

Dec. 21, 1943.

H. G. STRAIN

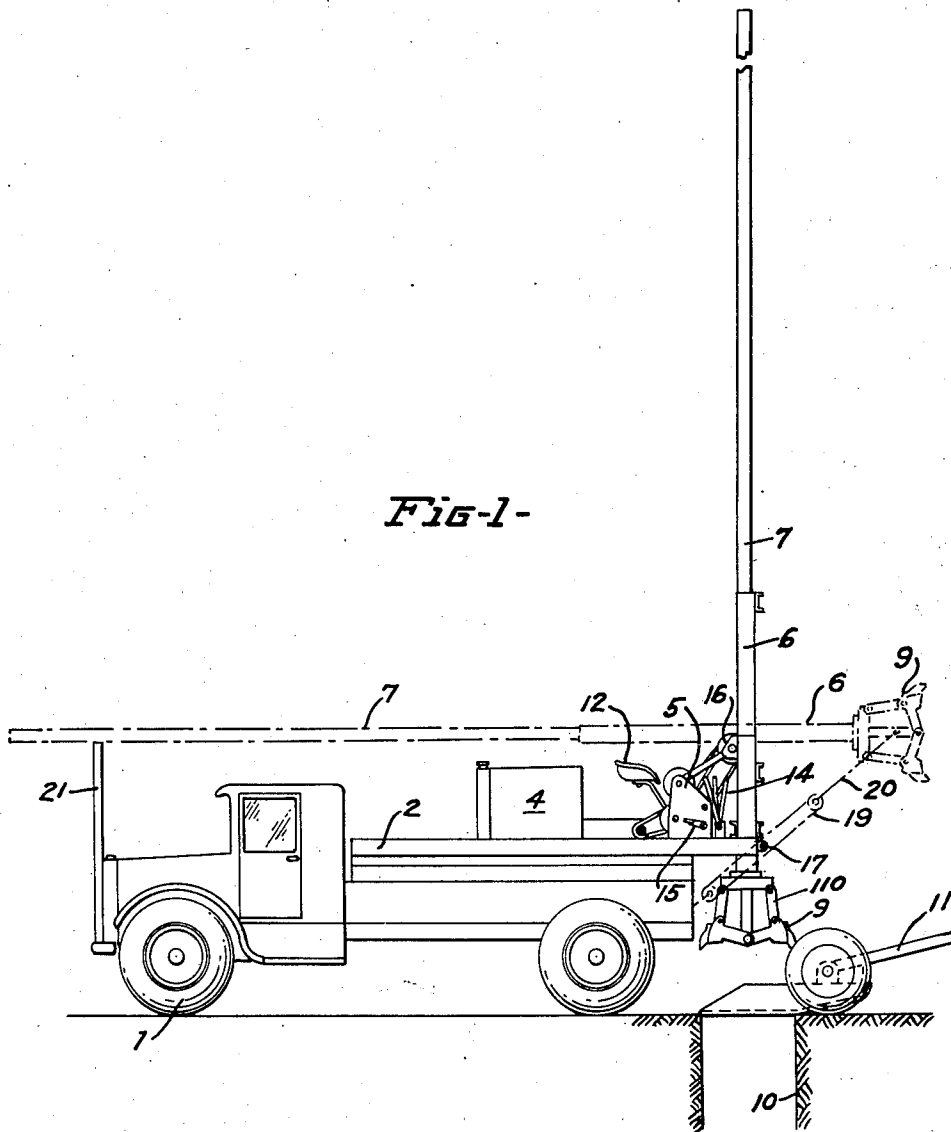
2,337,133

DIGGER

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5 Sheets-Sheet 1

Fig-1-



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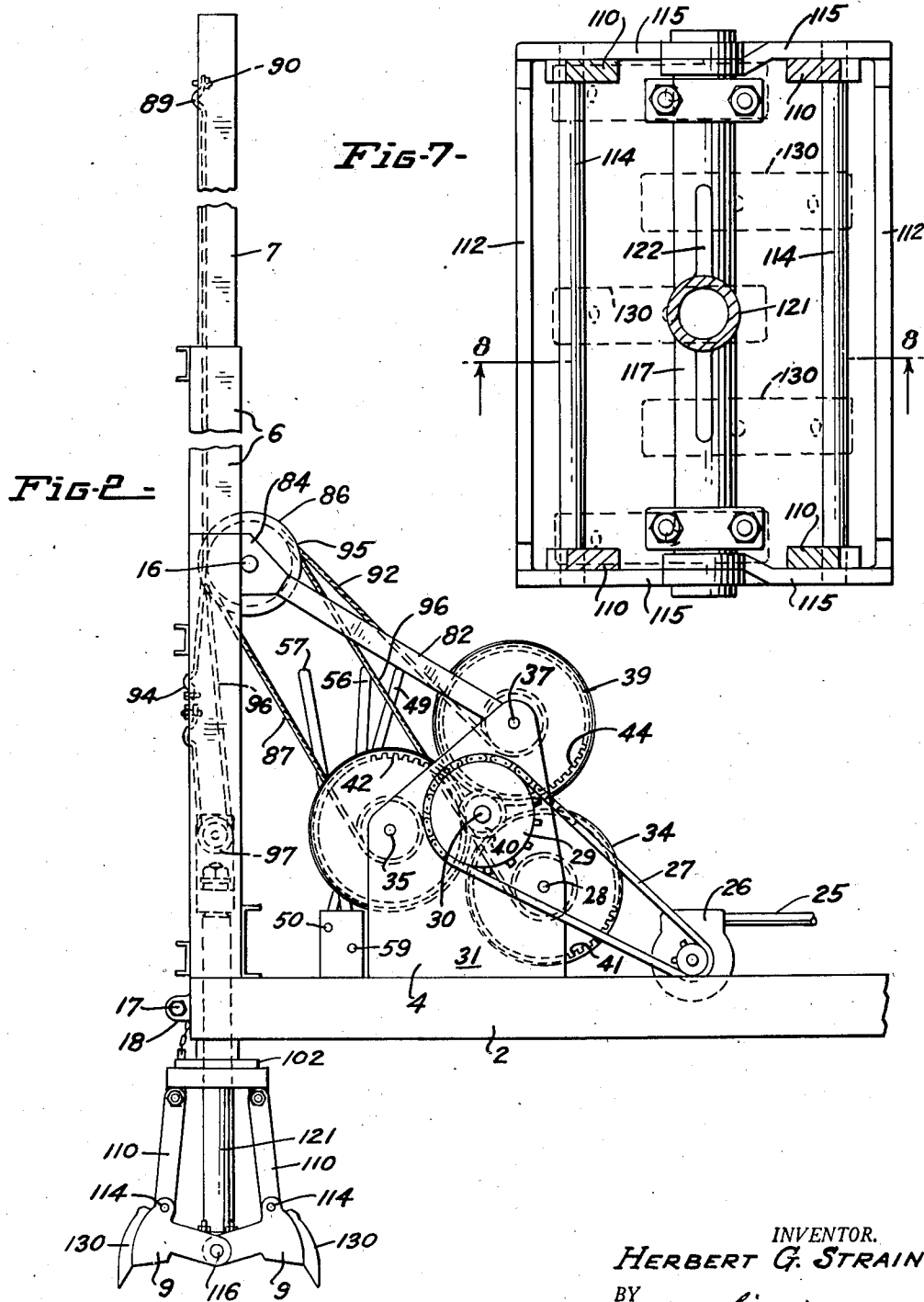
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DIGGER

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5 Sheets-Sheet 2



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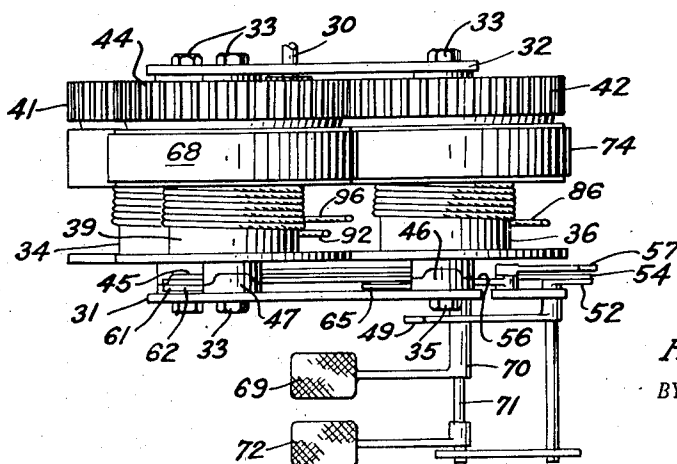
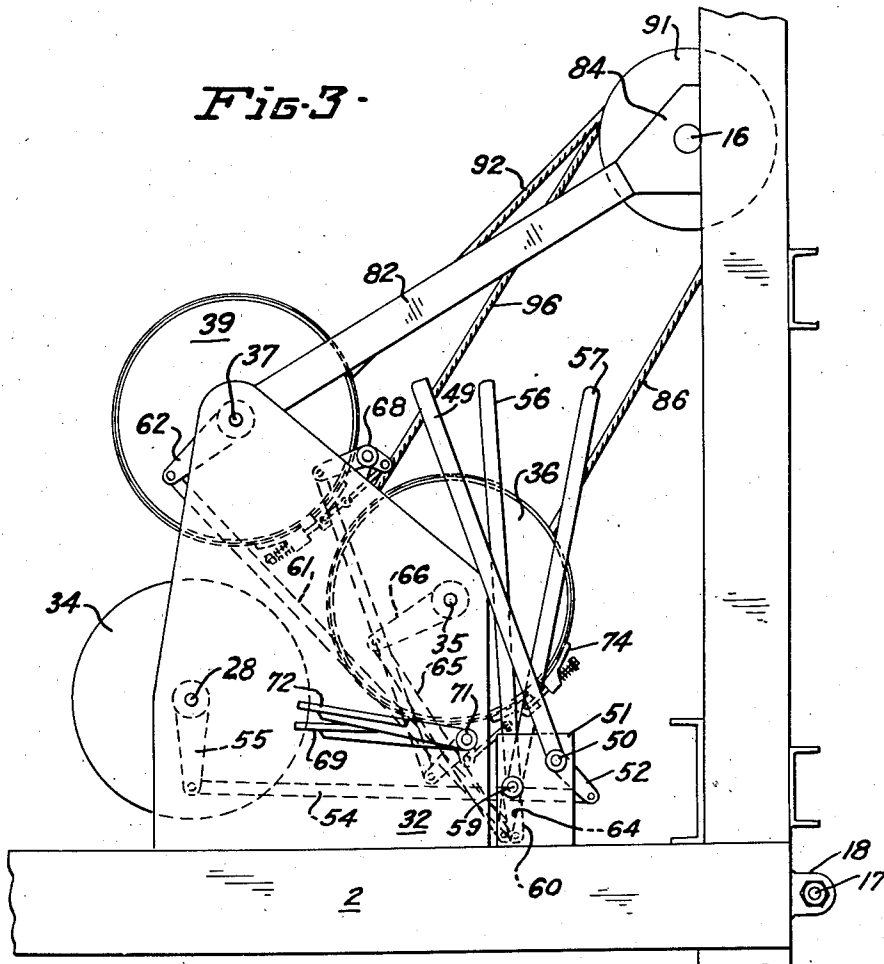
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DIGGER

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5 Sheets-Sheet 3



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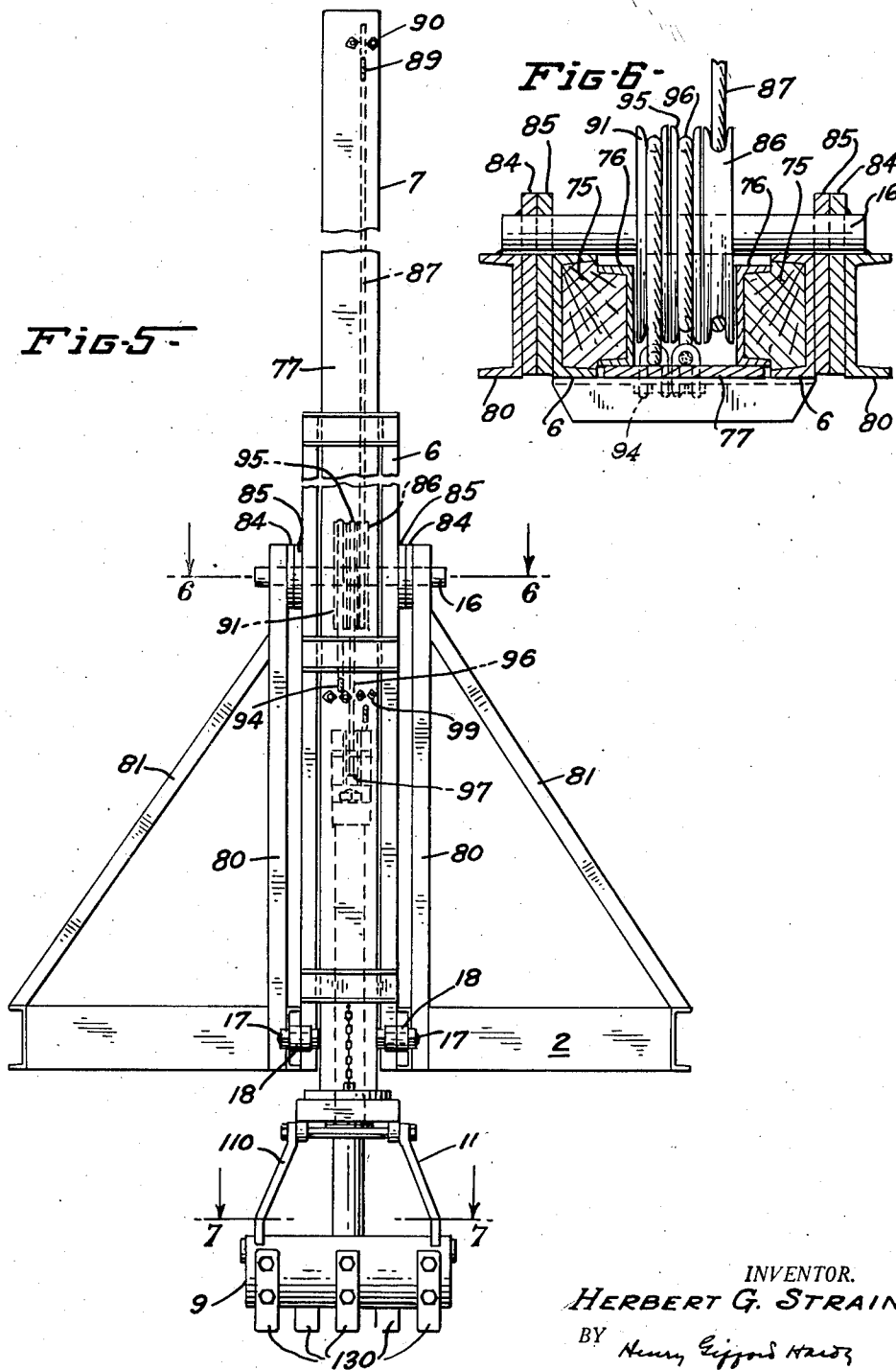
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DIGGER

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5 Sheets-Sheet 4



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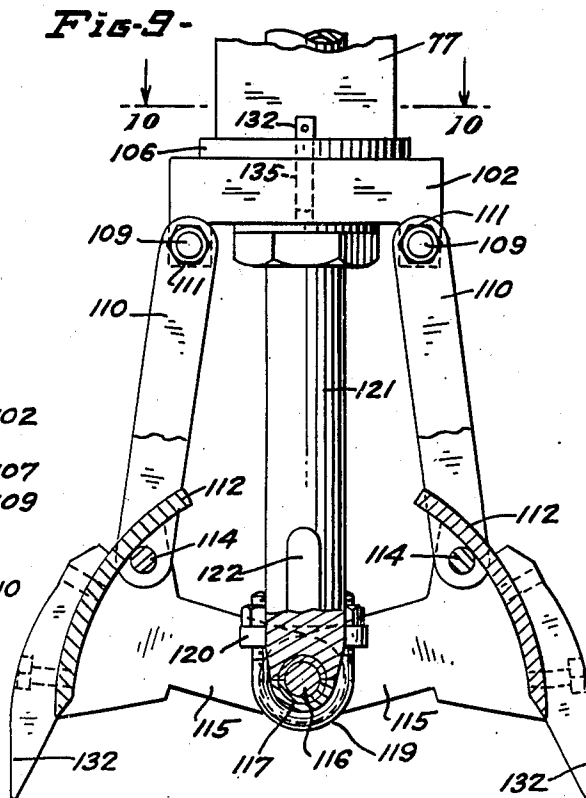
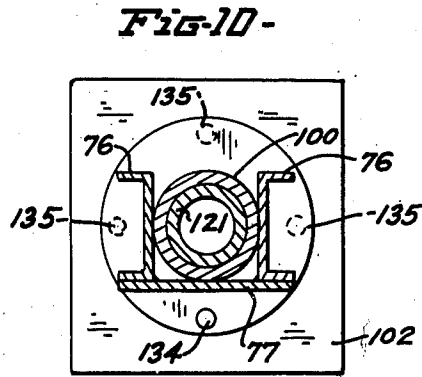
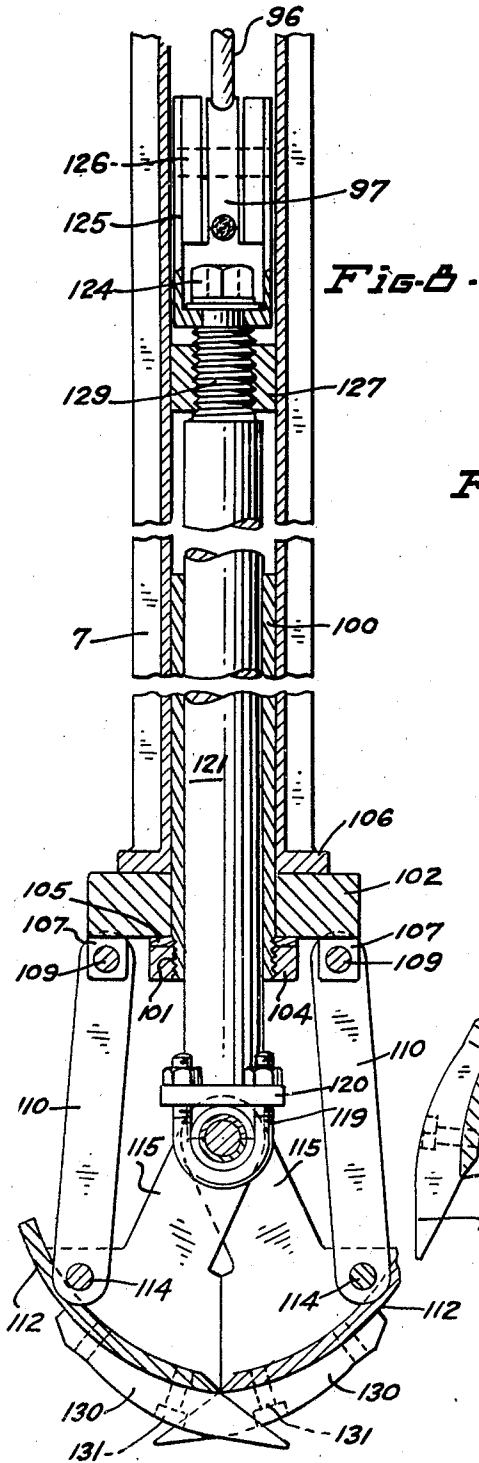
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DIGGER

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,337,133

DIGGER

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Application August 4, 1940, Serial No. 351,390

9 Claims. (Cl. 255—1)

This invention relates to digging equipment, and particularly to a digger for sampling purposes.

In testing properties for mining, it is necessary to take samples of the earth deposits for analysis. This analysis will be carried out separately for the different vertical levels thruout the properties, since different strata will vary in mineral content. For this purpose, various types of machines have been used. In some cases, a hand operation is sufficient. Where greater depth is required, earth augers, or screw type diggers have been used. These are open to objection, however, in that they are very slow in operation and are easily damaged by large rocks or small boulders in their path.

The present invention is designed to avoid such difficulties, and comprises, in brief, a power driven bucket digger of the clamshell type which is so adjusted as to dig a square hole of the same outer dimensions as the bucket, to any desired depth, and to permit very accurate sampling of the material dug.

Portability is secured by mounting the entire unit on a special frame built onto a truck chassis. The unit includes a motor, which may be of conventional internal combustion type or its equivalent. The motor drives a winch, which is controlled by an operator thru conventional hand levers and foot brakes, and actuates the bucket.

The unit includes a vertical guide in which the mast, or vertical column to which the bucket is attached, may slide. The mast must be of sufficient length to carry to the bottom of the desired hole, and the guides must be proportioned accordingly.

This digger is designed primarily for testing areas which will be surface mined by placer or strip methods, and hence ordinarily it is not necessary to dig below 50 feet, but greater depths can be handled successfully. The depth of the bucket is indicated by markings on the mast which may be read opposite the level of the ground.

In use, the operator raises the mast with the bucket open over the intended site by engaging the holding line drum on his winch. He then releases the holding line and forces the mast and bucket downward by means of a crowd line connected to another drum of the winch. The drive from the winch, plus the weight of the mast and bucket, forces or crowds the teeth of the latter into the ground. If it is exceptionally hard, repeated blows may be necessary. When the bucket has penetrated a desired distance, a closing line drum is connected to draw the bucket into closed position, after which it may be lifted out of the hole by again engaging the holding line drum.

A small cart is used to take away the earth

from the loaded bucket, which is released by disengaging the closing line drum. The discharged material is stored in separate piles arranged in a row, so that the character of successively deeper strata may be observed and the ore analyzed for the different levels.

The weight of the closing elements is so distributed that the bucket normally stays open and ready to deliver a digging blow unless the closing drum is engaged. A brake is provided to control the crowd and closing drum action.

More even digging action is obtained by the use of staggered teeth on the bucket shells which interlock when the shells are closed, and by making the bucket rotatable about a vertical axis. In this way, comparatively large rocks and other obstructions may be loosened, turning the bucket and attacking them from different angles.

The turning also insures a square hole with the sides more even and less likely to cave in, since the digging action of the teeth is more uniform than that of the bucket sides. With this method, I have consistently been able to dig from 20 to 40 feet of test hole per hour, removing approximately 1 cubic foot of earth at each bite of the bucket.

The objects of my invention thus include providing a more rapid and efficient core digger for sampling purposes:

The elimination of caved-in sections of test holes;

Better analyses by procuring more extensive samples;

Elimination of troublesome rocks and obstructions which seriously interfere with auger-type core samplers;

The application of power to core sampling; and

Providing a power digger which may be moved quickly from place to place.

The invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings and while there is shown therein a preferred embodiment, it is to be understood that the same is capable of further modification and change and comprehends other details and constructions without departing from the spirit or the scope of the present invention and the appended claims.

The invention has been illustrated in the drawings, in which:

Fig. 1 is a side view of my device installed on a truck, and showing a preferred form of dump cart used therewith;

Fig. 2 is a side view of the mast and the winch mechanisms taken from the right side of the truck;

Fig. 3 is a side view of the winch drums and their controlling levers, taken from the left side of the truck;

Fig. 4 is a fragmentary top view of the winch mechanism of Fig. 3;

Fig. 5 is a view of the mast and bucket from the rear of the truck;

Fig. 6 is a sectional view of the mast and supporting guides, taken along line 6—6 of Fig. 5;

Fig. 7 is a top sectional schematic view of the bucket, taken along line 7—7 of Fig. 5;

Fig. 8 is a schematic sectional view of the bucket and the associated closing mechanism, showing the bucket in closed position;

Fig. 9 is a view, partially in section, of a portion of the bucket and closing mechanism of Fig. 8, taken in open position; and

Fig. 10 is a top sectional view of the mast and crowd block, taken along line 10—10 of Fig. 9.

Referring now to the figures for a detailed description of a preferred form of the invention:

In Fig. 1, there is shown the digging machine of the present invention mounted as a portable unit on a motor truck 1. On the truck 1, which must be of substantial construction to withstand the strains of travel and of operation, is secured a frame 2 of heavy channel iron sections. This frame is designed to secure together a prime mover 4, a winch 5 actuated thereby, and the mast guide 6 in which mast 7 slides during operation of bucket 9. In the Fig. 1, the machine is shown in its vertical, or digging, position, with the hole 10 indicated in the ground beneath. There is also shown a small dumpcart 11 in position over the hole 10 to receive the discharged earth when bucket 9 is opened in the elevated position shown. Further reference will be made hereafter to the construction of bucket 11 and its special function in connection with testing of ore-bearing samples.

When digging a test hole, the operator sits on a seat 12 facing the rear of the truck. The seat 12 is located so that the operator can watch the bucket and observe his progress during the digging operation. Hand levers 14 are conveniently located to operate the three component drums of the winch 5, which will be explained in detail below, and foot brakes 15 are provided for control of the crowd and closing drums of winch 5.

When the entire unit is to be moved to a new location, the truck is put in motion and driven with the mast 7 and mast guide 6 in upright position. If the new location is at a considerable distance, or if overhead clearance is impaired en route, the mast is lowered to the traveling position shown by the dotted outline in Fig. 1. For this purpose, the mast guide 6 is pivoted, at 16, and by releasing locking bolts 17 from locking lugs 13 on frame 2, the mast guide 6 and mast 7 are free to tilt about pivot 16 to the horizontal traveling position. A block and tackle 19 is fixed to the rear portion of truck 1 and connected by any suitable means, such as a chain 20, to the bucket 9 to aid in lowering and raising the mast. At the front of the truck, I provide a supporting framework 21 on which the upper end of the mast may rest in transit.

Turning now to Figs. 2, 3, and 5, I have shown the framework 2 in fragmentary view from the right, left, and rear, respectively, of the frame in its position relative to the truck 1, which has been omitted from these figures for the sake of clarity.

Power is supplied to the winch 5 from the prime mover 4 by a shaft 25 thru a conventional speed reduction gear 26. The prime

mover 4 may be a conventional internal combustion engine, or any equivalent type which will provide adequate power in completely portable form. From the reduction gear 26, a chain drive 27 communicates with a drive sprocket 29 mounted on a shaft 30 journaled thru the winch side plates 31 and 32. Right and left side plates 31 and 32 respectively, constitute the framework of the winch 4, and the shafts supporting the winch drums are fixed in bores formed there-thru by suitable nuts 33 threadably secured thereto and seen in Fig. 4. Shaft 28 supports the closing line drum 34, shaft 35 supports the crowd line drum 36, and shaft 37 supports the "holding line" drum 39, the drums being journaled about the fixed shafts. The closing line supplies force to close the bucket, the crowd line transmits the force required to make the bucket dig into the ground; while the holding line keeps the bucket closed while raising the bucket and mast with each bucket load of earth.

Adjacent plate 31, a drive gear 40 is fixed to shaft 30, and is engaged by sprockets 41, 42, and 44 revolving on shafts 32, 35 and 37, respectively, and connected to drums 34, 36, and 39, by means of conventional clutch mechanisms 45, 46 and 47, respectively. Levers 14 controlling the drums operate by engaging these clutch mechanisms thru appropriate linkages. In Fig. 3, the closing line lever 49 is shown pivotally fixed on a shaft 50 supported by suitable framework 51 and rigidly connected to an intermediate lever 52, which in turn is connected by a link 54 to an arm 55 directly actuating the closing drum clutch 45.

The holding line lever 56 and the crowd line lever 57 are pivotally mounted on a shaft 59 fixed in the framework 51. An intermediate lever 60 and a link 61 connect to an arm 62 directly actuating the holding line drum clutch 47 from holding line lever 56. An intermediate lever 64 and link 65 connect to crowd clutch 46 thru arm 66.

A foot brake is provided for the crowd drum and for the holding drum. The holding drum is provided with a brake 68 actuated by a foot pedal 69 thru a tubular shaft 70 journaled thru winch side plate 32. Thru shaft 70, a crowd brake shaft 71 is inserted from crowd brake pedal 72. Shaft 71 controls brake 74 thru conventional linkages forming a part of the brake 74.

Turning from the winch construction to the mast and mast guides, it will be seen how the winch operator can readily control the bucket in digging. The mast guides 6 are composed of channel iron sections within which are wooden shoes 75, which conveniently may be formed of long timber sections. Between shoes 75, as shown in Fig. 6, and guided thereby, are channel sections 76 forming the mast sides and connected by a face plate 77 to form the mast unit 7. The mast 7 must be long enough to run up and down against the guide shoes 75 for any depth of hole, and can have additional sections bolted on the top if need arises. The shaft 16 on which mast 7 and guides 6 pivot is held to the main frame 2 by supporting channel iron columns 80, reinforced by auxiliary supporting members 81. Additional auxiliary frame members 82 connect to the top of the winch side plates 31 and 32 and to bearing plates 84. Mast guide bearing plates 85 fit against bearing plates 84 and are fixed on the mast guides 6 to insure proper alignment of mast, guides, and supporting framework while allowing the tilting of the mast into traveling position. Pulley sheaves are supported by shaft

16 between channel sections 76 of the mast 7 and are freely rotatable on shaft 16. A crowd line sheave 88 is provided beneath which the crowd line 87 may pass from the crowd drum 36. Crowd line 87 extends to the top of mast 7 and is tied thereto at the top by any convenient means. I have shown the crowd line 87 anchored by being passed thru suitable bores 89 in face plate 77 and secured by a U-bolt 90. It will be seen from this construction that the operator can apply the full force of his winch motor to driving the mast and bucket into the ground from an elevated position, adding to the blow by the weight of the mast itself.

A holding line sheave 91 is provided, over which the holding line 92 from the holding drum 39 is passed. Holding line 92 extends downwardly along mast 7 and is anchored to face plate 77 by a combination 94 of a U-bolt and face plate bores such as that used at the mast top to anchor the crowd line. When the operator applies power to the holding drum 39, holding line 92 raises the entire mast 7 and bucket 9. The closing line sheave 95, located on shaft 18, between sheaves 88 and 91, carries the closing line 96 from closing drum 34 to a bucket closing sheave 97 which is slidable within mast 7. Line 96 then passes underneath closing tube sheave 97 and upwardly to anchor in face plate 77 by means of a U-bolt and face plate bore unit 98. The operation of the closing drum 34 closes bucket 9, as will be set forth in greater detail hereafter, with particular reference to the detailed showing of Figs. 7, 8, 9, and 10.

The bucket 9 must be capable of being held in open position while it is driven or crowded into the ground, must then be closed to forcibly encompass a bucket-full of the ground being tested, and must be held closed while being raised out of the hole for dumping the load. Finally, the bucket must be rotated about its vertical axis in order to dig the desired square hole and to dislodge difficult rocks in its path.

For these reasons, it is necessary to use a double supporting structure for the bucket, firmly supporting the bucket shells centrally and at their sides. Within and at the bottom of mast 7, I fix a tubular guide sleeve 100 having a threaded terminal section 101 projecting beneath the mast 7. About the projecting portion of sleeve 100 I position a crowd yoke 102, which is rotatable about sleeve 100, and hold the yoke 102 on sleeve 100 by means of a lock nut 104 threadably engaging threaded sleeve portion 101. A washer 105 is set between the crowd yoke 102 and lock nut 104 to permit rotation of the former. A crowd collar 106 is formed on the lower portion of mast 7 to engage the upper surface of crowd yoke 102. Beneath crowd yoke 102 are extended lugs 107 bored to receive freely shafts 109 carrying bucket legs 110. Legs 110 are held on shafts 109 by suitable means such as nuts 111. To bucket legs 110, I connect the bucket shells 112 by shafts 114 journaled therein. Bucket end arms 115 are connected to a central shaft 116 housed within a split supporting tube 117 held together by U-bolts 119 and plate 120. The supporting tube 117 is attached securely to a central closing tube 121 and braced thereto by webs 122. Central closing tube 121 is slidably mounted in the tubular guide sleeve 100, and is threadably and rotatably secured by a lock nut 124 at its upper end to a sheave block 125 having a pin 126 securing the closing tube sheave 97.

Thus, actuation of the closing drum 34 by the

operator will, thru closing line 96, draw up closing tube 121 within guide sleeve 100, and by its central pull on the bucket legs 115 will close the bucket shells 112 together with as much force as the power unit can supply. It should be noted that the direct pull of the winch on the closing line 96 is doubled by anchoring the line 96 to face plate 77 and passing it under sheave 97. The degree of opening permitted the bucket shells 112 is controlled by the position of a threaded collar 127 adjustably positioned on threaded portion 129 of closing tube 121, which nut strikes against guide tube 130 as the bucket opens.

Staggered bucket teeth 130 are fixed to the bucket shells 112 by suitable bolts 131 and may be replaced when necessary. It will be observed from Fig. 9 that when fully open, the outer surfaces 132 of the bucket teeth are vertical, so that the digging action produces a straight-sided hole.

Crowd yoke 132 and crowd collar 106 are rotatable relative to each other, as is closing tube 121 relative to its block 125 and sheave 97, so that the bucket may be turned to avoid obstacles and produce the desired square hole. A pin 132 is insertable thru a crowd collar hole 134 into any one of four crowd yoke holes 135, permitting the bucket to be locked in four positions along two normal axes.

Returning now to the showing of Fig. 1, the dump cart 11, which may be of any form providing it has a low body which can be inserted under the bucket to receive its load and a wheel base wide enough to clear the hole, is used to aid in the analysis of the ore, by following a preferred procedure. Each load is dumped adjacent the previous load in a line and separated enough so that successive loads may be clearly differentiated.

Since the bucket capacity is a known constant, and a skilled operator can dig a full load each time, it will be apparent that the analyst can tell by observing the position of each pile of earth in the line, from what depth it was taken, and can tell the thickness as well as the character of each stratum.

From the above description, it will be seen that I have invented a machine for digging test holes and sampling ore which can be readily transported from place to place with great speed. The machine is able to dig with speed surpassing that of any known core-digging tool and to any desired depth. It is not prevented from functioning by the presence of large rocks in its path, altho of course it can not be expected to go thru solid rock strata of thickness sufficient to require blasting. The operator is able to remove a sample large enough so that errors in analysis, commonly formed with small cores, may be minimized. Only two operators are required, one of whom may be unskilled.

Finally, the expense of operation over all is substantially less than in prior sampling operations, and mechanical upkeep and breakdowns are a minimum.

I claim:

1. In a digger, the combination of a vertical guide, a mast traversable therein, a bucket assembly movable relatively with respect to said mast, a bucket closing member slidably disposed within said mast and arranged to hold said bucket normally in open position, and supporting means for said bucket and for said bucket closing means arranged to permit rotation of said

bucket and bucket closing means relative to said mast.

2. In a digger, the combination of a supporting framework a vertically transversable mast guided in a portion of said frame-work, a bucket assembly with a rigid central stem rotatable with respect to the longitudinal axis of said mast and mounted thereon with suitable locks against rotation for unitary operation of said bucket assembly, means for driving said mast and said bucket when open as a unit into the ground to be dug, means for closing said bucket, means for upwardly transversing said mast and said bucket in closed position and means for opening said bucket.

3. In a mobile digger, the combination of a vehicle, a digger supporting structure mounted on said vehicle, an auxiliary power plant mounted on said vehicle, a vertically traversable mast guided for movement in a portion of said supporting structure, a clam shell type bucket assembly with a rigid central stem mounted for horizontal rotation on said mast and forming a unitary structure with said mast in the digging phase when in locked position, means for operating said mast and said bucket from said auxiliary power plant and means on said supporting structure for mounting said mast and said bucket assembly in a substantially horizontal position for mobility when not in use.

4. In a digger, in combination with a supporting framework and a vertically traversable mast guided in one portion of said framework, of a clam shell type bucket assembly mounted for rotatable change of position about the vertical axis at the lower end of said mast and means for locking said bucket assembly and holding the same to the mast for operation as a unitary structure in the digging operations.

5. In combination with a digger having a vertically slidable mast, of a crowd collar secured to the lower end of said mast, a crowd yoke for supporting the bucket assembly disposed adjacent to said crowd collar and rotatable with the central stem of the bucket assembly relative to said mast for changing the position of the bucket assembly, a bucket assembly comprising a clam shell type bucket with staggered teeth projecting from the lips thereof, arms pivotally mounted on said crowd yoke and said bucket shells arranged to produce a bucket opening tendency upon impact with the ground to be dug and a central rigid stem, and means for holding the bucket assembly against rotation on the mast during the digging operation.

6. The combination with a vehicle, of a portable digger comprising an auxiliary power plant and a mast guide fixed on said vehicle, a mast slidably disposed in said guide and controlled as

to movement in operation by said auxiliary power plant, a bucket assembly mounted on the lower end of said mast for change of position rotatably between bucket loads, means for carrying said mast and said bucket assembly in horizontal position on said vehicle when said digger not in operation, means for moving said mast and said bucket assembly from the horizontal position to a vertical position relative to said vehicle, means including a central rigid stem in the bucket assembly controllable by said auxiliary power plant for maintaining said bucket in normally open position and for rigidly resisting impacts in the digging operation.

7. The combination with a vehicle, of a portable digger comprising an auxiliary power plant, a winch, and a mast guide fitted on said vehicle, a mast slidably disposed in said guide and controlled as to movement in operation by said auxiliary power plant, a bucket assembly mounted at the lower end of said mast for change of position rotatably between bucket loads comprising a rigid central stem for applying closing force centrally to said bucket, a split housing fixed to said closing force applying means, a shaft journaled in said housing and passing through said bucket centrally of the sides thereof, means for maintaining said housing together about the shaft, a pair of oppositely disposed bucket shells, digging teeth attached to said bucket shells and arranged in staggered fashion to intermesh and permit the lips of the bucket to meet when it is in closed position, said teeth being also arranged so that their outer surfaces are substantially vertical to the digging surface when the bucket is in open digging position.

8. In a bucket assembly adapted for vertical digging, the combination of oppositely disposed bucket shells, digging teeth on each of said bucket shells projecting beyond the lips thereof in staggered relation so as to permit the lips of the bucket shells to meet when in closed position, a rigid central stem for centrally applying the digging force to the teeth and for applying the closing force centrally and linkage arms pivotally mounted between said bucket shells and the assembly supporting means assisting in delivering the digging force to the bucket teeth and arranged to produce a bucket opening tendency on impact of the assembly with the ground to be dug.

9. A bucket assembly as described in claim 8 and means for adjusting the length of the central rigid stem so that the outer surface of the digging teeth on the bucket shells may always be directed substantially at right angles to the surface to be dug when the bucket assembly is in open digging position.

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