

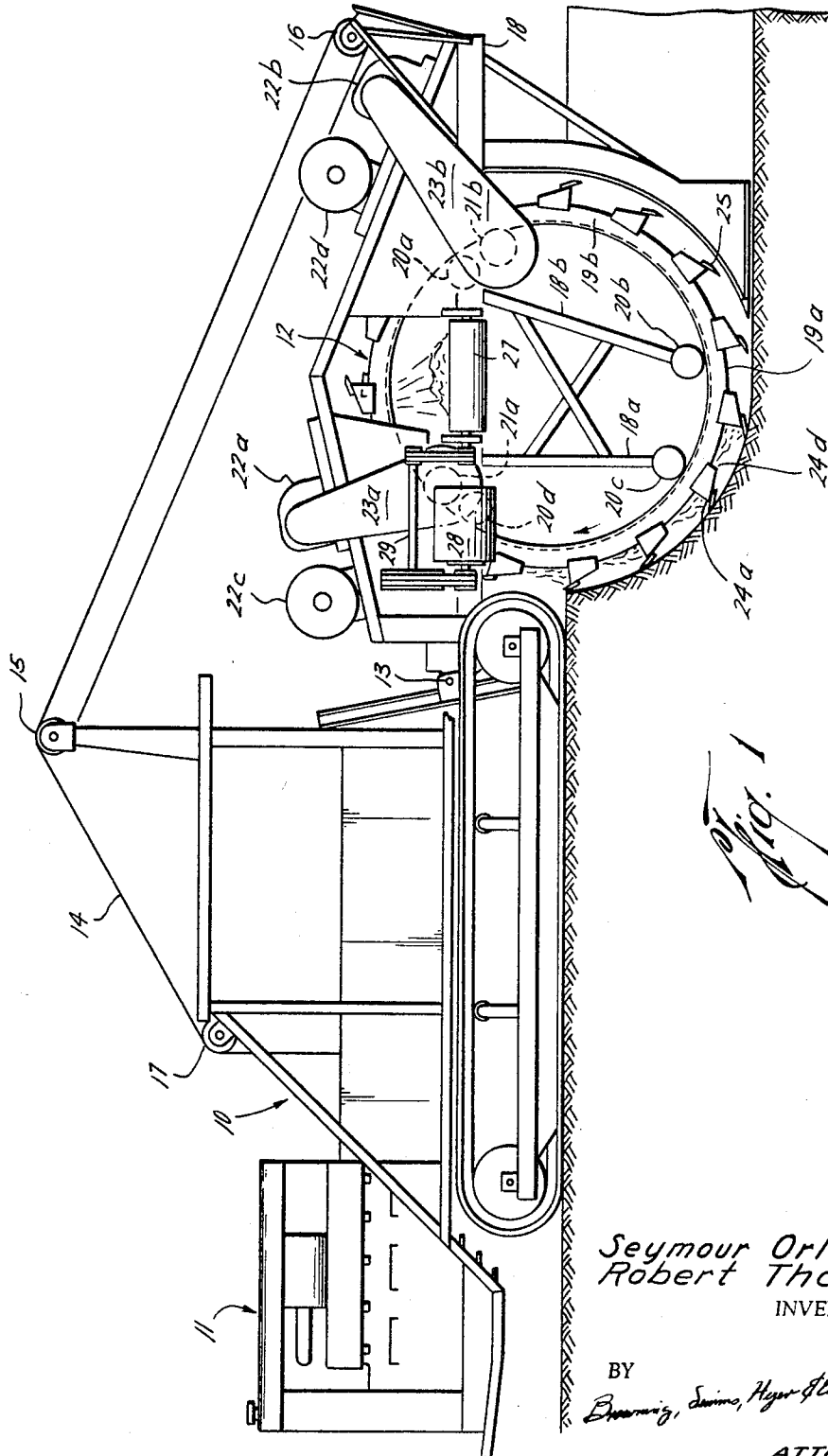
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R. THOMAS ETAL
DITCHING MACHINE

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3 Sheets-Sheet 1



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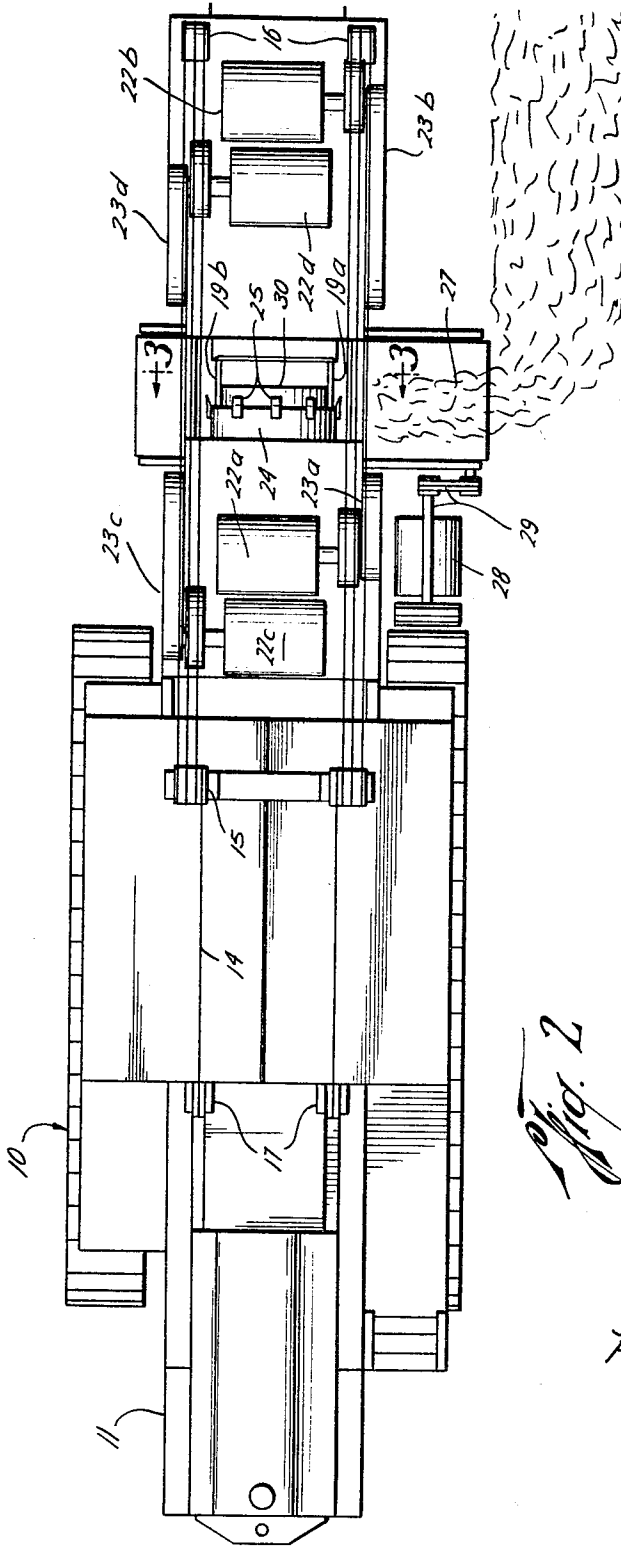


Fig. 2

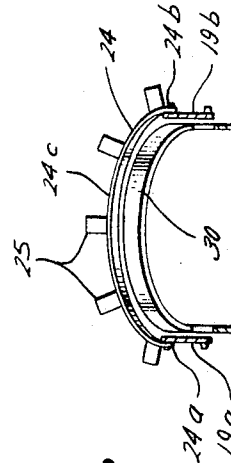


Fig. 3

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3 Sheets-Sheet 3

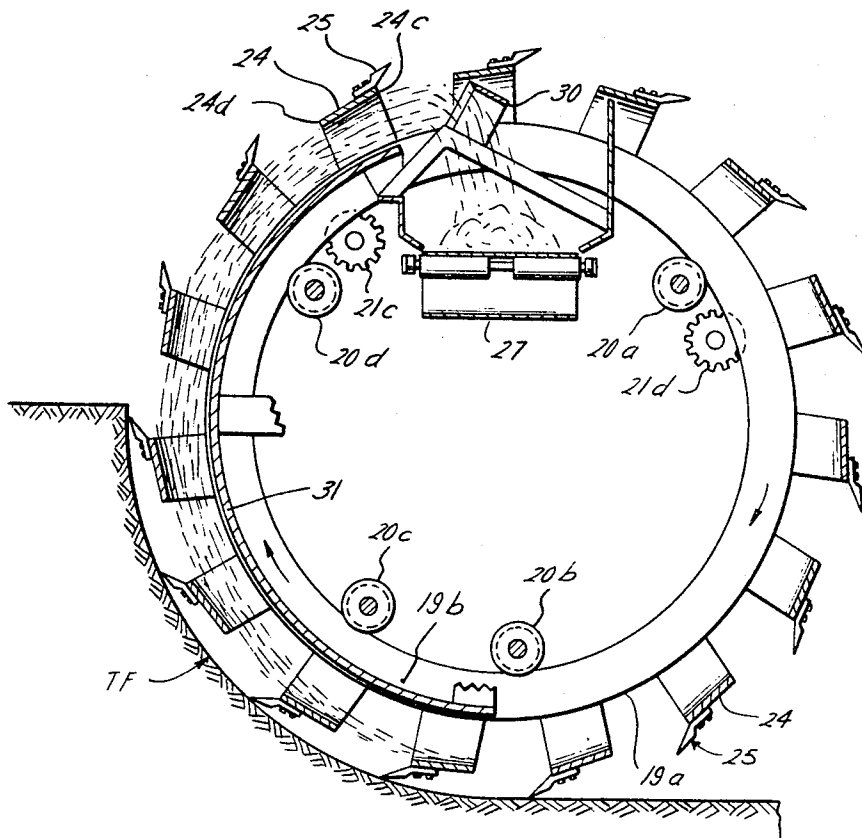


Fig. 4

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DITCHING MACHINE

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3 Claims. (Cl. 37-190)

This invention relates to a method and apparatus for digging a ditch in the earth for the laying of a pipeline or other conduit.

In the conventional ditching machine, a bucket wheel equipped with a plurality of buckets is rotated while maintained in engagement with the ground to cause each bucket to dig away sufficient dirt to fill itself after which the bucket moves over a conveyor belt where the dirt it carries is dumped. In the past, it has been considered necessary to rotate the bucket wheel rather slowly so that the buckets could dig and be filled with dirt, and to allow the buckets to dump their load of dirt above the conveyor belt under the influence of gravity. Efforts to rotate the bucket wheel at high rates of speed caused the buckets to "buck" as they dig causing the wheel to vibrate excessively.

It is an object of this invention to provide a method of digging a ditch in the ground which allows the bucket wheel to be rotated rapidly thereby greatly increasing the amount of dirt the bucket wheel can remove in a given period of time.

It is another object of this invention to provide a ditching machine which has a bucket wheel which can be rotated at relatively high speeds without undue vibration or loss of stability.

It is another object of this invention to provide a ditching machine which will dig at relatively high speeds and yet there will be a positive removal of dirt from the buckets despite the rotation thereof at such high speeds that the dirt tends to remain therein due to centrifugal action.

In the drawings:

FIG. 1 is a view in side elevation of an embodiment of a ditching machine constructed in accordance with this invention;

FIG. 2 is a top plan view of the ditching machine in FIG. 1.

FIG. 3 is a view partly in section and partly in elevation of one of the buckets used on the bucket wheel of the ditching machine of FIG. 1 and FIG. 2 showing the bucket as it passes over the bucket cleaner mounted above the conveyor belt on the machine to clean the buckets of dirt as they pass over the conveyor belt; and

FIG. 4 is a side view partly in elevation and partly in section of the bucket wheel of this invention showing how it is rotatably mounted and driven, and also showing the manner that the cleaner shown in FIG. 3 passes through the buckets carried by the bucket wheel to deflect the dirt carried by the buckets onto the conveyor belt which carries the dirt to the side of the machine.

In accordance with this invention, it has been discovered that centrifugal force can be used to advantage to remove the dirt from the ditch by providing buckets which employ the centrifugal force produced by their rapid rotation to hold the dirt in the buckets. Further by using bottomless buckets, they can be made to dig continuously as long as they are in engagement with the ground because any dirt dug in excess of the internal volume of a bucket will merely occupy the space between buckets rather than filling the bucket so as to prevent its further digging. Then by rotating the buckets rapidly enough, not only is the dirt in the buckets held therein but dirt between the buckets is carried along so that

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there is a more or less continuous stream of dirt being lifted from the ditch.

The large vibrations which would be expected from rotating the buckets at high speed are avoided by a novel arrangement for supporting the bucket wheel. Also contributing to the unusual stability of the bucket wheel of this invention even though it is rotated at speeds considerably above those of conventional bucket wheels, is the arrangement of the apparatus used to drive the wheel.

The preferred arrangement for mounting and driving the bucket wheel is illustrated in FIGS. 1 and 4. FIG. 1 shows the side view of a complete ditching machine constructed according to this invention. It consists of a crawler type tractor 10 having an engine 11 which is cantilevered in front of the tractor to counter-balance the weight of the bucket wheel assembly 12 which is cantilevered out from the back end thereof. Engine 11 provides the power for not only moving the tractor along the ground but also for raising and lowering the bucket wheel assembly and also for driving the bucket wheel and all of the various equipment connected therewith.

The bucket wheel assembly 12 is pivotally connected to the frame of the tractor by means of pin 13 so that the entire assembly can be raised or lowered by means of the hoisting line 14 and sheaves 15, 16 and 17. Hoisting line 14 is connected to a hoisting drum (not shown) which is also driven by engine 11 so that by rotating the hoisting drum the line will cause the ditching machine to pivot around pin 13 and be raised or lowered relative to the ground level.

The bucket wheel assembly is provided with a rigid frame 18 which supports the assembly. One end of the frame is pivotally supported by pin 13 and the other end is supported by hoisting line 14 through sheaves 16. As best seen in FIG. 3, bucket wheel 19 consists of two annular ring members 19a and 19b, which are spaced apart and parallel to each other. The two ring members are rotatably mounted on four spaced rollers 20a, 20b, 20c and 20d. Rollers 20a and 20d are rotatably mounted on frame 18 with the rollers 20b and 20c rotatably supported by sub-frame members 18a and 18b. The rollers are arranged to engage the inner periphery of the two ring members and hold them in parallel alignment so that they rotate around a common axis.

It will thus be seen that there is provided a plurality of means for rotatably supporting the bucket wheel and that these are distributed around the wheel in such a spacing that the reaction to the wheel digging is more or less evenly distributed among the various supporting means. Thus rollers 20b act primarily to oppose the thrust of the wheel in an upward direction as brought about by the buckets beginning to dig in the bottom of the ditch. Rollers 20c and 20d primarily oppose the thrust of the wheel in a rearward direction due to the buckets digging into the transverse face of the ditch. Although roller 20c also exerts a downward component and roller 20d an upward component. Roller 20a is primarily an idler during the digging operation although it can help support some of the weight of the wheel and in any event, it also acts to stabilize the rear of the wheel against lateral whip or shimmy.

Each ring member is also provided with gear teeth (not shown) adjacent its inner periphery to be engaged by sprockets. Each annular ring is driven by two separate sprockets which engage the gear teeth at spaced points. That is, sprockets 21c and 21d (FIG. 4) drive ring member 19b, whereas sprockets 21a and 21b (FIG. 1) drive ring member 19a.

In the embodiment illustrated in the drawings, each sprocket is driven by separate drive means. Thus as shown in FIG. 1, ring member 19a is driven by motors 22a and 22b which drive sprockets 21a and 22b through

drive belts 23a and 23b. By the same arrangement, annular ring 19b is driven by motors 22c and 22d which drive sprockets 21c and 21d through drive belts 23c and 23d. Thus, each sprocket is independently driven by a separate power source. In the preferred embodiment illustrated, electric motors are used to drive the sprockets since they can be connected in parallel to the power source and the load will be evenly distributed to all four of the sprockets. By providing power to each annular ring at two spaced points which results in the power being supplied to the wheel at four separate points, there is produced a very smooth and even transmission of power to the wheel.

Attached to the annular ring members 19a and 19b are a plurality of bottomless buckets indicated generally by number 24. Each bucket is provided with a plurality of teeth 25 which engage the earth and break it away toward the rotating bucket wheel. In the embodiment illustrated, the buckets comprise a curved or U-shaped member which, when mounted on the bucket wheel with end 24a attached to annular ring 19a and end 24b attached to annular ring 19b, will curve outwardly from the wheel between the two annular ring members. Preferably the leading edge 24c of the bucket, which is the edge provided with teeth 25, is spaced further away from the outer peripheral edge of the annular ring members than is the trailing edge 24d. This results in the buckets having a decreasing cross-sectional area through them from their front to their rear. This provides a slight wedging action of the dirt removed by the bucket as it travels through the bucket and tends to help hold the dirt in the bucket even though it has no bottom. Further, by spacing leading or cutting edge 24c farther away from the wheel than trailing edge 24d, the outside surface of the bucket makes an angle with the surface of the ground which provides relief for the cutting edge of the bucket.

Also mounted on frame 18 of the trenching mechanism is conveyor belt 27 which is mounted on rollers (not shown) and driven by electric motor 28 through drive mechanism 29. This conveyor belt is located to receive the dirt carried out of the ditch by the bucket wheel and to carry the dirt to the side of the ditch where it is deposited in position to be placed back in the ditch when the time comes to fill the same.

Also mounted on frame 18 and located above conveyor belt 27 is bucket cleaner 30, which in the embodiment illustrated, consists of a curved member shaped so that it will pass through buckets 24 as they rotate with the bucket wheel 18 and stop the forward movement of the dirt being held in the bucket by centrifugal force causing it to fall downwardly onto the moving conveyor belt. The cleaner preferably passes through the buckets with a minimum of clearance so that as much of the dirt as possible can be removed from the buckets. In its preferred form the dirt removing means, i.e. cleaner 30, is generally U-shaped and is open at its front and rear with its front edge lying proximate and parallel to the interior surface of the bucket passing over it. Preferably the U-shaped member is inclined with respect to the inner surface of the bucket as is best shown in FIG. 4. This causes the dirt to be deflected downwardly to the conveyor 27.

Frame 18 also supports arcuate plate 31 which is located between the annular ring members of the bucket wheel to keep the dirt carried by the bucket wheel upward from the trench to a point above the conveyor belt from falling inwardly into the inside of the bucket wheel.

The plate substantially fills the space between the annular ring and extends preferably from the point where the buckets start digging to a point above the conveyor belt. This plate also provides a fourth side to the buckets which helps wedge the dirt in the buckets as the dirt flows through them from the cutting edge of the buckets.

In operation, the bucket wheel is rotated by the four sprockets 20 powered by electric motors 22 and lowered downwardly by means of hoisting lines 14 until it reaches

the proper depth below the surface of the earth. At this point the tractor 10 begins to move forward at the proper speed determined by the ability of the bucket wheel to remove the dirt while continuing to rotate the bucket wheel in a clockwise direction when observing the wheel from the position shown in FIG. 1. The proper speed for the bucket wheel will depend upon its size, etc.; however, it should be sufficient to provide enough centrifugal force to hold the loosened dirt in the buckets. Thus, as each bucket in engagement with the ground, it will loosen the earth and cause a continuous stream of dirt to flow into it. This dirt will tend to be held in the bucket by centrifugal force if the wheel is rotating fast enough and it will also tend to wedge in the bucket between the sides of the bucket and plate 31. These centrifugal holding forces are not great and if the bucket digs excess dirt which is forced into the bucket, some of the dirt at the rear of the bucket will be pushed out. In actual practice, ditching machines constructed and operated in accordance with this invention produce a continuous stream of dirt from the bucket wheel to the conveyor belt. Thus the dirt which falls from the rear of the bucket is caught up as a part of the continuous stream and by spacing the buckets relatively close, the dirt between them will "bridge" to some extent so that most of it will be retained against being thrown out by centrifugal force.

In the embodiment illustrated, each individual sprocket which is used to drive the annular ring members of the bucket wheel are independently driven. This would not necessarily have to be the case as one motor could be used to drive two sprockets or one motor could be used to drive all four sprockets; however, in the preferred form as indicated above particularly where electric motors are the source of power, each sprocket is independently driven.

The invention having been described, what is claimed is:

1. A machine for digging a ditch in the ground, including, a bucket wheel having two spaced annular members, a plurality of buckets carried by the wheel to engage the ground and dig a ditch therein; first and second roller means supporting the wheel respectively on the upper forward and rear quadrants of the wheel, third roller means engaging the wheel at the bottom thereof, fourth roller means engaging the wheel between the first and third roller means, the first, third and fourth roller means taking the major part of the thrust of the wheel caused by the digging of the buckets into the earth; and two driven members engaging each annular member respectively in said upper forward and rear quadrants of the annular member for rotating the annular members.

2. A ditching machine having a wheel including two spaced annular members, means for rotatably supporting the wheel including at least four rotatably mounted members supporting each annular member at four spaced points; two driven members engaging each annular member, driving means for independently driving each of the driven members for rotating the annular members on the support members, and a plurality of buckets carried by the wheel to engage the ground and dig a ditch therein, said buckets comprising a member extending between and connected to the two annular members of the wheel with said bucket member being curved outwardly away from the wheel and being open at its front and back and with its leading edge spaced farther from the wheel than the trailing edge to provide a bucket having an opening therethrough of decreasing cross-sectional area.

3. The ditching machine of claim 2 further provided with means for cleaning the bucket, comprising a stationary member positioned to pass through the bucket as the wheel is rotated and after the bucket has moved out of engagement with the ground.

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