper attachment generally designated by the numeral 10 and incorporating a preferred embodiment of the present invention. The illustrated ripper 10 includes a shank 12 for creating fissures when the ripper is pulled through the ground in the usual manner.

Turning now to FIG. 2, shank 12 is provided at its upper end with a combustion chamber 14 communicating with a central shank passage-way 16 which extends downward through the ripper shank 12 and out a suitable forwardly directed port or orifice 18 in the wedge shaped tip. The combustion chamber 14 is initially of greater diameter than the shank passage 16, which diameter gradually decreases toward the shank passage 16.

The detonation chamber and the passage-way 16 are shaped so that ignition in the chamber creates a detonation shock wave which propagates through the ripper passage and out the forwardly directed port. This detonation wave creates a secondary reaction or explosion within the rock fissures. The length and diameter of the passage-way 16 is adapted for the formation and maintenance of detonation waves.

A suitable oxidizing gas such as oxygen is supplied to the combustion chamber 14 through a conduit 20 which is connected to a suitable pressurized source 24. A second fuel component such as hydrogen, acetylene, or a similar gas is fed through conduit 22 also connected to a suitable pressurized fuel source 26. The reactive fuel mixture is ignited by a spark plug 28 or similar device. The firing of the spark plug 28 is accomplished by a suitable ignition circuit including a spark coil 30, battery 32 and cam operated switch 34. A suitable cam 36 operates switch 34.

Spring biased valves 38 control the flow of combustible gases into the combustion chamber 12 and are actuated by a cam 40 which is correlated with the spark timing cam 36 so that the following sequence of operations occurs:

1. Cam 40 opens spray biased valves 38 simultaneously admitting sufficient quantities of combustible fuel and oxidizing gas into the combustion chamber 14 to flush the chamber 14 and shank passage-way 16 and
introduce a quantity of the mixture into fissures created in the rock by the ripper shank.

2. Cam 40 then permits spring biased valves 38 to close.

3. Immediately after valves 38 close, spark timing cam 36 fires the ignition device 28.

4. Ignition of the reactive fuel mixture produces a detonation wave that travels through the shank passage-way 16 to the mixture in the fissures, and serves as an ignition source for the fuel mixture in the fissures in the rock.

5. After detonation has occurred the spring biased valves 38 controlling the entry of the gases should remain closed until all combustion has ceased at least in the area of the combustion chamber.

6. The cycle is repeated with reopening of the spring biased valves 38 to form the next combustion mixture.

From the above description, it is seen that there is provided a ripping method and apparatus wherein a detonable mixture is ignited to produce a detonation wave which transmits sufficient energy to the detonable mixture in the fissures to ignite the mixture. The resulting explosions of the mixture provide high energy release for rock breaking and fracturing.

It will be apparent that changes and modifications may be made in the disclosed embodiment without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A method of fracturing rock or hard soil formations comprising:
   providing a ripper shank having a width that is less than the thickness thereof and a pointed tip, a combustion chamber, and converging passage communicating said chamber with a forwardly directed port in said tip of said shank;
   forcing the tip of said shank into a solidified formation to create fissures forward thereof;
   introducing a combustible gaseous mixture into said fissures created by said ripper shank by way of said port; and
   igniting said gaseous mixture in said fissures by generating a detonation wave in the combustion chamber which propagates along said converging passage into said fissures.

2. An apparatus for fracturing rock and hard soil formations comprising:
   a ground engaging ripper shank having a width that is less than the thickness thereof and a forwardly extending tip;
   a source of combustible gases;
   a forwardly directed port formed in said tip;
   means for communicating said combustible gases from said source to said combustion chamber;
   valve means for controlling said communication;
   means for igniting said combustible gas mixture;
   a combustion chamber comprising an enlarged chamber formed integral with said shank at the upper end; and
   conduit means comprising a detonation wave-forming passageway formed in and running along said shank from said combustion chamber to said tip, and terminating in said port at said tip.

3. The apparatus of claim 2 wherein said means for igniting said combustible gaseous mixture comprises:
   a spark igniting means positioned in the combustion chamber;
   firing means communicating with said spark igniting means; and
   switch means for controlling said firing means.

4. An apparatus for fracturing rock and hard soil formations comprising:
   a ground engaging ripper shank having a forwardly extending tip;
   a source of combustible gases;
   a forwardly directed port formed in said tip;
   means for communicating said combustible gases from said source to said combustion chamber;
   valve means for controlling said communication shaped to define a substantially conical section at the area of communication with said passageway; and
   conduit means comprising a detonation wave-forming passageway formed in and running along said shank and shaped to gradually converge from the area of communication with said chambers to the area of said port to thereby form and maintain detonation waves moving therethrough.

* * * * *