April 29, 1952 A. H. BECK, JR 2,594,720

PIER HOLE EXCAVATOR

Filed Nov. 4, 1949 3 Sheets-Sheet 1

Fig. 13.

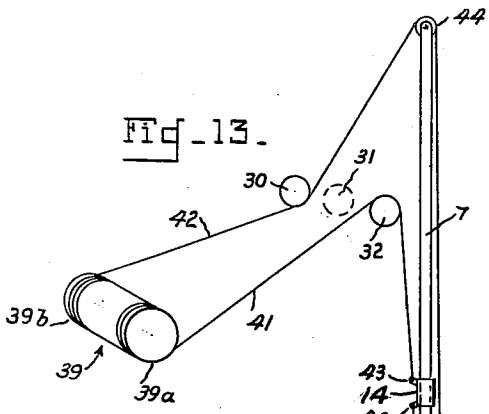
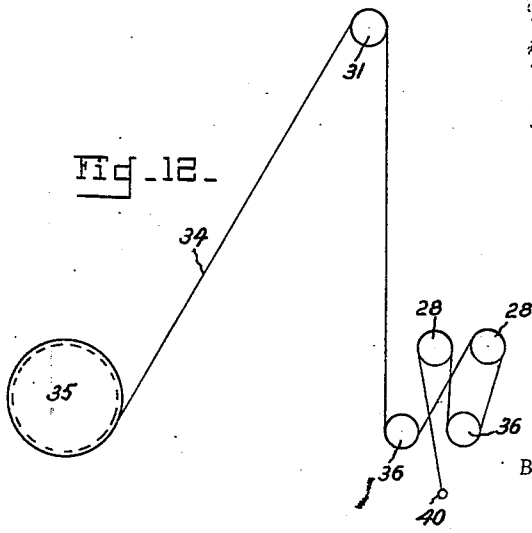


Fig. 1.

Fig. 12.



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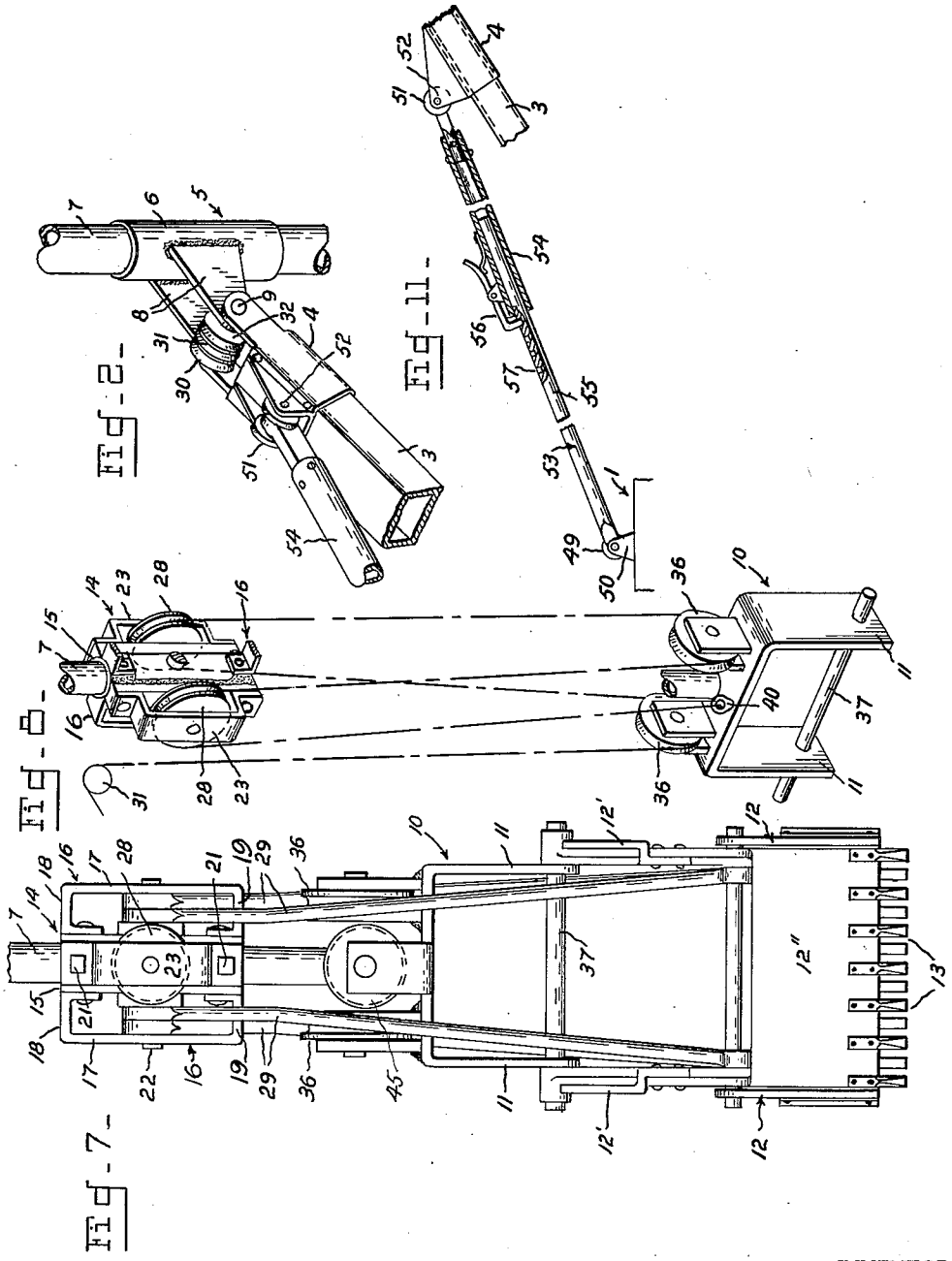


Fig. 2.

Fig. 11.

Fig. 8.

Fig. 7.

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PIER HOLE EXCAVATOR

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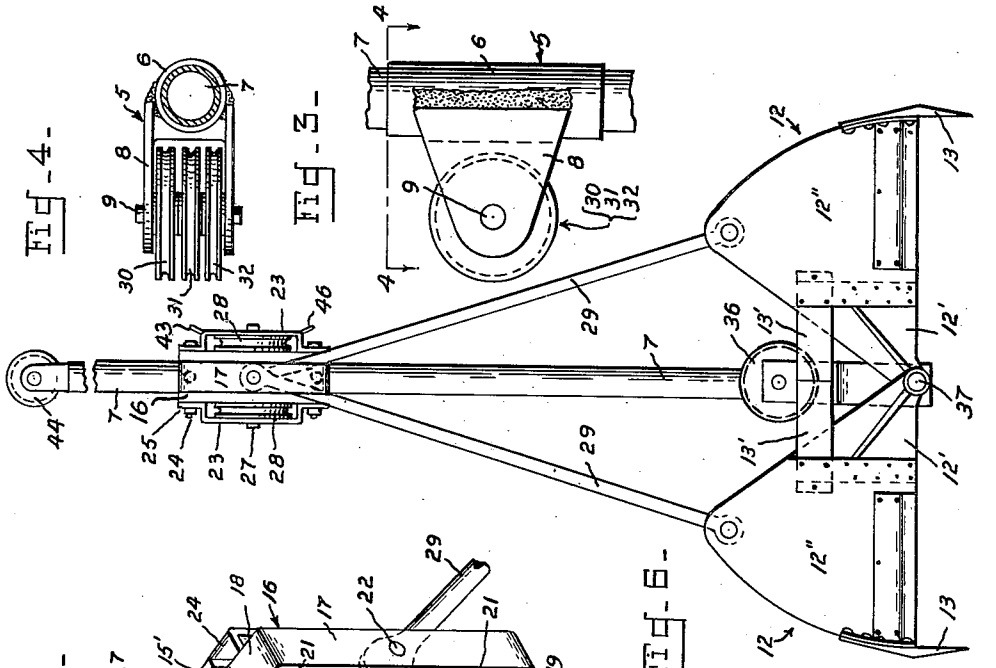


Fig. 6.

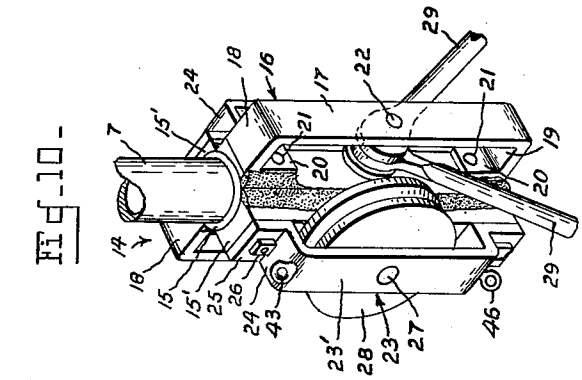


Fig. 10.

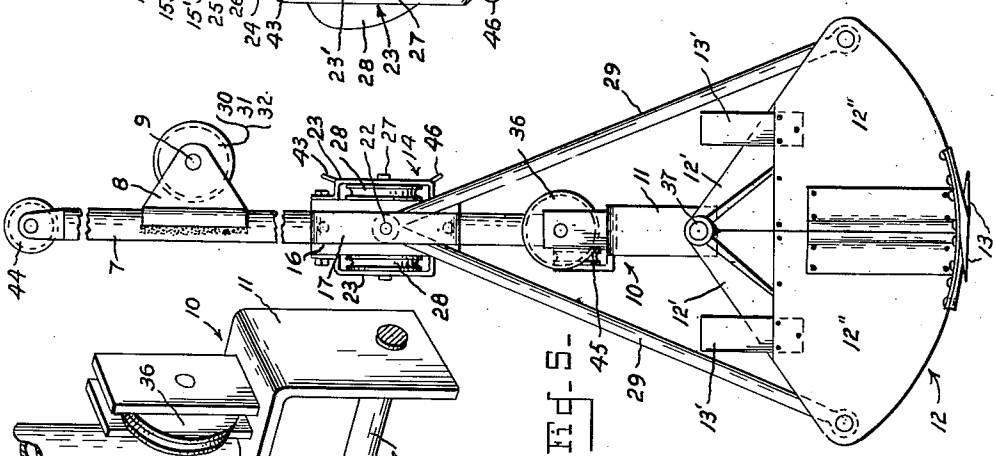


Fig. 5.

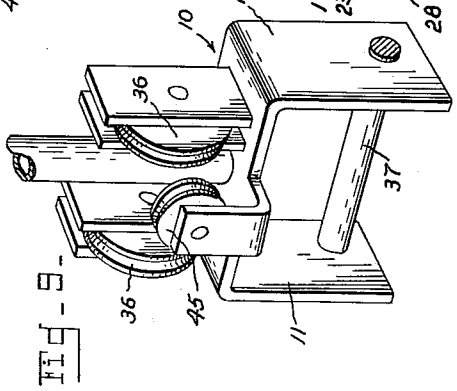


Fig. 9.

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UNITED STATES PATENT OFFICE

2,594,720

PIER HOLE EXCAVATOR

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Application November 4, 1949, Serial No. 125,497

11 Claims. (Cl. 214—115)

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This invention relates to pier hole excavators and is particularly directed to an improvement in excavators and excavator buckets constructed primarily for digging pier holes for the reception of foundation piers.

In the mechanical digging of pier holes, which often are of great depth as compared with their surface dimensions, great difficulty has been experienced in maintaining the hole of the same size throughout its depth while at the same time insuring the proper excavation and uniform removal of the dirt. In all machines designed for this purpose so far as known, the machine is effective for a portion of the desired depth and then, owing to the inability to properly handle the excavator, and also owing to the inability of known machines to dig hard material in the restricted space of the pier hole, such known machines become useless and the hole is generally completed to the required depth by hand digging.

The primary object of the present invention, therefore, is to provide means for excavating pier holes and the like wherein the excavator is under the complete control of the operator for both direct vertical descent and ascent; for securing direct and positive opening and closing of the members of the excavator bucket proper; for providing means by which the excavator proper may be subjected to additional force in the event hard material is encountered; and for providing additional means to raise the excavator in the event the same should become overloaded beyond the power of the usual lifting means.

A further object of the invention is to provide means by which the excavator may, when loaded and above the hole, be readily and conveniently moved to a position to deposit the load in a truck or the like to thereby avoid the necessity and reduce the expense incident to manual operation in either digging or loading.

A further object of the invention is the provision of means whereby the bucket or excavator proper is held rigid in operation regardless of the uneven character of the surface encountered by the excavtor.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several figures and in which:

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Fig. 1 is a side view in elevation of an excavator in accordance with the present invention;

Fig. 2 is an enlarged fragmentary view in perspective of the outer end of the excavator boom and its connection with the bucket supporting dipper stick;

Fig. 3 is a fragmentary side view in elevation of the dipper stick guide;

Fig. 4 is a view in cross-section taken on the line 4—4 of Fig. 3;

Fig. 5 is a side view in elevation of the bucket supporting mechanism and the bucket in closed position;

Fig. 6 is a side view in elevation of the bucket supporting mechanism with the bucket in open position;

Fig. 7 is an end view in elevation of the open bucket and supporting mechanism;

Fig. 8 is a fragmentary view in perspective of the bucket supporting mechanism;

Fig. 9 is a view in perspective of the bucket supporting bracket;

Fig. 10 is a view in perspective of the bucket arm guide;

Fig. 11 is a side view partially in elevation and partially in section, of the boom brace;

Fig. 12 is a diagrammatic layout of the bucket closing, hoisting and releasing line; and

Fig. 13 is a diagrammatic layout of the dipper stick holding and crowding lines.

Referring now to the drawings, specifically to Fig. 1, an excavator, in accordance with the present invention, comprises a typical housing 1 that encloses the usual power plant, which may be of any desired type and requires no particular illustration. The housing 1 is supported for mobility and horizontal lateral turning in any desired manner, as for instance by conventional caterpillar tractor supports 2. A boom 3 of conventional type is supported for usual and vertical swinging movement with respect to the housing 1, the boom being modified slightly in accordance with the invention.

A fitting or bearing bracket 4 is secured on the free end of the boom 3 and a dipper stick guide 5 is pivotally supported by the fitting 4, as best shown in Figs. 1 and 2. This guide 5 includes a cylindrical sleeve 6 of a size and shape to slidingly fit an elongated dipper stick 7, as best shown in Figs. 3 and 4. The sleeve 6 is supported by a bearing bracket comprising rigidly attached spaced bearing jaws or triangular plates 8 which are pivotally supported by a stub shaft 9 which

is supported by the fitting 4. The dipper stick guide 5, and therefore the dipper stick 7 slidably mounted therein, is thus swingingly mounted for vertical movement on stub shaft 9 as a horizontal pivot at the free end of the boom 3, the arc of permissible movement being increased by the formation of the plates 8 which taper from the pivot 9.

An inverted U-shaped bucket supporting bracket 10 is fixed to the lower end of the dipper stick 7, as best shown in Figs. 5–9. The bracket 10 has depending arms 11 which carry a pivot 37 for supporting the arms 12' of the respective halves 12'' of the bucket 12. The bucket is of the conventional clam-shell type provided with digging teeth 13 and is so pivotally supported upon the bracket or casting 10 that the halves of the bucket may be forced together as seen in Figure 5 to dig and pick up a load, or may be opened with their open sides disposed downwardly in substantially horizontal alignment as seen in Figure 6 so that the teeth are substantially in parallel relation for the start of the digging operation or for the discharge of the load. A pair of pulleys 36 are mounted on the bracket 10 on opposite sides of the dipper stick 7. These pulleys 36 are mounted on substantially coincident or aligned axes which are perpendicular to the dipper stick 7. In addition, another pulley 45 is mounted on the bracket 10 on one side perpendicular to and between pulleys 36 and an anchor ring 40 is also fixed to the bracket 10 at the side opposite pulley 45.

Slidably supported upon the dipper stick intermediate the dipper stick guide 5 and the bracket 10 is a bucket arm guide 14. This guide 14, best shown in Figures 5–8 and 10, includes a sleeve element 15 which slidably embraces and conforms to the contour of the dipper stick 7, the sleeve being exteriorly reinforced by a materially thickened shell 15' which is secured to and forms part of the sleeve, said shell comprising diametrically opposite plates if desired. Open rectangular sections or C-shaped bearing straps 16 are secured at diametrically opposite points to the reinforced sleeve 15. These sections 16 have opposed aligned ends 20 turned inwardly from upper and lower arms 18 and 19 which are turned from the central outer walls 17. The ends 20 of the sections 16 are rigidly secured, as by bolts 21, to the reinforced sleeve 15 or plates 15' and, consequently, the walls 17 are parallel with and spaced from the sleeve 15. Mounted in each of the sections 16 and extending transversely thereof is a pin 22, the inner end of which is mounted in the reinforcement 15' and the outer end of which is mounted in the outer wall 17 of each section.

The bucket arm guide 14 also includes two pulley housings or supports 23 which are arranged in diametrically opposed relation and at right angles to the sections 16. The pulley supports 23 comprise straps which are bent in step formation at their ends to present intermediate walls 23' that are spaced from the reinforced sleeve 15, the ends of the straps being bent inwardly at 24 and then outwardly at 25 to contact the reinforced sleeve 15, with bolts 26 securing the outwardly extended portions 25 to the reinforced sleeve. Pulley shafts 27, carrying pulleys 28, both horizontally aligned, are supported in the reinforcement 15' and the outer walls 23' of the straps. Two anchor rings 43 and 46, or the like, are fixed at each end of the bucket arm guide 14 and are shown as being

secured to the inturned ends of one of the pulley supports 23.

The bucket arm guide 14 is slidably mounted on the dipper stick 7, and four bucket guide rods or arms 29 arranged in two opposite pairs are pivotally connected at one end to the bucket sections and at the other end to the pins 22 of the bucket arm guide. Each bucket section 12'' has two such rods connected at their lower ends at opposite points on the bucket section, as best shown in Fig. 7. The upper ends of one of the pairs of rods 29 connected to each bucket section and on the same side of the bucket, are comounted on the respective pin 22; that is to say, each pin 22 forms a pivot for the upper ends of two rods, which rods at their lower ends are respectively connected to one of the bucket sections. Thus, the bucket sections may be opened or closed by movement of the bucket arm guide 14 in relation to bracket 10 which is held in a stationary position at the lower end of the dipper stick, the rods or arms 29 serving to insure a positive movement of the bucket sections and preventing relative turning movement of the bucket sections and the bucket arm guide.

Pulleys 30, 31 and 32 are mounted on the pivot 9 between the boom terminal bearing fitting or bracket 4 and the dipper stick guide 5, and cables for operating the dipper stick and bucket are run over these pulleys. These cables are wound on and operated by conventional power driven drums such as a drum 35 in the housing 1 and a double drum 39 journalled on the boom 3.

A cable 34 extends from the drum 35, over pulley 31 and down around one of the pulleys 36 on the bucket bracket 10, then up over one of the pulleys 28 on the bucket arm guide 14, down and beneath the other pulley 36 on the bucket bracket or casting 10, up and over the other pulley 28 of the bucket arm guide, and then extended downward and terminally secured to the anchor ring 40 on the bracket 10. The arrangement of the cable 34 is best illustrated in Figs. 8 and 12. In Fig. 12, the arrangement of the cable is shown diagrammatically so that its course may be readily evident. In Fig. 8, the cable arrangement is fragmentarily shown to illustrate the relation of the bracket 10 and guide 14, and the course of the cable 34 over the respective pulleys. As best seen in Fig. 8, the pulleys 28 and 36 are respectively disposed at right angles to each other so that the run of the cable 34 is not crossed or twisted, but is freely spaced around the dipper stick 7, the latter being broken away to present an unobstructed view of the cable run.

The double drum 39, as best shown in Fig. 13, comprises two drum sections 39*a* and 39*b*, and a cable 41 is wound under and over the section 39*a*, while a cable 42 is wound over and under the section 39*b* so that as the drum is rotated it winds one cable and simultaneously unwinds the other cable. The cable 41 leads from its drum section 39*a* and passes over pulley 32, at the end of the boom 3, and is terminally connected with the anchor ring 43 on the bucket arm guide 14, serving to hold the bucket arm guide in a fixed position when the cable 34 is released. This permits the dipper stick 7 and bucket 12 to descend, which effects the opening of the bucket, either for digging or discharge purposes. When the bucket is open or in digging position, it may be raised or lowered in this open position by the cable 41, which will hereinafter be referred to as the holding cable.

The cable 42 leads from the top side of its

drum section 39b to and under pulley 30, at the end of the boom 3, up to and over a pulley 44, which is mounted on top of dipper stick 7, then down and under pulley 45 on bracket 10 at the lower end of the dipper stick 7, and finally up to and terminally connected to anchor ring 46 on the bucket arm guide 14. The drum 39 may comprise a single sectional drum or two coordinated drums which are simultaneously driven with the cables 41 and 42 wound thereon in reverse directions so that when one cable is tightened the other is correspondingly loosened. The cable 42 is reeved so as to keep both cables 41 and 42 under tension at all times. Cable 42 provides means by which the bucket may be crowded down into the material to be excavated, particularly when extra hard material is encountered, and is called the crowd cable.

In operation, the cable 34 has three functions, namely, closing, hoisting and releasing the bucket. First, starting with the bucket 12 in the open or digging position with the bucket halves 12'' spread, as shown in Fig. 1, the drum 35 is operated to wind up the cable 34 which acts to pull the pulleys 28 and 36 together. This causes the bucket arm guide 14 to slide down the dipper stick toward the bucket bracket 10, thus depressing the bucket arms or rods 29 which forces the halves 12'' to converge until they are in the closed position, as shown in Fig. 5. The digging operation then has been completed.

Upon continued winding of the cable 34, with the bucket arm guide 14 and the bucket bracket 10 in contact or as close together as possible as see in Figures 5 and 7, depending upon the length of the bucket guide rods or arms 29, the bucket 12 and dipper stick 7 will be raised as a single unit. This then changes the function of the cable 34 from a closing cable to one of a hoisting cable. The bucket 12 is raised to the desired height and then the drum 35 is braked. This then completes the second function of cable 34.

In order to open the bucket halves 12'' to discharge the excavated materials or prepare for digging, the bucket arm guide 14 is held in a fixed position by holding line or cable 41, and the drum 35 is then released. The weight of the dipper stick 7 tends to bear down on the bucket bracket 10 and lowers it from the bucket arm guide 14 as seen in Figures 1 and 6, thereby causing the bucket halves 12'' to separate and reach their maximum open position. The third function of the cable 34 has been completed and is known as the release or discharge operation.

The holding line 41 is operative to hold the bucket arm guide 14 at any desired position or height, it being connected to the tip of the bucket arm guide by anchor 43, as best shown in Figs. 1 and 13. The drum 39 is controlled by the operator and can be held in a fixed position by a brake, be released to lower the bucket arm guide 14, or be driven to raise or lift the guide 14. The function of this cable 41 is twofold. First it is used to hold the bucket arm guide in a fixed position while the cable 34 is released for discharge purposes. Secondly, after the cable 34 has been released and the bucket halves are in extreme open or digging position, the bucket 12 and dipper stick 7 are suspended as a unit and held by line 41. The operator then releases the brake on drum 39 and permits the lowering of the bucket in open position to the desired place of excavation by the gravity action of the dipper stick 7 slipping through the sleeve guide 5 pivoted to the boom 3, and, in effect, rolling down the line 42. By this means the bucket can also be raised in the open position by engaging the drum 39 and turning it in the direction to wind up the cable 41 which lifts the guide 14 and, through the bucket arms or rods 29, raises the bucket 12 and dipper stick 7 as a unit, with the bucket in open or digging position.

The function of the crowd cable 42 is unique in that it enables the operator to bear down on or crowd the dipper stick 7 in order to dig hard materials. Cable 42 leads over, down, under and up the dipper stick 7, and is terminally connected to the bottom of the bucket arm guide 14 by anchor 46. When the drum 39 is driven in the direction to wind up the cable 42, it gives the effect of pulling or crowding the dipper stick 7 down. This action depresses the bucket 12 in open position against the material in the bottom of the hole. While the cable 42 is crowding the bucket 12 down, the cable 34 is then wound up to close the bucket halves 12''. The action of the cable 42 keeps the bucket bracket 10 in a fixed position as the bucket halves close, keeping the bucket teeth 13 at a fixed radius from the bucket bracket 10, so that they will dig into the material rather than scraping across the surface of the material. After the bucket halves 12 are closed, the drive for the drum 39 is put in neutral so that, as the bucket and dipper stick are raised by cable 34, the cable 42 unwinds from its drum 39b and by this action the drum 39a winds in the cable 41 so that at any part of the operation these cables 42 and 41 are in constant tension and no slack occurs. In order to hold the bucket sections 12'' rigidly in open position with the teeth 13 in parallel relation during the lowering and crowding down action, each section 12'' is provided on each side with an abutment member 13'. These members 13' cooperatively abut each other when the sections 12'' are opened.

The boom 3 is angularly adjustable in the usual manner by cable 47 which extends from a drum 48, in the housing 1, over pulleys 49 on the boom gantry 50 and around pulleys 51 journalled on a pivot 52 carried by the boom terminal fitting 4. In order to hold the boom 3 rigid against upward pressures in reaction to the crowding down of the dipper stick 7 by the line 42 during digging operations, a brace 53 is provided and is rigidly connected at one end to the boom bracket 4 as to the pivot 52, and at the other end to the boom gantry 50 on the housing 1, as to the pivot for the pulleys 49, as shown in Figs. 1 and 11. The brace 53 is pivotally supported at the boom gantry 50 and also at the boom bracket 4.

This brace 53 comprises two telescopic members including a larger diameter pipe or sleeve 54 slidably telescoping a smaller diameter pipe or rod 55. A latch 56 is mounted on the inner end of the sleeve 54 for selective cooperation with notches 57 in the rod 55. The latch 56 may be of any desired type and is shown as a lever biased to closed position by a spring. This brace 53 is used to withstand compressive forces only, and if it is desired to raise or lower the boom 3, the latch 56 is released from the notches 57 and when a desired angular position of the boom 3 is reached, the latch 56 is engaged with the selected notch 57. This then permits the operator to use the entire weight of the machine to bear down on the bucket when extremely hard materials are to be excavated.

The dipper stick 7 is designed to hold the bucket

in rigid position and to keep the bucket from tilting or turning to different positions while digging in uneven farms or uneven ground. This permits the bucket to be held true so that the teeth may trim the walls of the pier hole on substantially true lines.

Although a specific embodiment of the invention has been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not to be restricted except in so far as is necessitated by the prior art and by the spirit of the appended claims.

What is claimed to be new is:

1. A pier hole excavator including a boom, a dipper stick guide pivotally mounted at the free end of the boom, a dipper stick slidably mounted in the guide, a bracket at the lower end of the dipper stick, a bucket having its sections pivotally supported by the bracket, a bucket arm guide slidably mounted on the dipper stick and including diametrically opposed supporting pins and diametrically opposed pulleys, the latter being located at right angles to the pins, a pair of arms mounted on each pin and connected at their opposite ends to the respective sections of the bucket, a first cable guided over the boom to and through the bracket, over one of the pulleys on the bucket arm guide, over the second pulley on the bucket arm guide, and terminally secured to the bracket, and a second cable connected to the boom and leading to the lower end of the dipper stick for supporting the bucket sections.

2. A pier hole excavator including a boom, a dipper stick guide pivotally supported by the boom, a dipper stick supported in the guide, bucket sections pivotally supported at the lower end of the dipper stick, a bucket arm guide slidably mounted on the dipper stick above the bucket sections, rods connecting the bucket sections and bucket arm guide, a cable having guiding connection with the boom and leading to and over the upper end of the dipper stick, and down and under the lower end of the dipper stick and terminally connected to the bucket arm guide, and a second cable having guided connection with the boom and leading to the lower end of the dipper stick for supporting the bucket sections, said cables being simultaneously and reversely operated for seecuring the bucket to its work or for holding the bucket and dipper stick while discharging or placing the bucket for digging position.

3. A bucket operating means for a pier hole excavator of the type including a vertically movable dipper stick, comprising a bracket to be secured to the lower end of the dipper stick, a sectional bucket having the sections thereof pivotally supported by the bracket, a bucket arm guide slidably mounted on the dipper stick, and including a member for slidably receiving the dipper stick, diametrically opposed housings carrying pivot pins and diametrically opposed straps fixed on said member, pulleys pivotally supported within said straps, rods pivotally connected at one end to the pivot pins of said housings and at the opposite ends to the respective sections of the bucket, an operating cable terminally connected at one end to the bracket and having a plurality of operating turns between the bracket and the pulleys on the guide, and a second cable connected to the boom and leading to the lower end of the dipper stick for supporting the bucket sections.

4. A bucket operating means for a pier hole excavator of the type including a dipper stick, a bracket at the lower end of the stick, opposed pulleys journalled on the bracket, a sectional bucket having the sections thereof pivotally supported on the bracket, a bucket arm guide slidably mounted on the dipper stick and including diametrically opposed pivot pins, diametrically opposed pulleys carried by the bucket guide at right angles to the plane of the pivot pins and supported wholly beyond the plane of the dipper stick, a pair of bars pivotally mounted at their upper ends on the respective pivot pins, the lower end of each pair of bars being connected to the respective sections of the bucket, a power operated cable having one end secured to the bracket to pass thence to and around one of the pulleys on the guide, then to and around one of the pulleys on the bracket, then to and around the second pulley on the guide, then to and around a second pulley on the bracket, and then extended to power operated mechanism whereby the guide may be operated relative to the bracket to open and close the bucket sections, and a second cable leading over, down, under and up the dipper stick and terminally connected to the bottom of the bucket arm guide whereby the dipper stick may be used to dig hard materials.

5. A bucket operating means for a pier hole excavator of the type including a dipper stick, a bracket at the lower end of the stick, opposed pulleys journalled on the bracket, a sectional bucket having the sections thereof pivotally supported on the bracket, a bucket arm guide slidably mounted on the dipper stick and including diametrically opposed pivot pins, diametrically opposed pulleys carried by the bucket arm guide at right angles to the plane of the pivot pins and supported wholly beyond the plane of the dipper stick, a pair of bars pivotally mounted at their upper ends on the respective pivot pins, the lower end of each pair of bars being connected to the respective sections of the bucket, a power operated cable having one end secured to the bracket to pass thence to and around one of the pulleys on the guide, then to and around one of the pulleys on the bracket, then to and around the second pulley on the guide, then to and around the second pulley on the bracket, and then extended to power operated mechanism whereby the guide may be operated relative to the bracket to open and close the bucket sections, and a power operated cable terminally connected to the guide.

6. A clamshell bucket for excavators, comprising two bucket sections which are pivotally connected for movement between a closed position with adjacent edges of said sections in abutment and an open position wherein said bucket sections are separated for digging, and abutment members extending from the sides of said sections opposite said abutting edges and mutually cooperative to limit the opening of said sections to a position wherein the abutting edge portions are substantially parallel.

7. A pier hole excavator including a boom, a dipper stick, a bucket carried by the dipper stick, means for swingingly and slidably connecting the dipper stick to the end of the boom, a bucket arm guide slidable on the dipper stick above the bucket arms carried by the guide and leading to the bucket sections for opening and closing the bucket in the relative movement of the guide, and cable connections whereby the bucket sections and guide may be moved relatively, and means for sliding the dipper stick relative to the boom and guide and supporting the dipper stick in any position to which it is slid.

8. A pier hole excavator including a boom, a

dipper stick, a bucket carried by the dipper stick, means for swingingly and slidably connecting the dipper stick to the end of the boom, a bucket arm guide slidable on the dipper stick above the bucket, arms carried by the guide and leading to the bucket sections for opening and closing the bucket in the relative movement of the guide, cable connections whereby the bucket sections and guide may be moved relatively, and cable connections whereby the bucket arm guide may be held fixed against movement on the dipper stick to permit an opening of the bucket sections upon upward movement of the dipper stick and whereby the bucket arms may be held fixed against upward movement while digging.

9. A pair hole excavator including a boom, a dipper stick guide pivotally supported by the boom, a dipper stick slidably supported in the guide, bucket sections pivotally supported at the lower end of the dipper stick, a bucket arm guide slidably mounted on the dipper stick above the bucket sections, rods connecting the bucket sections and bucket arm guide, a cable having guiding connection with the boom and leading to and over the upper end of the dipper stick, and down and under the lower end of the dipper stick and terminally connected to the bucket arm guide, and a second cable having guided connection with the boom and movably engaged with and antifrictionally guided at the lower portion of the dipper stick for supporting the bucket sections, said cables being simultaneously and reversely operated for securing the bucket to its work or for holding the bucket and dipper stick while discharging or placing the bucket for digging position.

10. A pier hole excavator including a boom, a dipper stick guide pivotally mounted at the free end of the boom, a dipper stick slidably mounted in the guide, a bracket at the lower end of the dipper stick, a bucket having its sections pivotally supported by the bracket, a bucket arm guide slidably mounted on the dipper stick above the bucket sections, rods connecting the bucket sections and bucket arm guide, a cable having guiding connection with the boom and leading to and over the upper end of the dipper stick, and down and under the lower end of the dipper stick and terminally connected to the bucket arm guide, and a second cable having guided connection with the boom and movably engaged with and antifrictionally guided at the lower portion of the dipper stick for supporting the bucket sections, said cables being simultaneously and reversely operated for holding the bucket to its work or for holding the bucket and dipper stick while discharging or placing the bucket for digging position.

11. A bucket operating means for a pier hole excavator of the type including a dipper stick, a bracket at the lower end of the stick, opposed pulleys journalled on the bracket, a sectional bucket having the sections thereof pivotally supported on the bracket, a bucket arm guide slidably mounted on the dipper stick and including diametrically opposed pivot pins, diametrically opposed pulleys carried by the bucket arm guide at right angles to the plane of the pivot pins and supported wholly beyond the plane of the dipper stick, a pair of bars pivotally mounted at their upper ends on the respective pivot pins, the lower end of each pair of bars being connected to the respective sections of the bucket, a power operated cable having one end secured to the bracket to pass thence to and around one of the pulleys on the guide, then to and around one of the pulleys on the bracket, then to and around the second pulley on the guide, then to and around the second pulley on the bracket, and then extended to power operated mechanism whereby the guide may be operated relative to the bracket to open and close the bucket sections, and a power operated cable terminally connected to the guide and movably trained around the upper and lower ends of the dipper stick.

AUGUST H. BECK, JR.

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