

- | | | | | | |
|------|---|-----------|---------|----------------|-----------|
| [54] | NARROW ROCK CUTTING TRENCHER | 1,455,608 | 5/1923 | Duder..... | 37/DIG. 2 |
| | | 3,203,188 | 8/1965 | Evans..... | 37/96 X |
| [75] | Inventor: Clifford J. Evans, Glen Rose, Tex. | 1,244,006 | 10/1917 | Wadsworth..... | 37/DIG. 2 |

[73] Assignee: **Shields-Jetco, Inc.**, Dallas, Tex.

[22] Filed: **Apr. 19, 1971**

[21] Appl. No.: 135,213

Primary Examiner—Ernest R. Purser

Attorney—Marcus L. Bates

[57] **ABSTRACT**

A narrow rock cutting trencher having a single disk rotatably captured about a framework, and having inwardly opening trench forming buckets disposed about the outer periphery of the disk. An arc plate cooperates with the buckets so as to transport material from the trench into an overhead position as the apparatus progresses along the ground.

[56] **References Cited**

UNITED STATES PATENTS

- 2,826,839 3/1958 Kolbe 37/97 X

10 Claims, 13 Drawing Figures

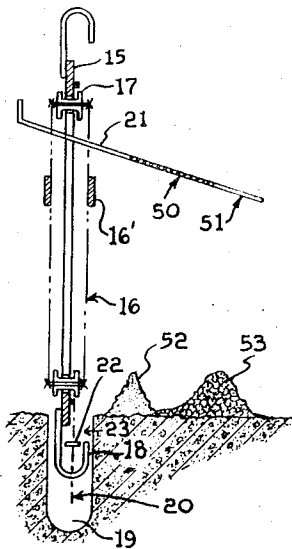


Fig. 1

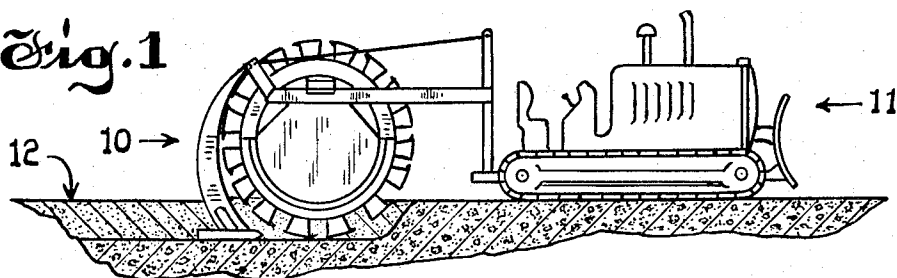


Fig. 4

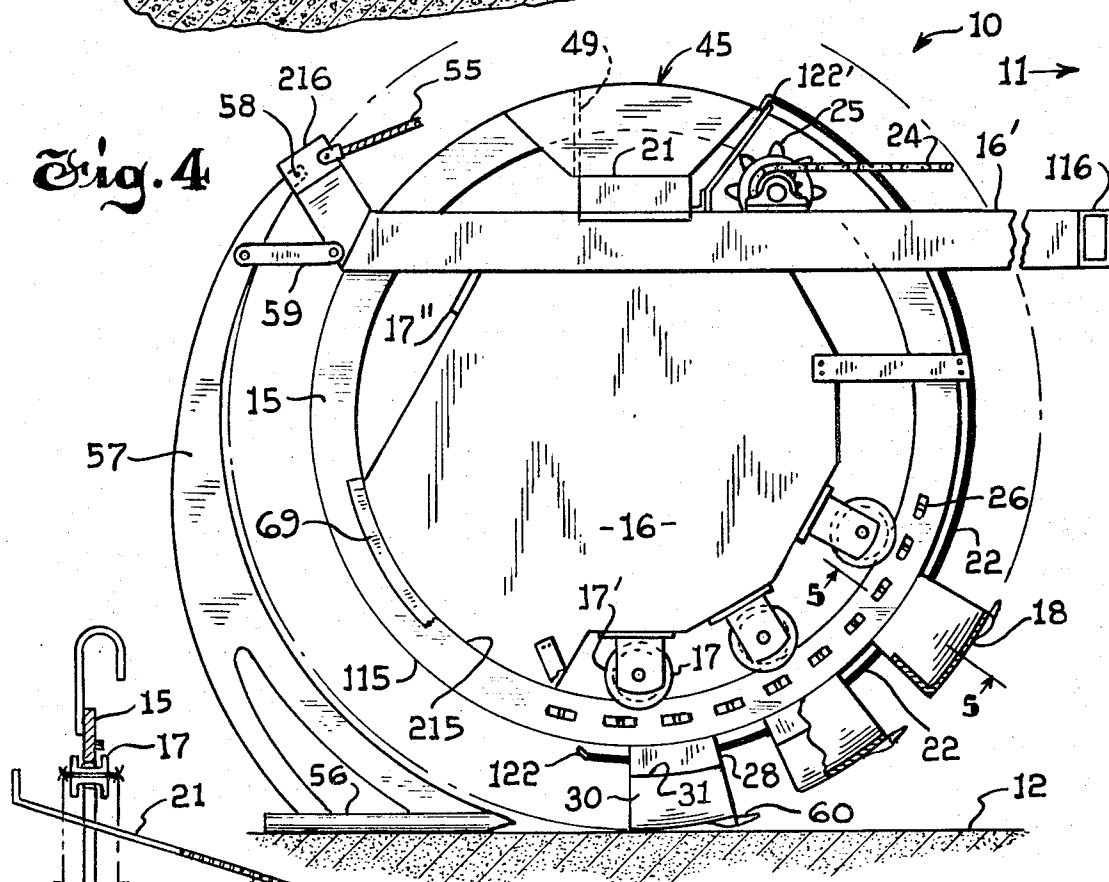


Fig. 2

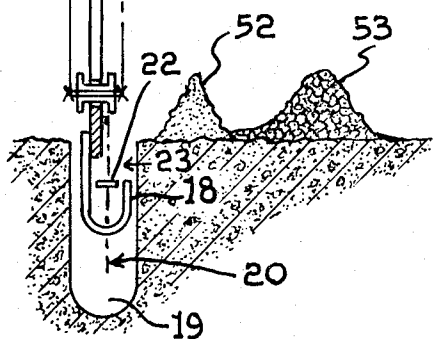
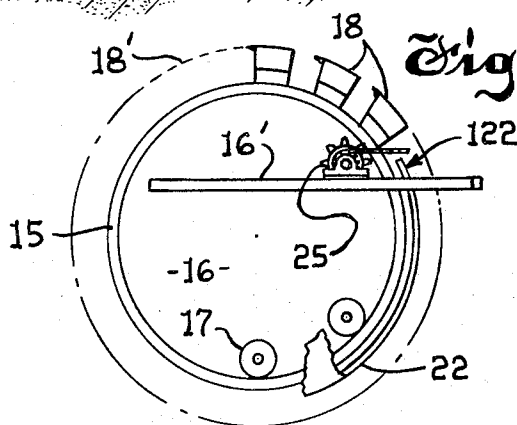
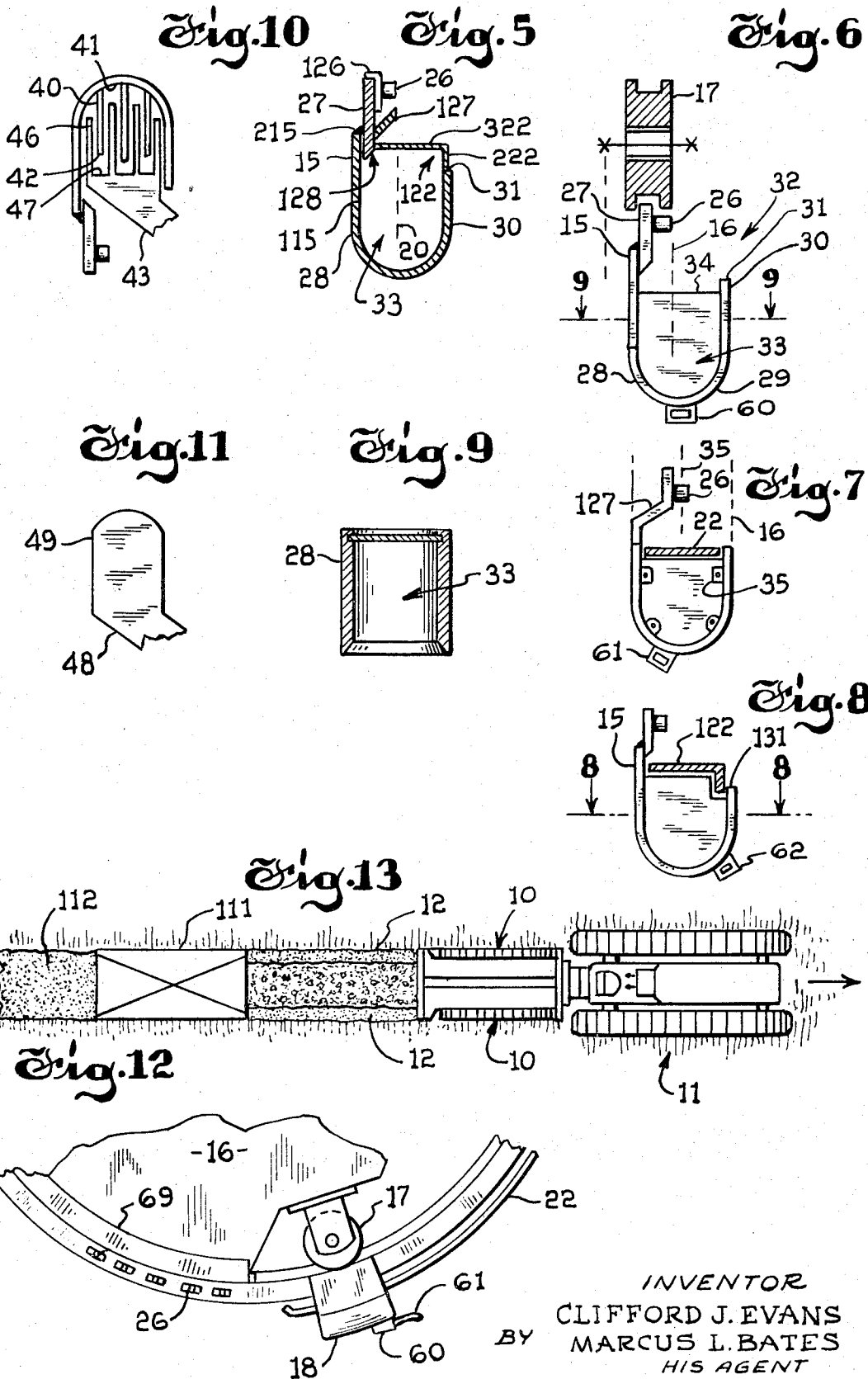


Fig. 3



INVENTOR
CLIFFORD J. EVANS
BY MARCUS L. BATES
HIS AGENT



INVENTOR
CLIFFORD J. EVANS
BY MARCUS L. BATES
HIS AGENT

NARROW ROCK CUTTING TRENCHER

BACKGROUND OF THE INVENTION

Formation of a trench through rock and rock-like strata of the earth is usually accomplished by the employment of explosives wherein a longitudinally extending ragged elongated opening is formed into the surface of the earth. The use of explosives is expensive, and often such usage is prohibitive, especially where the trench must be formed in highly populated areas, or adjacent to sensitive industrial sites.

Prior art devices for excavating a narrow trench through soil or relatively soft strata have been proposed for the formation of trenches measuring eight inches or less in width. However, formation of a trench through rock or rock-like strata, wherein the trench measures 8 inches or less in width, has not heretofore been completely successful because the massive structure required for imparting sufficient power into the digging means leaves insufficient width by which conventional means can be employed for transporting the commuted rock from the bottom of the ditch to another location.

Accordingly, it would be desirable to have a trenching machine having a digging wheel associated therewith which can support a narrow bucket which is substantially no wider than its supporting structure, and at the same time the bucket has means associated therewith for transporting the commuted material from the bottom of the trench to another location.

SUMMARY OF THE INVENTION

Broadly, the present invention encompasses trenching apparatus for attachment to a prime mover. The trenching apparatus includes a framework in the form of a supporting structure which is adjustably affixed to the prime mover, with the framework rotatably capturing and supporting an annular disk which is circumferentially disposed thereabout to thereby present a mechanism which is unusually narrow in cross-section, and which accordingly enables the formation of a trench of extremely narrow cross-section.

More specifically, a plurality of U-shaped inwardly opening buckets are attached by one sidewall thereof to the outer peripheral edge portion of the disk, and a suitable rock cutting and digging means is attached to the individual buckets. The buckets are therefore radially disposed in an outward direction with respect to the disk and aligned in a common plane with respect to the supporting structure.

Means connected to the framework cooperate with the buckets so as to enable material scooped up by the bucket to be transported into an elevated position, whereupon the material is dumped from the bucket into a chute and transported to a location away from the trench.

Several different embodiments of the bucket are set forth so as to enhance the operation of the apparatus as it digs in different type strata through which the trench is to be formed.

Therefore, a primary object of the present invention is to provide digging apparatus having an extremely small cross-sectional area to thereby form a longitudinally extending trench of minimum width.

Another object of this invention is to provide trenching apparatus in the form of a single disk which is rotatably captured by structure, with buckets having

digging means attached thereto being disposed about the outer peripheral surface of the disk.

A further object of this invention is to provide a digging wheel having buckets supported by a single disk-like member so as to enable removal of a narrow elongated portion of the earth.

A still further object of this invention is to provide an improved narrow digging wheel having a bucket width substantially equal to the cross-sectional width of its supporting structure to thereby enable a trench of the smallest possible width to be formed.

These and other objects of the present invention are attained by the provision of a new combination of elements broadly fabricated in a manner essentially as set forth in the above abstract and summary. Various other objects and advantages of this invention will be readily apparent to those skilled in the art upon reading the following detailed description and claims in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general side elevational view showing the present invention in its operative configuration;

FIG. 2 is an enlarged diagrammatical representation which sets forth a part cross-sectional view so as to disclose the essence of the present invention;

FIG. 3 is a reduced diagrammatical representation which discloses a side view of the device seen in FIG. 2;

FIG. 4 is an enlarged detailed side elevation view of the present invention;

FIG. 5 is a cross-sectional view taken along line 5-5 of FIG. 4;

FIG. 6 is similar to FIG. 5, and sets forth one of the teachings of the present invention;

FIG. 7 is a modification of FIG. 5;

FIG. 8 sets forth another modification of FIG. 5;

FIG. 9 is a cross-sectional view taken along line 9-9 of FIG. 6;

FIG. 10 illustrates a modification of the apparatus of FIGS. 5-9;

FIG. 11 is a modification of FIG. 10;

FIG. 12 is a fragmentary, side elevational view of apparatus disclosed in part of FIG. 4; and

FIG. 13 is a top plan view which diagrammatically illustrates a method of forming a large trench by the use of the present invention in conjunction with other digging apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout this specification, wherever possible, like or similar numerals refer to like or similar elements.

FIG. 1 generally sets forth apparatus for forming a trench within the surface 12 of the ground, with the apparatus being comprised of a prime mover 11, which can take on several different known forms, and to which there is adjustably attached trenching apparatus 10 made in accordance with the present invention.

In FIGS. 2 and 3, which broadly set forth the essence of the present invention, there is disclosed an annular plate member 15, hereinafter called a "disk," which is rotatably captured by support structure 16. The support structure is in turn supported by spaced apart beams 16' having free depending ends which are at-

tached by any of several known means to any suitable prime mover. A plurality of spaced apart journaled trucks 17 bear against the inside peripheral wall, or innermost edge portion, of the disk so as to maintain the disk properly aligned with respect to the remaining structure.

Radially spaced about the outer extremity of the disk, and attached thereto, are a plurality of buckets 18, having any suitable digging means affixed thereto. The buckets are disposed in a manner to cut away and remove dirt in order to form a trench or ditch 19.

Center line 20 of the apparatus preferably is aligned with the center of the buckets as well as the driving means so as to equally distribute the various loads associated with the apparatus, and to present a minimum profile in cross-section.

A chute 21 is attached to the before mentioned support structure and is disposed in underlying relationship with respect to the uppermost buckets. Member 22, hereinafter called an "arc plate" provides "means cooperative with the buckets" for enabling material to be transferred from the trench to another location. The arc plate is circumferentially disposed outwardly of the disk and inwardly of the bucket cavity where it prevents material from falling from a bucket until the bucket has assumed an overhanging relationship with respect to the chute. The member is affixed at several different attachment points to the support structure.

It is desirable that the structure width at 16 be substantially equal to or smaller than the effective width of the trench formed by the buckets, and that the bucket and structure be located in the same vertical plane, so as to enable an extremely narrow ditch to be dug by the apparatus while utilizing minimum power requirements.

Looking now to more of the details of the apparatus, and in particular to FIG. 4, in conjunction with FIGS. 1-3 and 5, the trucks 17 are seen to be rotatably mounted by a yoke which transfers its load to a mounting pad, with the pad being attached to the support structure. The support structure preferably is a boxed-in reinforced member comprised of spaced apart reinforced plate members, all of which forms a unitized unique structure, and which is rigidly attached to the spaced apart beams 16'. Member 116 and 216 provide means by which the beams are supported from the prime mover. Arc plate 22 commences at 122 and continues circumferentially about the disk into close proximity of the chute where the member terminates at 122. The arc plate lies closely adjacent to the discharge opening formed in each bucket so as to provide a seal in conjunction therewith in a manner as best illustrated in FIGS. 5, 7, and 8.

A power takeoff means connected from the prime mover drives chain 24, which in turn drives gear 25, with the gear teeth being meshed with the illustrated sprocket teeth 26. The teeth 26 outwardly depend in a lateral direction from a vertical face of plate member 27, with the plate member being welded to the before mentioned disk so as to provide 360° of effective teeth. The disk is welded to one vertically disposed side 28 of the bucket, with the bucket being curved at 29 to form a reversed bend so as to leave the freely depending wall 30 parallel to the fixed or attached wall 15, and to form a material receiving cavity therein. Edge portion 31 ter-

minates short of plate member 27 so as to leave an inwardly disposed discharge opening 32 of a sufficient size to permit large rocks which may be contained within the interior 33 of the bucket to flow therethrough in an unobstructed manner.

As particularly seen in FIG. 5, the plate member 27 is welded in an off-set manner to the disk, and the illustrated outwardly and inwardly sloped shield member 127 is disposed respective to the sprocket and teeth so as to preclude contamination thereof with debris. Arc plate 322 includes vertical portion 222 which form right angles with respect to one another. The plate 27 is contoured at 128 so as to avoid hold-up of material within the bucket as gravity causes the material to flow therefrom when the bucket is inverted and ready to be dumped.

As seen in FIGS. 6 and 7, bulkhead 34 can be removably attached to the bucket by means of the fasteners 35, or alternatively, the bulkhead can be received within grooves which are formed in the vertical side walls of the bucket in the illustrated manner of FIG. 9, with any suitable fastener means being employed to maintain the bulkhead properly seated within the grooves.

Where deemed desirable, the sprocket 26 can be attached by means of the illustrated off-set plate 127, so as to more closely arrange the center line of the bucket in aligned relationship with respect to the drive sprocket and with respect to the spaced apart walls of the support structure.

As an alternate embodiment, the arc plate 22 can be made in the illustrated manner of FIG. 8 so as to provide a discharge opening which can be made as large as the effective bucket diameter, if deemed desirable. The arc plate is in the form of a right angle and is seen to have a horizontal and vertical component disposed at right angles with respect to each other, with the vertical component lying closely adjacent to edge portion 131 while the remaining free edge portion of the arc plate lies closely adjacent to the disk.

Looking now to the details of FIG. 10, the previously illustrated bulkhead 34 is seen to have been removed from the bucket, and a plurality of upstanding fingers 40 substituted therefor. The fingers are attached to the inside peripheral surface of the bucket at 41, with the fingers having a free end portion 42 which terminate below the free edge portion 31 and are disposed well within the interior of the bucket. A stationary plate member 43 is attached to the support structure of the apparatus in the general area indicated by the arrow at numeral 45. Member 43 includes a plurality of vertically upstanding fixed fingers 46 which cooperate together to form a cutout 47 so as to enable each of the movable fingers 40 to pass through the cutout 47.

FIG. 11 discloses a member having an arm 48 from which paddle 49 depends, and which is attached to the superstructure in the vicinity of the area generally illustrated by the arrow at numeral 49 in FIG. 4.

Looking now to the details of FIG. 12, the digging means are seen to be in the form of teeth which are attached to the bucket by means of a holder device 60. The holder removably affixes a single rock breaking and digging tooth to the bucket. The teeth preferably are made in accordance with U.S. Pat. No. 3,606,471, and are affixed to the bucket in an alternate arrange-

ment, such as set forth in FIGS. 6-8, with the holder device being progressively offset from center as seen at 60, 61, and 62. It is preferred that the tooth pattern be repeated in cycles of five teeth, with 25 buckets being arranged about the disk.

FIG. 13 discloses two spaced apart narrow rock cutting trencher apparatus 10, 10, each being made in accordance with the present invention, and each being attached to a prime mover so as to enable the simultaneous formation of two parallel spaced apart trenches 12, 12. A conventional large trencher 111 follows behind, removing the strata from between the trenches 12, so as to form the wider ditch disclosed at numeral 112.

In operation, the spaced apart beams 16' are adjustably attached at 116 to the prime mover so as to enable end portion 116 of the beam to be moved vertically as may be required. Cable 55 is adjustably attached to mast 216 to complete the four point suspension of the trenching apparatus.

As the prime mover imparts rotational motion into the disk, it simultaneously moves along the ground longitudinally of the ditch in the usual manner. Gear 25 engages the sprocket 26 to cause the disk to rotate relative to the support structure, whereupon the rock cutting teeth engage the upper strata of the earths surface, and removes increments thereof so as to form a narrow trench or ditch. As the digging teeth reduce the strata into smaller particles, the resulting debris is scooped into the inlet end of the buckets and carried into the overhead position where gravity causes the debris to be transferred into the hopper; and the debris then flows along chute 21.

As the debris flow down the chute 21, the fines are separated from the course material by screen means 50, with the larger particles continuing along plate 51 and towards the end of the chute. Accordingly, fines are deposited at 52 while the larger size material is deposited at 53. This expedient provides a dust-like material for bedding tubular goods within the ditch. Hence, conduits such as plastic pipe or cable can be placed within the trench, the fines deposited over the pipe, after which the remaining debris can be used as backfill in the usual manner.

It will be noted that the arc plate can take on several different forms, such as specifically illustrated in FIGS. 5, 7, and 8. The L-shaped arc plate of FIGS. 5 and 8 are the preferred form since this embodiment admits the usage of a discharge opening which is larger than the width of the discharge opening of the bucket.

Regardless of the specifics of the arc plate, it will be appreciated that the presence of this member is essential for the proper operation of the apparatus since it slidably and sealingly cooperates with the sidewalls of the bucket so as to capture material contained therein as the debris are transported from the trench into an overlying relationship with respect to the hopper.

Where the moisture content of the material being removed to form the trench refuses to flow from the bucket, it is advantageous to employ the apparatus of FIG. 10 in lieu of the buckets disclosed in the previous figures. The member 43 is attached to structure of the hopper near numeral 45 so as to enable the fingers to remove the material from the bucket as it reaches an overlying position relative to the chute.

Upon encountering mud or wet soil, it is expedient to employ the apparatus of FIG. 11 in conjunction with a bucket, such as disclosed in FIG. 5, wherein it will be noticed that the bulkhead 34 has been removed from the bucket. The paddle 49 is attached by portion 48 to the hopper structure as illustrated at 49 in FIG. 4. Those skilled in the art will realize that the interior of the bucket will be filled with mud, although there is no bulkhead attached to the bucket.

It will be appreciated that the requirements of a narrow ditch demand that the structure 16 be of a minimum size, and that the structure have associated therewith journal means as exemplified by the illustrated trucks. By employment of a single set of circumferentially extending trucks, each arranged in a common plane, and journaled to and supported by a support structure of a width equal to or less than the bucket width, a rock cutting apparatus is provided which can cut a trench of minimum width relative to the structure thereof. Since an absolute minimum of material is removed in forming the trench, the power requirements are held to an absolute minimum.

I claim:

1. A narrow rock cutting trencher apparatus adapted to be connected to a prime mover and moved across the ground while cutting a narrow trench, said apparatus comprising:

support structure adjustably affixed to and moved by the prime mover;

a disk in the form of a single annular plate member, said disk being circumferentially disposed about said structure; means affixed to said support structure rotatably capturing said disk thereto; drive means affixed to said disk for imparting rotational motion into said disk;

a plurality of earth receiving buckets, means on said buckets for digging earth to form a trench, said buckets being attached to and circumferentially disposed about said disk;

each said bucket having means forming an inlet thereinto and an inwardly opening discharge; means cooperative with said buckets for enabling earth received within a bucket to be carried from a lowermost position relative to the trench to an uppermost position relative to the trench, to thereby enable material removed to form the trench to be deposited at another location;

each bucket includes means forming a side wall which is bent back upon itself to form a bottom and spaced apart side walls, one of said side walls being affixed to said disk, the remaining said side wall terminating in an edge portion which defines part of said discharge opening; means forming a bulkhead, said bulkhead being arranged normally to said side walls and forming part of said bucket.

2. The trenching apparatus of claim 1 wherein said bulkhead further includes means by which it is removably affixed to said spaced apart side walls.

3. The trenching apparatus of claim 1 wherein said means for enabling earth to be transported includes an arc plate;

said arc plate being a discontinuous plate which commences near a lowermost extremity of said support structure and ends near an uppermost extremity of said support structure;

said arc plate being circumferentially disposed about a portion of said disk, and having a portion thereof located adjacent to said discharge opening; whereby:

said arc plate provides a stationary wall member 5 which prevents material from falling from the discharge opening of said bucket.

4. The trenching apparatus of claim 1, wherein said support structure has a cross-sectional area substantially equivalent to the effective width of the trench 10 being formed; and further including means forming a chute, and a screen means;

said chute being laterally arranged with respect to the trench and disposed in underlying relationship with respect to an uppermost bucket; said screen 15 being placed within said chute; whereby the earth removed from the ditch is separated into fine and course material as it flows through the chute.

5. The trenching apparatus of claim 1 wherein said means cooperative with said buckets for enabling earth 20 to be transported away therefrom includes arc plate means having an edge portion which slidably abuts one said side wall of said bucket and another edge portion which slidably abuts the remaining said side wall of said bucket.

6. A narrow rock cutting trencher apparatus adapted to be connected to a prime mover and to dig a narrow trench as the prime mover moves the apparatus along the ground; said apparatus including a disk in the form of an annular plate member, a supporting structure, 30 earth receiving bucket means circumferentially disposed about said disk;

each bucket includes a bottom and spaced apart side walls, with one of said side walls being affixed to said disk, and the remaining said side wall terminating in an edge portion which defines part of a discharge opening; means forming a bulkhead, said bulkhead being arranged normally to said side walls and forming a part of said bucket so that a lateral vertical cross-section of the apparatus is 40 substantially equivalent to the width of the trench being formed;

drive means affixed to an outer marginal edge portion of said disk for imparting rotational motion 45 thereinto; means for rotatably capturing an inner

portion of said disk about an outer portion of said support structure so as to enable said disk to be rotated about a central axis thereof;

arc plate means cooperative with said buckets and having an edge portion which slidably abuts said one side wall of said bucket and another edge portion which slidably abuts the remaining side wall of said bucket for enabling earth received within a bucket to be carried to a location away from the trench while the trench is being dug;

a circumferentially extending shield member having a circumferentially extending edge portion affixed to the side opposite of the disk to which said bucket is attached, said shield member extending at an acute angle relative to said disk into overlying relationship relative to said drive means.

7. The apparatus of claim 6 wherein said arc plate is a discontinuous plate affixed to said support structure and commences near a lowermost extremity of said support structure and terminates near an uppermost extremity of said support structure;

said arc plate being circumferentially disposed about a portion of said disk, and having a portion thereof located adjacent to said discharge opening thereby providing a stationary wall member which prevents material from falling from the discharge opening of said bucket.

8. The apparatus of claim 7 and further including means associated with said support structure and said bucket for causing at least part of the contents of the bucket to be removed therefrom as the bucket attains an overhead position.

9. The apparatus of claim 7 and further including a paddle, means mounting said paddle to said supporting structure with said paddle having a face thereof lying normal to said disk; means by which said paddle is adapted to be received within a bucket as the disk is rotated relative to said support structure.

10. The apparatus of claim 6, and further including a chute; a screen formed in said chute; means by which said chute is fixed relative to said superstructure, with said chute underlying an uppermost bucket; whereby fine and course material flowing from the buckets are separated into two different locations.

* * * * *

50

55

60

65