Jan. 2, 1962 R. D. SMITH 3,015,175

EXCAVATOR

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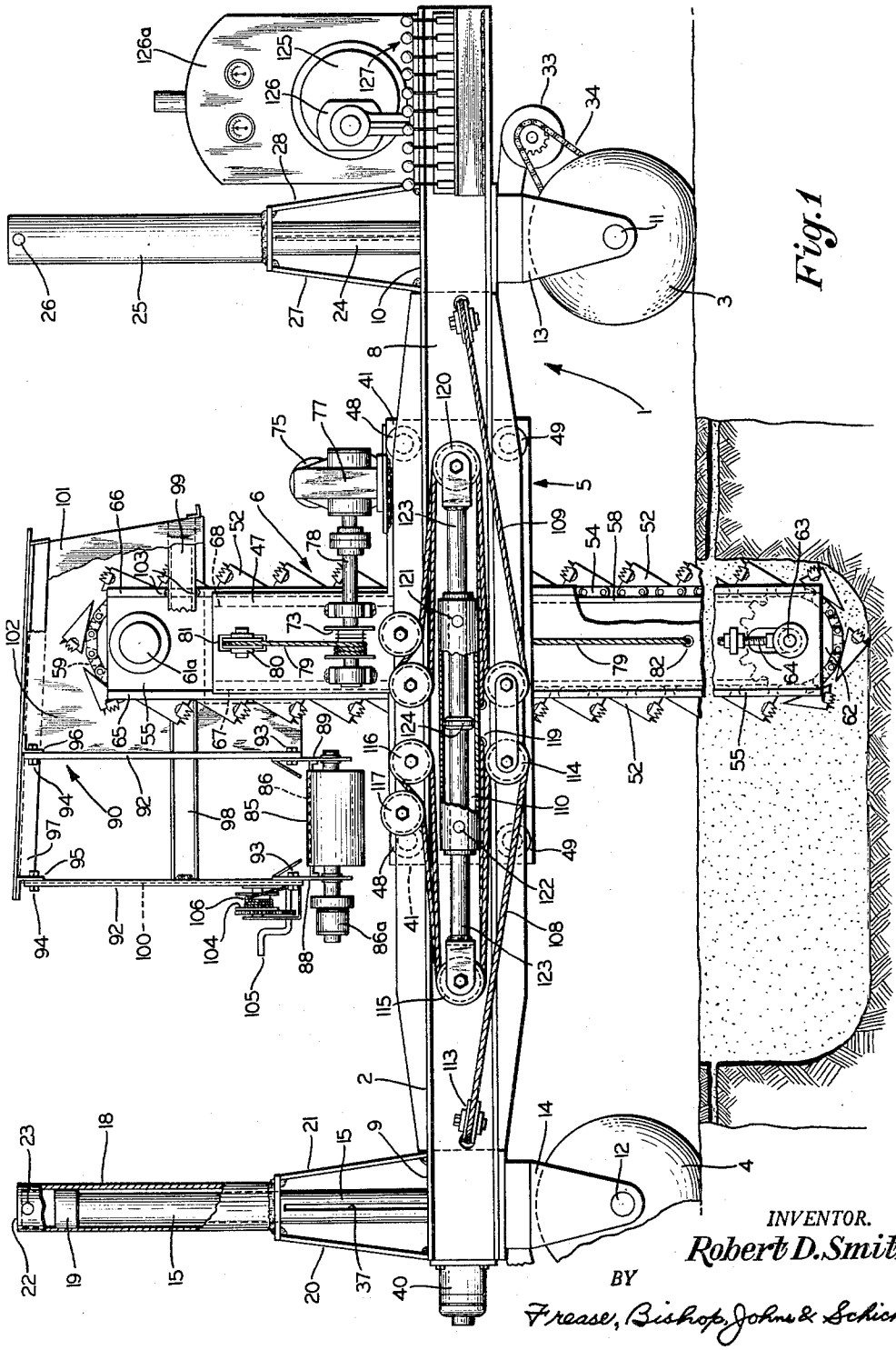


Fig. 1

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EXCAVATOR

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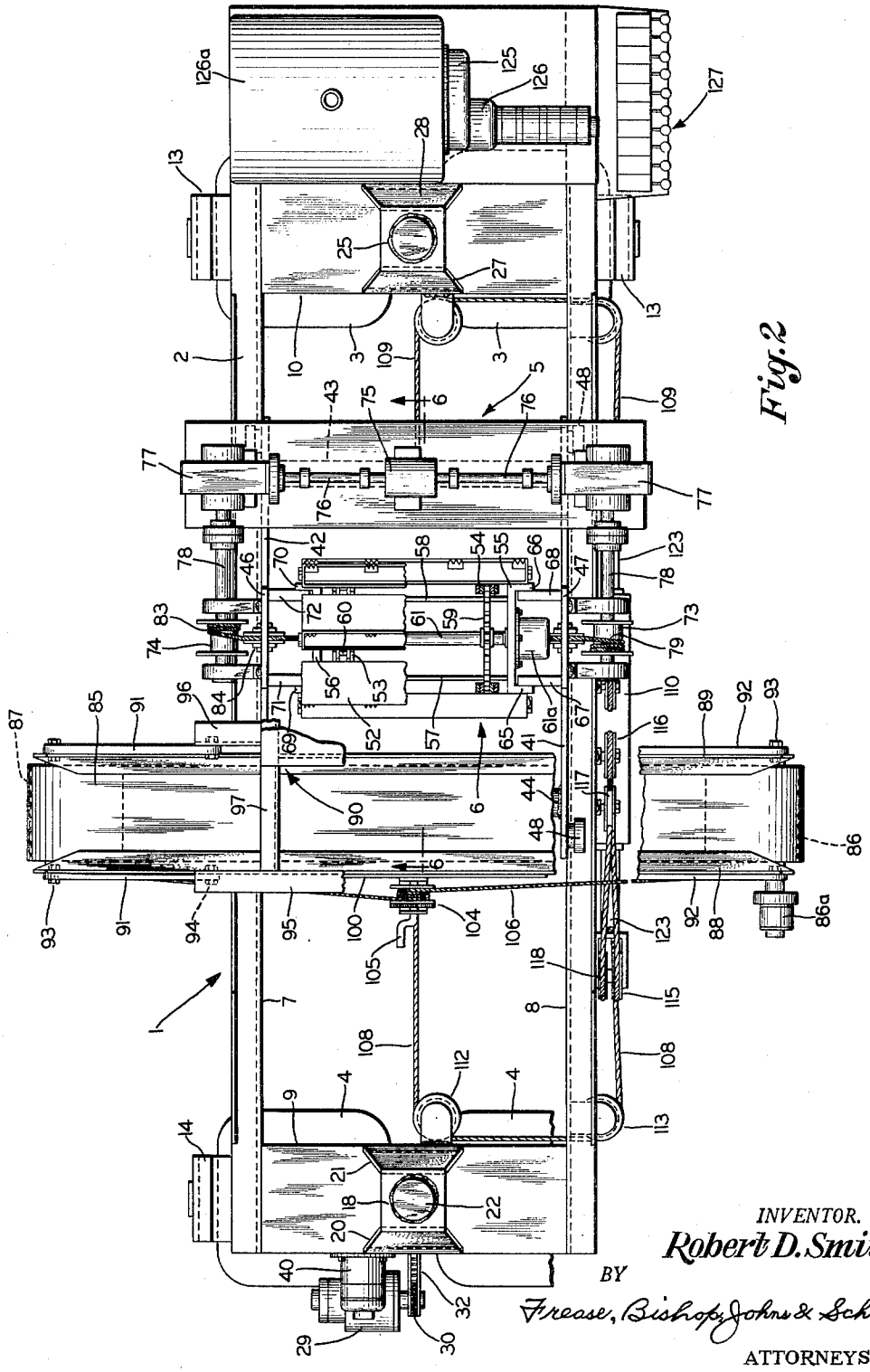


Fig. 2

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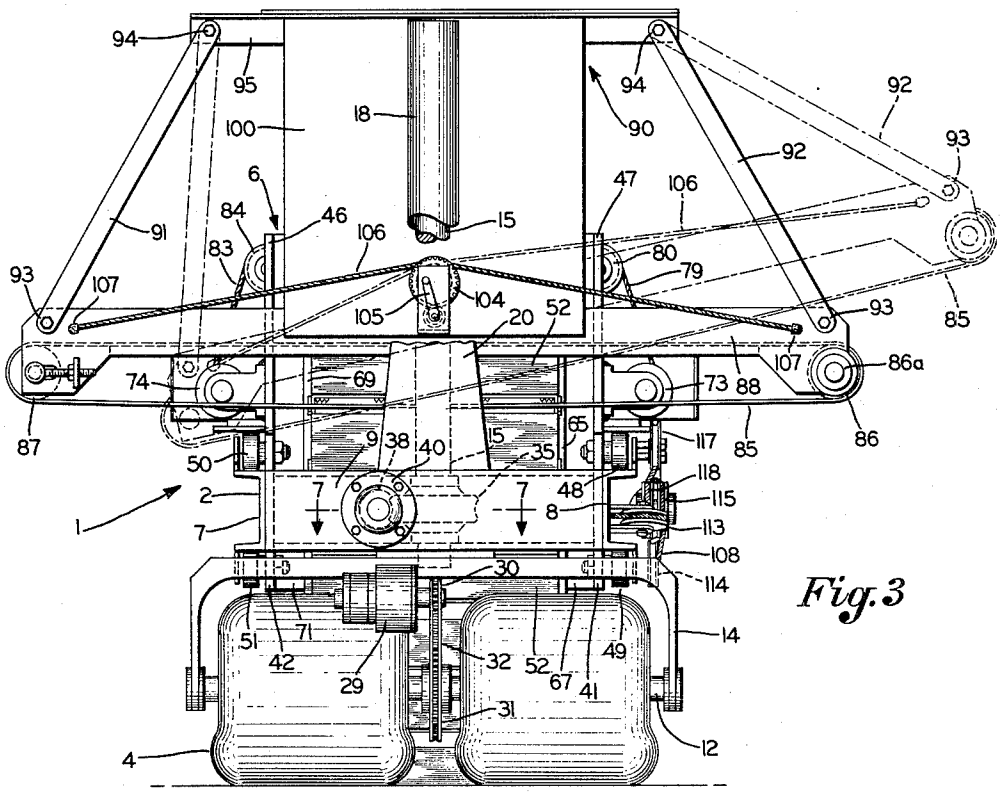



Fig. 3

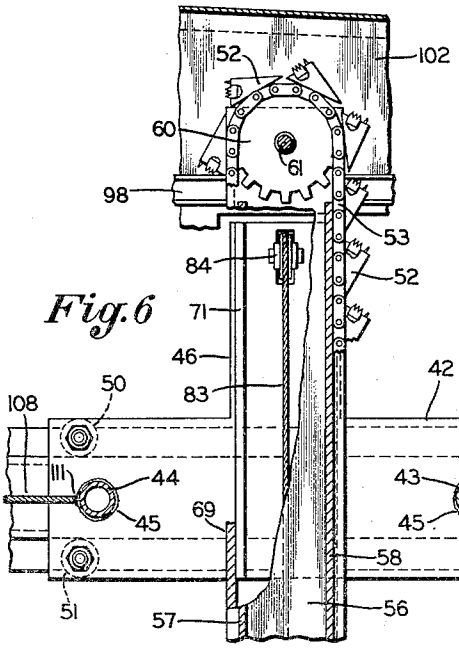



Fig. 6

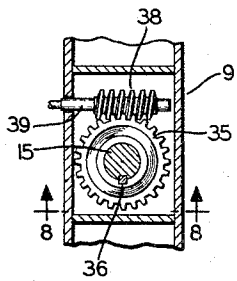



Fig. 7

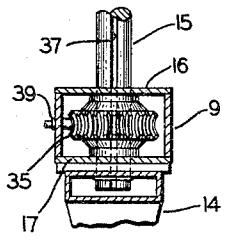



Fig. 8

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EXCAVATOR

Filed July 10, 1959 5 Sheets-Sheet 4

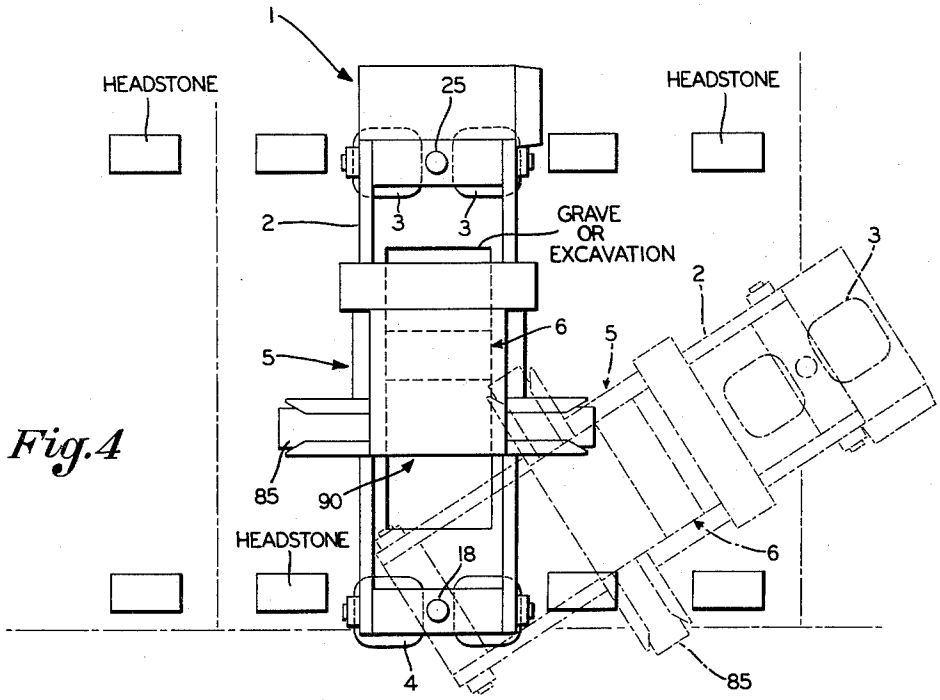



Fig.4

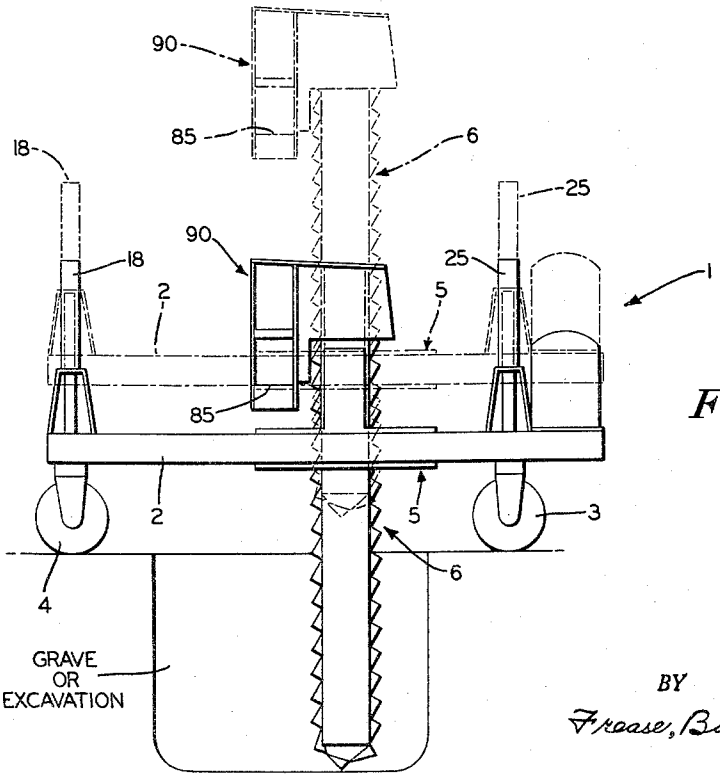



Fig.5

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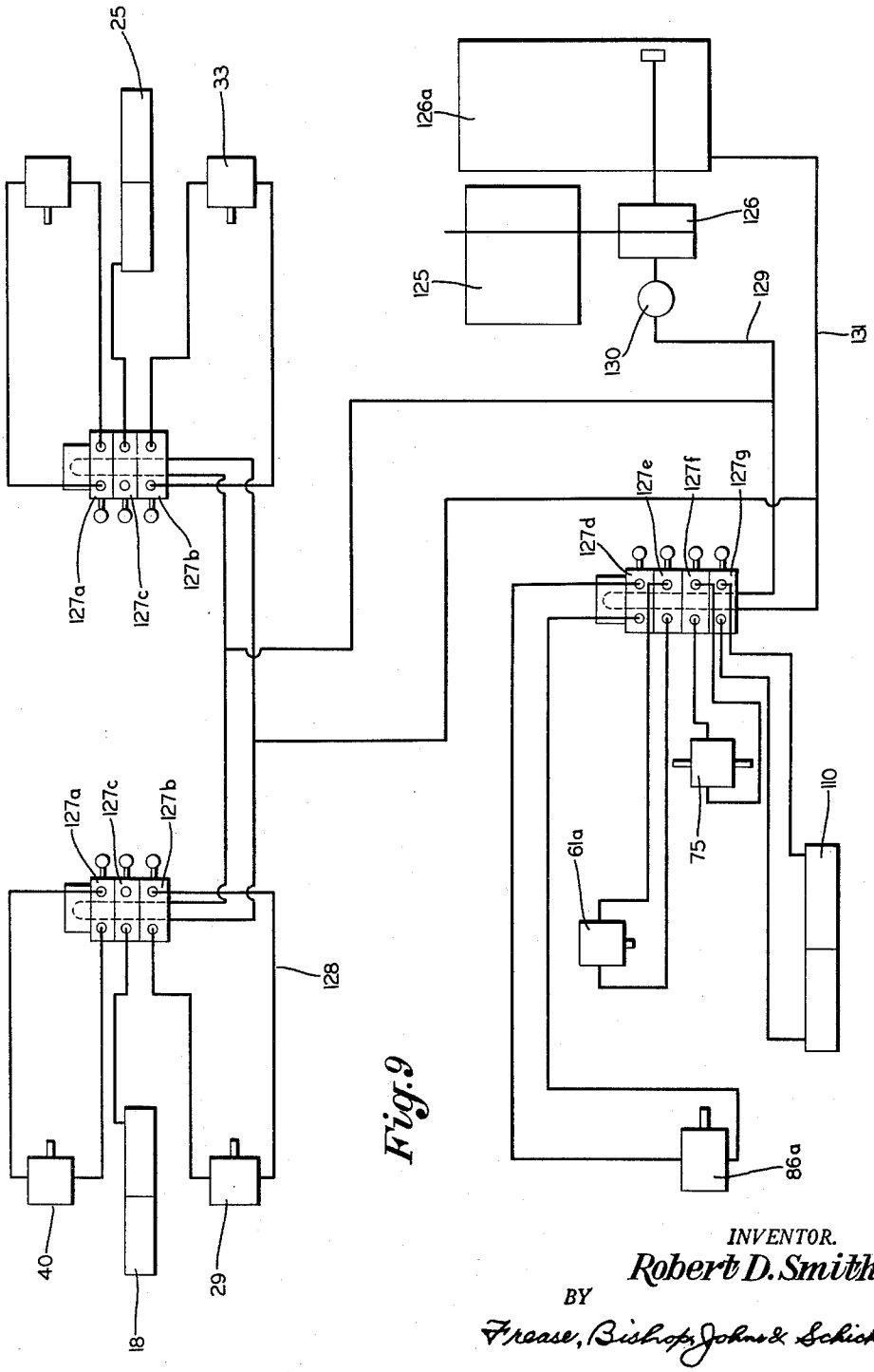



Fig. 9

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United States Patent Office 3,015,175 Patented Jan. 2, 1962



3,015,175

# EXCAVATOR

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Filed July 10, 1959, Ser. No. 826,357
1 Claim. (Cl. 37—192)

This invention relates to an excavator for digging a hole in the earth. More particularly, it pertains to a grave digger.

A primary requisite for a mechanical device for digging graves is maneuverability. Most excavators of prior construction for digging either trenches or graves have lacked such a primary requisite, not only with respect to performing the excavation but also in approaching and leaving the excavation.

When a typical grave is to be excavated with powered equipment the grave site is usually located among graves or headstones, trees and plants which provide narrow confines within which to operate. Most of the prior powered grave excavators have not been sufficiently maneuverable within the narrow confines of grave lots to permit the use of such devices as often as is desirable. That is, it is difficult, if not impossible, to get to a grave site, and/or to leave it without damaging plants, lawn, and headstones on adjacent graves.

The device of the present invention is particularly adapted for use in cemeteries for operation between, over and among graves or headstones, plants and the like which must be undisturbed by the mechanical excavator. Moreover, the device of the present invention is readily maneuverable along cemetery walks and within the narrow confines of low-hanging tree branches and relatively high tombstones or plants.

Furthermore, it is necessary that a satisfactory excavator for graves be sufficiently maneuverable to readily remove the excavator from the grave site after the grave is opened. The device of the present invention is easily maneuvered away from an excavated grave without the necessity of laying planking or auxiliary trackways to cover the grave to facilitate its removal, which is the case with most prior devices.

The devices of the prior art do not completely satisfy the problem of maneuverability in a cemetery between and over graves and cemetery walks within narrow confines. Unlike the prior devices which normally consist of excavator buckets on the continuous chain, mounted on a conventional truck bed or similar vehicle having conventional pneumatic tires of high pressure or other rolling means such as so-called crawler or track vehicles, the device of the present invention is specifically adapted for maneuverability between and/or over grave headstones and lawns without causing damage thereto.

Accordingly, it is the general purpose of the present invention to provide an excavator which is readily maneuverable in and out of narrow confines.

It is another object of this invention to provide an excavator which is primarily operated by hydraulic means which makes for more maneuverability than is possible with conventional chain and gear powered driving means.

It is another object of this invention to provide an excavator for digging graves which performs the excavation in a minimum of time.

It is another object of this invention to provide an excavator for digging graves which is readily maneuverable within the narrow confines of cemetery walks and grave lots.

It is another object of this invention to provide an excavator for digging graves which may be maneuvered in and out of location over a grave lot without damaging adjacent gravestones, lawns, etc.



It is another object of this invention to provide an excavator for digging graves which is mounted on low pressure pneumatic tires which are readily maneuverable over most headstones and lawns without damage thereto.

Finally, it is an object of this invention to provide an improved excavator for digging graves which substantially eliminates the difficulties enumerated and which obtains the foregoing desiderata in a simple and effective manner.

These and other objects and advantages apparent to those skilled in the art from the following description and claims may be obtained, the stated results achieved, and the described difficulties overcome by the discoveries, principles, apparatus, parts, elements, combinations, and subcombinations which comprise the present invention, the nature of which is set forth in the following general statement, a preferred embodiment of which—illustrative of the best mode in which applicant has contemplated applying the principles—is set forth in the following description and shown in the drawings, and which is particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the improvements of the excavator construction of the present invention may be stated in general terms as including a vehicle having a rectangular frame mounted on a pair of low pressure pneumatic tires at each end of the frame, each pair of tires being mounted on a yoke having an upright shaft extending from the yoke, the shaft being rotatably mounted in one end of the frame, the upper portion of each shaft being disposed in a hydraulic cylinder mounted on the frame, a carriage mounted on the frame for movement between opposite ends of the frame, means for reversibly moving the carriage on the frame and for holding the carriage at a stationary position on the frame, an excavator member mounted on the carriage and having a series of spaced excavator buckets arranged to operate as the carriage moves on the frame, the excavator member being movable vertically on the carriage, and the entire excavator being provided with separate hydraulic means for actuating the several operable parts.

The preferred embodiment of the present invention is illustrated by way of example in the accompanying drawings wherein:

FIGURE 1 is an elevational view of the excavator mounted over an excavation, such as a grave;

FIG. 2 is a plan view of the excavator;

FIG. 3 is an end view of the excavator showing alternate positions of the conveyor table;

FIG. 4 is a diagrammatic plan view showing the manner in which the excavator is maneuvered away from an excavated grave among headstones of adjacent graves;

FIG. 5 is an elevational view showing alternate positions of the excavation buckets as well as of the main frame of the excavator;

FIG. 6 is a vertical sectional view taken on the line 6—6 of FIG. 2 showing one side of the carriage and the manner in which the buckets are mounted thereon;

FIG. 7 is a horizontal sectional view taken on the line 7—7 of FIG. 3 showing one turning mechanism of the excavator;

FIG. 8 is a vertical sectional view taken on the line 8—8 of FIG. 7; and

FIG. 9 is a hydraulic circuit showing the lines of connection between the various hydraulically operated parts of the excavator.

Similar numerals refer to similar parts throughout the various figures of the drawings.

In FIG. 1 an excavator is generally indicated at 1. It includes a chassis or main frame 2 which is mounted on wheels or swamp tires 3 and 4 at opposite ends, a carriage 5, and an excavator bucket means 6.

The frame 2 includes a pair of spaced longitudinally extending channel members 7 and 8 and transverse members 9 and 10 (FIG. 2) at opposite ends of the frame. The frame 2 is mounted on a pair of pneumatic tires 3 and 4 at each end. Each pair of tires 3 and 4 is mounted on an axle 11 and 12, respectively, and each axle is disposed between opposite sides of yokes 13 and 14. As shown in FIGS. 3 and 8, the yoke 14 is rotatably mounted on a vertical axis below the transverse member 9 on the lower end of a vertical shaft 15. The shaft 15 extends through the upper and lower sides 16 and 17 of the member 9 and is slidably movable therethrough. The shaft 15 extends upwardly above the frame 2 into a hydraulic cylinder 18 (FIG. 1), the upper end 19 of which serves as a piston in the cylinder. As shown in the drawings, the lower end of the cylinder 18 is supported on the frame by plates 20 and 21. The upper end 22 of the cylinder is closed and is provided with an aperture 23 which in turn communicates with a hydraulic conduit or hose not shown in the drawing.

In a similar manner, the yoke 13 is secured to the lower end of a shaft 24 which extends through the transverse member 10 into a hydraulic cylinder 25. The upper end of the cylinder 25 is likewise provided with an aperture 26 for connection with a hydraulic conduit or hose (not shown). The cylinder 25 is mounted on support plates 27 and 28. The assembly of the shafts 15 and 24 with the hydraulic cylinders 18 and 25 permits raising of the frame 2 from the position shown in FIG. 1 of the drawing to an elevated position as shown by the broken line in FIG. 5. The elevated position of the frame is obtained by pumping hydraulic fluid into the upper end of the cylinders 18—25 through the apertures 23 and 26. When it is necessary to lower the frame to the normal position for usual operation, the hydraulic fluid pressure is reduced to permit reverse flow out of the cylinder. In the elevated position of the frame the excavator 1 may be maneuvered over and around various obstacles such as high tombstones, which would otherwise prevent its easy positioning in place over the lot to be excavated.

Inasmuch as the wheels or pneumatic tires 3 and 4 are of the low pressure type, the excavator 1 may be rolled over many objects such as low gravestones without damaging the same, whereby the maneuverability of the excavator is greatly increased. Moreover, inasmuch as the tires 3 and 4 are of the low pressure type, the excavator may be positioned in place for excavation without the tires causing damage to grass or the like.

The excavator 1 is propelled by means of a pair of hydraulic motors, each motor attached to each pair of wheels or tires 3 and 4. As shown for the wheels 4 in FIGS. 2 and 3, a hydraulic traction motor 29 is mounted on the yoke 14 and is provided with a sprocket 30 at the outer end of the shaft thereof. The sprocket 30 in turn is operatively connected to a sprocket 31 which is fixedly mounted on the axle 12 by a continuous chain 32. As shown in FIG. 1, the wheels or tires 3 are provided with a hydraulic traction motor 33 similar to the motor 29 and drivably connected by a chain 34 to a sprocket on the axle 11 in a manner similar to that shown in FIG. 3. The hydraulic motors 29 and 33 are reversible whereby the excavator 1 may be propelled forward or backward as necessary.

Moreover, each pair of wheels or tires 3 and 4 is provided with rotating means. As shown in FIGS. 3, 7, and 8, the shaft 15 is provided with rotation means including a gear 35 which is slidably mounted on the shaft. In order that the wheels 3 and 4 may be turned at any elevation of the frame 2 between the positions shown in FIG. 5, the gear 35 is keyed on the shaft 15 by a key 36 which moves with the gear along a keyway 37 on the shaft when the frame 2 is raised and lowered as described above.

The rotating means also include a worm 38 engaging the gear 35 and mounted on a shaft 39 of a hydraulic motor 40 (FIGS. 2 and 3). Operation of the reversible motor 40 turns the wheels or tires 4 in a conventional manner. The tires or wheels 3 are similarly provided with a rotation mechanism (not shown) as described above for the wheels 4. The rotation means for each pair of wheels, however, is separately operable so that one or both wheels may be turned as shown in FIG. 4 and thereby facilitate the maneuverability of the excavator.

The carriage 5 is mounted for longitudinal movement on the channel members 7 and 8 of the frame 2. The carriage includes a pair of similar plates 41 and 42 which are connected by spacer bars 43 and 44, the ends of which are welded to the sides of the plates at 45 as shown in FIG. 6. The plates 41 and 42 have an inverted T-shape which includes an upright portion 46 as shown for the plate 42 in FIG. 6.

As shown in FIG. 1, the plate 41 includes an upright portion 47. The plate 41 (FIGS. 1 and 2) is provided with an upper pair of longitudinally spaced rollers 48 and a pair of lower rollers 49. Likewise the plate 42 is provided with a pair of upper rollers 50 and lower rollers 51. The rollers 48–51 engage the upper and lower surfaces of corresponding channels 7 and 8 and thereby hold the carriage 5 on the frame and permit movement of the carriage longitudinally of the excavator.

The excavator bucket means 6 include a plurality of buckets 52 which are mounted at spaced intervals on a pair of spaced continuous chains 53 and 54. The means also include a vertically extending frame including spaced channel members 55 and 56 (FIG. 2) having interconnecting spacer plates 57 and 58 which are substantially coextensive with the plates 55 and 56. The upper and lower ends of the channel members 55 and 56 support an upper pair of sprockets 59 and 60 which are mounted on an axle 61 extending between said channels. The axle 61 is driven by a hydraulic motor 61*a*. Likewise the lower ends of the channels support a similar pair of sprockets, one of which sprockets 62 is shown in FIG. 1 mounted on an axle 63. A slack takeup means 64 is provided at opposite ends of the axle 63. The chains 53 and 54 are tautly disposed over and around corresponding sprockets 59, 60, and 62 in a conventional manner.

The excavator bucket means 6 are maintained vertical at all times because, as shown in FIG. 2, flanges 65 and 66 of the channel member 55 are in sliding contact with vertical flanges 67 and 68 extending from the upright portion 47 of the plate 41. The opposite side of the carriage is similarly provided with flanges 69, 70, 71, and 72 corresponding to the flanges 65–68 as shown in FIGS. 2 and 6.

As shown in FIGS. 1 and 2, the excavator bucket means 6 are raised and lowered by a pair of winches 73 and 74 which are driven by a reversible hydraulic motor 75 which is operatively connected to the winches 73 and 74 by means including similar shafts 76, worm and worm gear assemblies mounted within similar housings 77, and shafts 78 on which the winches 73 and 74 are mounted.

A pair of cables extend between the winches and corresponding channel members 56 and 55. As shown in FIG. 1, a cable 79 extends from the winch 73 over a pulley 80 at the upper end of the member 55 mounted in an aperture 81 therein and thence downwardly to a location near the lower end of the member 55 where the cable 79 is secured at 82 thereto. Likewise a cable 83 (FIGS. 2 and 6) extends from the winch 74 and upwardly over a pulley 84 and thence downwardly to the lower end of the channel member 56 where it is secured in a manner similar to that shown in FIG. 1 for the cable 79. Accordingly, when it is desirable to raise the excavator bucket means 6 between the positions shown in FIG. 5, the hydraulic motor 75 is operated to wind the cables 79 and 83 on the respective winches 73 and 74.

As shown in FIG. 1, a tiltable continuous conveyor

belt **85** is mounted at the upper end of the excavator bucket means **6** to receive and carry away earth removed by the buckets **52**. Thus, as the buckets rotate counterclockwise, they empty their contents onto the belt **85**. The belt **85** is disposed over and between a pair of spaced belt-supporting rollers **86** and **87** which are disposed at opposite ends of elongated frame members **88** and **89**. The roller **86** is driven by a hydraulic motor **86***a*. The frame members are in turn secured to a supporting frame generally indicated at **90** by pairs of similar connecting links **91** and **92**, the lower ends of which links are pivotally secured at **93** to opposite ends and sides of the frame members **88** and **89**. The upper ends of the links are pivotally mounted at **94** to frame members **95** and **96** which are part of the support frame **90** and which are maintained in place by other frame members **97, 98, 99, 100, 101,** and **102** which are secured in place at the upper ends of the channel members **55** and **56** by means of similar welds **103** as shown in FIG. 1.

The conveyor belt may be tilted in either direction such as shown by the broken line of FIG. 3 by means of a manually operated winch **104** which is mounted on the lower portion of the frame member **100** and operated by a hand crank **105**. As shown in FIG. 3, the ends of a cable **106** extend in opposite directions from the winch **104** and are secured as by welds **107** to opposite end portions of the frame member **88**. Accordingly, rotation of the winch in one direction tilts the conveyor belt **85** to one side of the excavator and rotation of the winch **104** in the opposite direction tilts the conveyor belt **85** in the opposite direction.

The carriage **5** is movable longitudinally on the frame **2** by carriage drive means which includes a pair of cables **108** and **109** (FIG. 2) and a double-acting hydraulic cylinder **110** (FIG. 1) together with a plurality of pulleys. The cables **108** and **109** are secured to the carriage such as by similar welds **111** as shown in FIG. 6. The cable **108** extends longitudinally from the carriage over and around a pulley **112** transversely to and around a pulley **113** (FIG. 2), then to a pulley **114** (FIG. 1), then to a pulley **115**, then to a pulley **116** where it is retained by an idler **117**, then to a pulley **118** (FIG. 2) and then to a joint **119** where the cable **108** is secured to the channel member **8**. The cable **109** extends over a set of pulleys and idlers in a manner similar to that of cable **108** and includes a particular pulley **120**. The carriage **5** is driven to the left by applying hydraulic pressure into the cylinder **110** through an aperture **121** while similar fluid exits through a similar aperture **122** at the other end of the cylinder.

The pulleys **115** and **120** are mounted on an elongated rod **123** which extends through the cylinder **110** and which is provided with a pistonlike flange **124** within the cylinder. The fluid pressure within the cylinder **110** operates on the flange **124**, thereby applying opposite pressures to the cables **108—109**, taking up slack in the cable **108** and providing slack in the cable **109**. Conversely, when the carriage is moved to the right, the flange **124** is driven to the right, whereby the cable **109** pulls the carriage to the right and the cable **108** merely follows the carriage over the pulleys in the manner described.

The hydraulic excavator **1** is provided with a prime mover such as a gasoline engine **125** (FIG. 1) which operates a hydraulic pump **126**. An oil reservoir or sump **126***a* is operatively connected to the pump. The pump **126** provides pressure for the hydraulic fluid which actuates all of the various motors and cylinders on the excavator. Each motor and hydraulic cylinder is individually connected to the pump **126** by a particular valve generally indicated at **127** in FIG. 1.

As shown more particularly in FIG. 9, each operating unit including a motor or hydraulic cylinder is separately operated by a particular valve **127**. Thus the steering motors **40** and the other of which is not shown in the drawings are reversibly operated by separate valves **127***a*.



Likewise the traction motors **29** and **33** are reversibly operated by particular valves **127***b*. The hydraulic cylinders **18** and **25** for raising and lowering the frame are operated by valves **127***c* which apply the hydraulic fluid to the cylinders in one position and permit evacuation thereof in the other position.

Similarly, the conveyor motor **86***a* is reversibly operated by a particular valve **127***d*. The excavator motor **61***a* is operated in one direction by the particular valve **127***e*. Likewise the motor **75** for raising and lowering the excavator is reversely operated by the particular valve **127***f*. The pump or cylinder **110** is actuated in either direction by the particular reversible valve **127***g*. As shown in FIG. 9, all of the hydraulic motors and cylinders are interconnected with their respective hydraulic valves by conduits or flexible hoses (not shown) such as indicated, for example, at **128**. In addition, all of the valves **127***a–g* are connected with the pump **126** by a conduit **129** in which a pressure regulator **130** is provided. A conduit **131** is provided to return hydraulic fluid to the sump **126***a*.

The device of the present invention is an improvement over prior excavators, particularly of the grave digging type, because it provides a unit which is readily maneuverable within the limiting confines of a cemetery. Unlike prior devices which required the use of auxiliary equipment for leaving the lot where a grave is dug, the device of the present invention is readily maneuverable on a cemetery lot when the excavation of the grave is completed in order to remove the excavator without the use of planking and the like. One of the features which makes for easy maneuverability is the use of hydraulic motors and cylinders wherever possible in order to avoid other power transmitting means such as chains and gears which ordinarily limit operation of a device having many operating units.

In addition, the use of wheels having low pressure tires is an advantage in that the device may be rolled over obstacles such as low gravestones which would present a barrier to excavators provided with other types of wheels and tires. Moreover, the advantage of low pressure tires permits rolling of the device over lots without permanent damage to the grass. Finally, where an obstacle such as a particularly high gravestone is encountered, the entire frame of the unit may be raised to a height which permits passing over such a stone in order to place the excavator over the proper cemetery lot for excavation of a grave.

In the foregoing description certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations have been implied therefrom as such words are used for descriptive purposes and are intended to be broadly construed.

Moreover, the embodiment of the improved construction illustrated and described herein is by way of example and the scope of the present invention is not limited to the exact construction shown.

Having now described the invention, construction, operation and use of a preferred embodiment thereof and the advantageous, new and useful results obtained thereby; the new and useful excavator and reasonable mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claim.

What is claimed is:

An excavator including a rectangular frame mounted on a pair of low pressure pneumatic tires at each end of the frame, each pair of tires being fixedly mounted on an axle, a yoke journally mounting the ends of each axle, a vertical shaft secured to and extending upwardly from the yoke through an end portion of the frame, a hydraulic cylinder vertically mounted on each end of the frame, the upper end of each shaft having a piston end portion, each shaft extending through the end portion of the frame and into the corresponding hydraulic cylinder, a shaft turning gear mounted in each end portion of the frame and slidably mounted on each shaft, the shaft

and turning gear having corresponding key and keyway members, each shaft turning gear being independently operable by a hydraulic motor, a hydraulic traction motor operatively connected to each axle for rotating each pair of tires, each hydraulic traction motor being independently operable, a carriage mounted on the frame, reversible means for moving the carriage and for holding the carriage at a stationary position on the frame, an elongated upright excavator frame mounted for vertical movement on the carriage, a series of spaced excavator buckets mounted on the frame for continuous movement thereon, conveyor belt means for receiving excavated soil from the excavator buckets, and said conveyor belt means being tiltably mounted at the upper end of the excavator frame, whereby excavated soil can be conveyed to either side of the excavator.



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