

Nov. 24, 1953

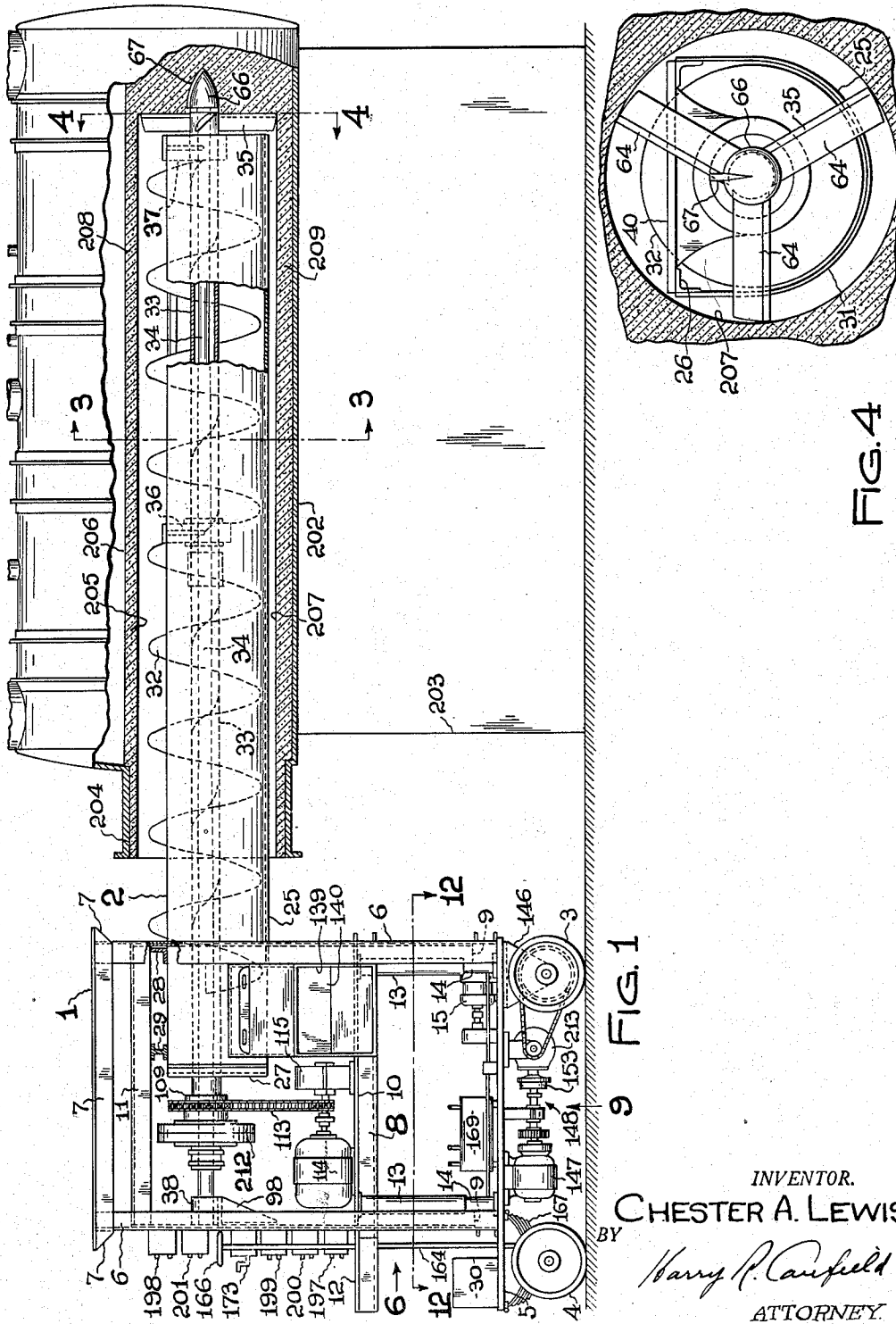
C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILLs AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 1



Nov. 24, 1953

C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILLs AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 2

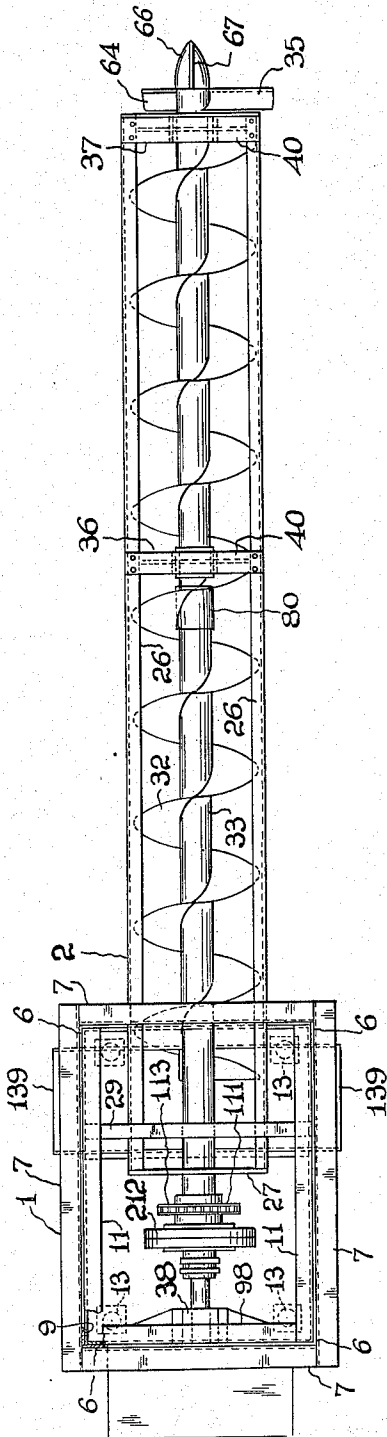


FIG. 2

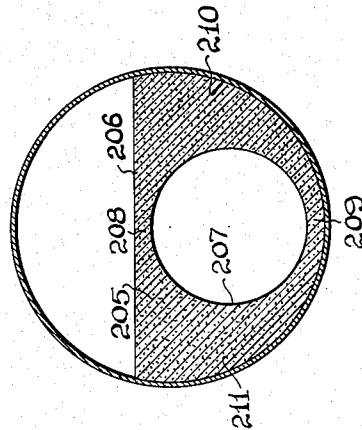


FIG. 3

INVENTOR.
CHESTER A. LEWIS
BY
Harry R. Canfield
ATTORNEY.

Nov. 24, 1953

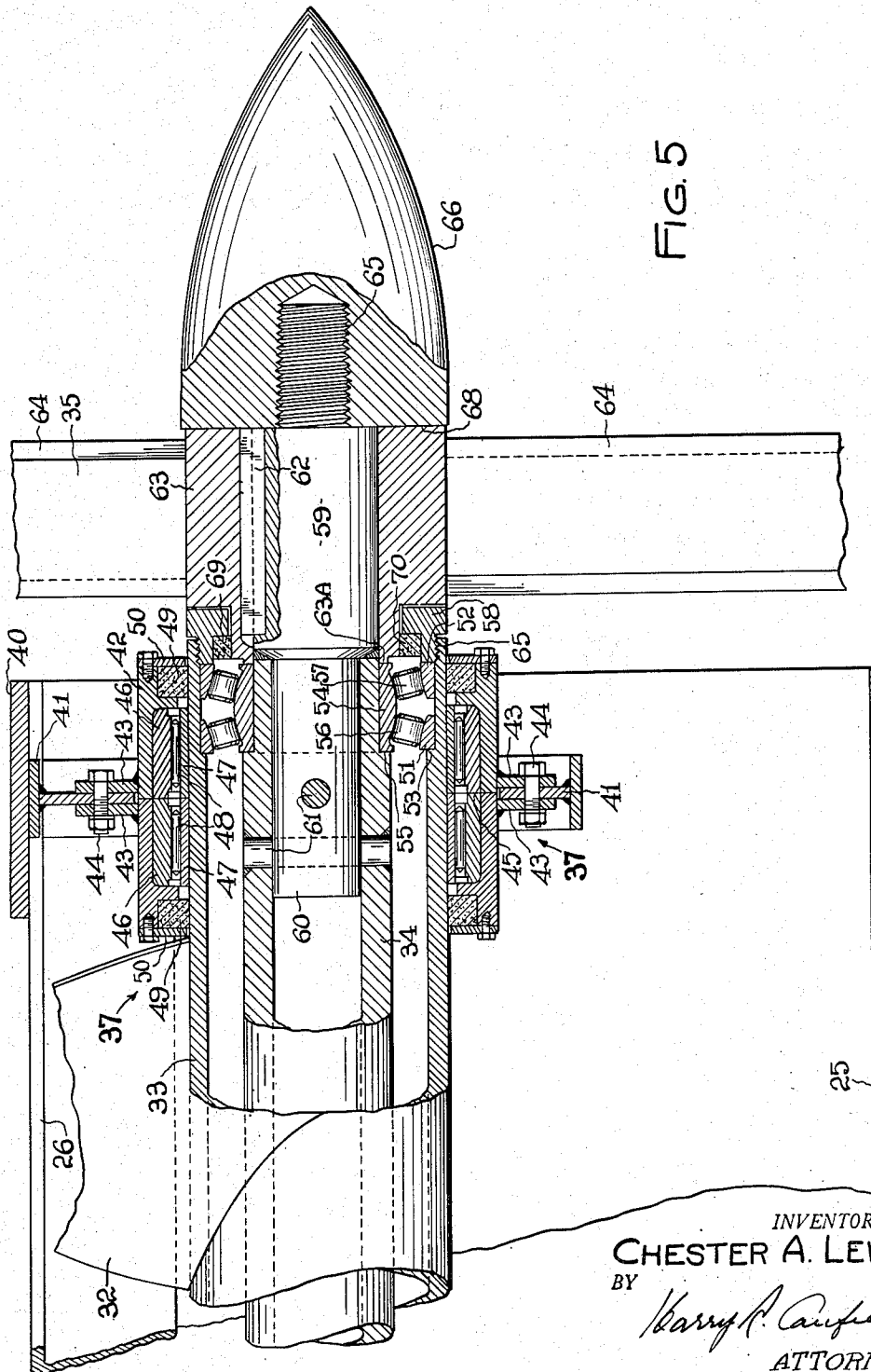
C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILL'S AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 3



Nov. 24, 1953

C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILLs AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 4

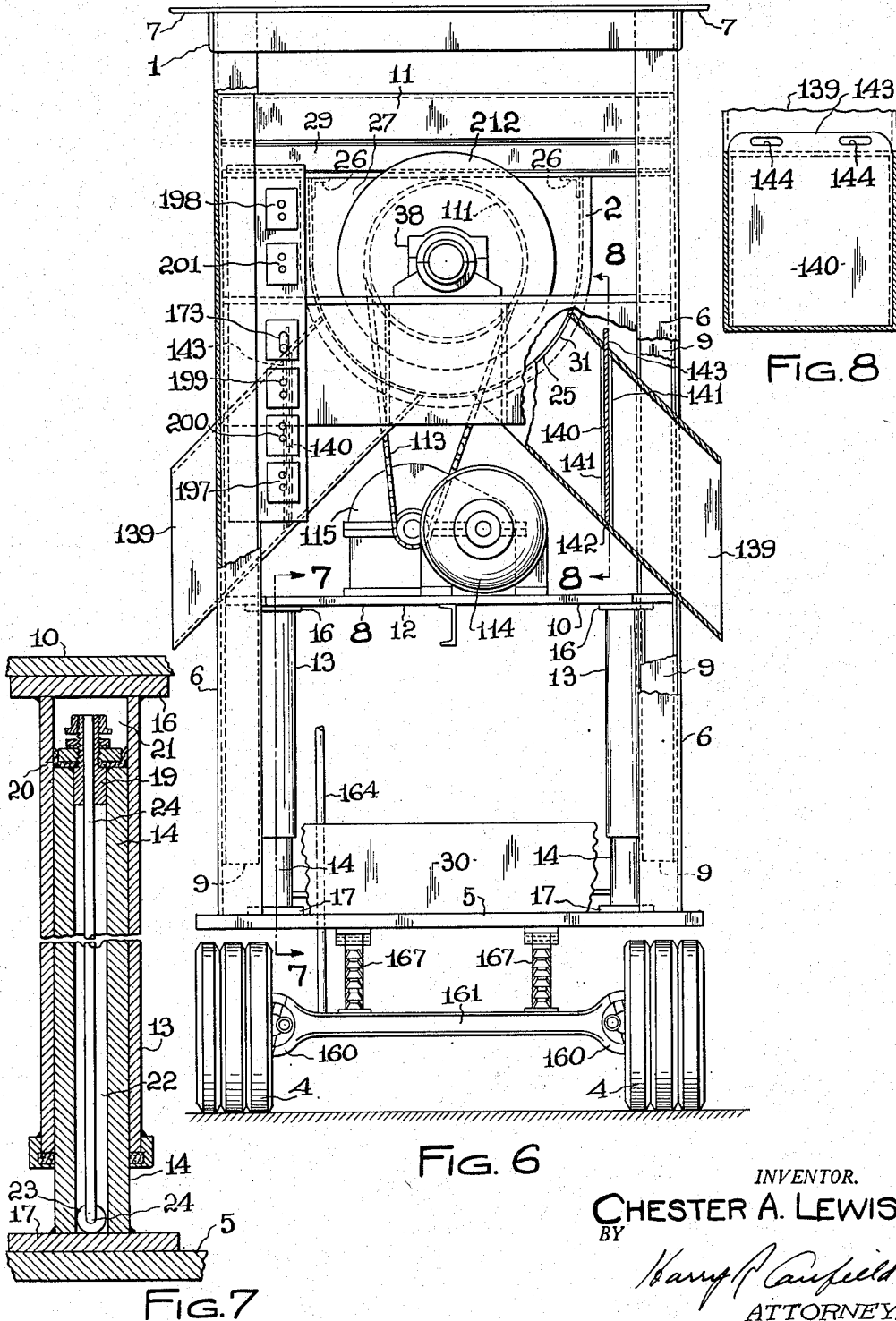


FIG. 6

FIG. 7

INVENTOR.

CHESTER A. LEWIS

BY

Harry P. Fairfield
ATTORNEY.

Nov. 24, 1953

C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILLTS AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 5

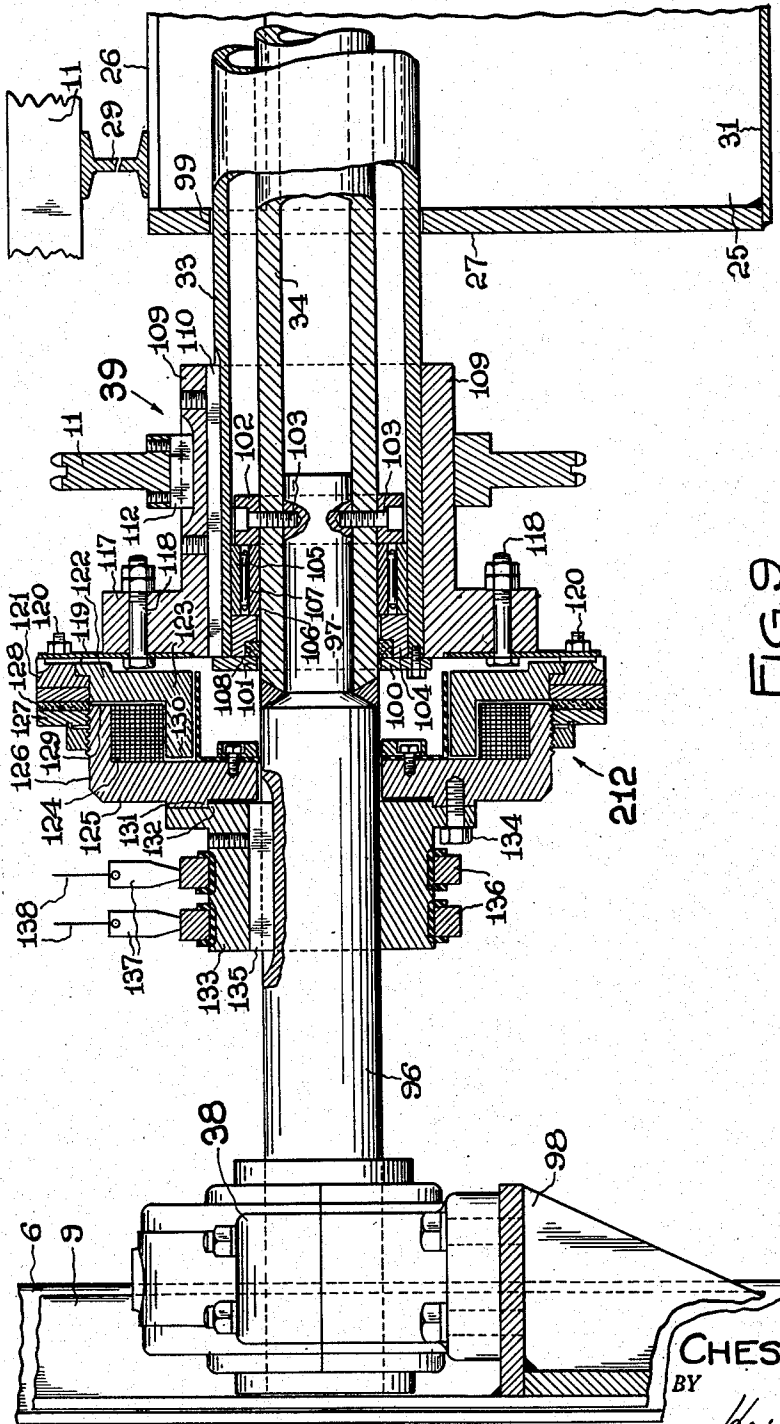


FIG. 9

INVENTOR.
CHESTER A. LEWIS
BY *Harry P. Canfield*
ATTORNEY

Nov. 24, 1953

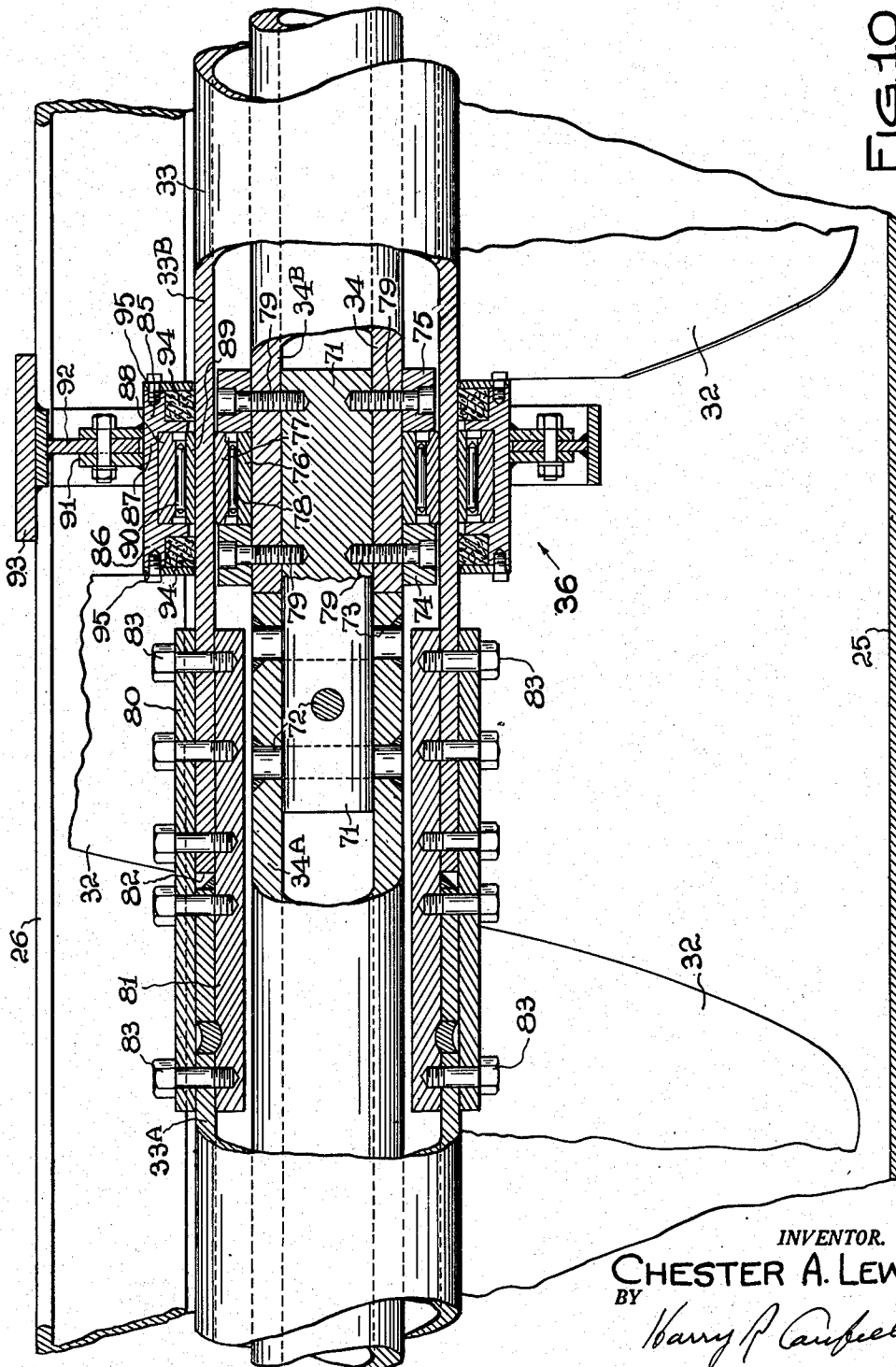
C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILL'S AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 6



INVENTOR.
CHESTER A. LEWIS
BY *Harry P. Canfield*
ATTORNEY.

Nov. 24, 1953

C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILLTS AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 7

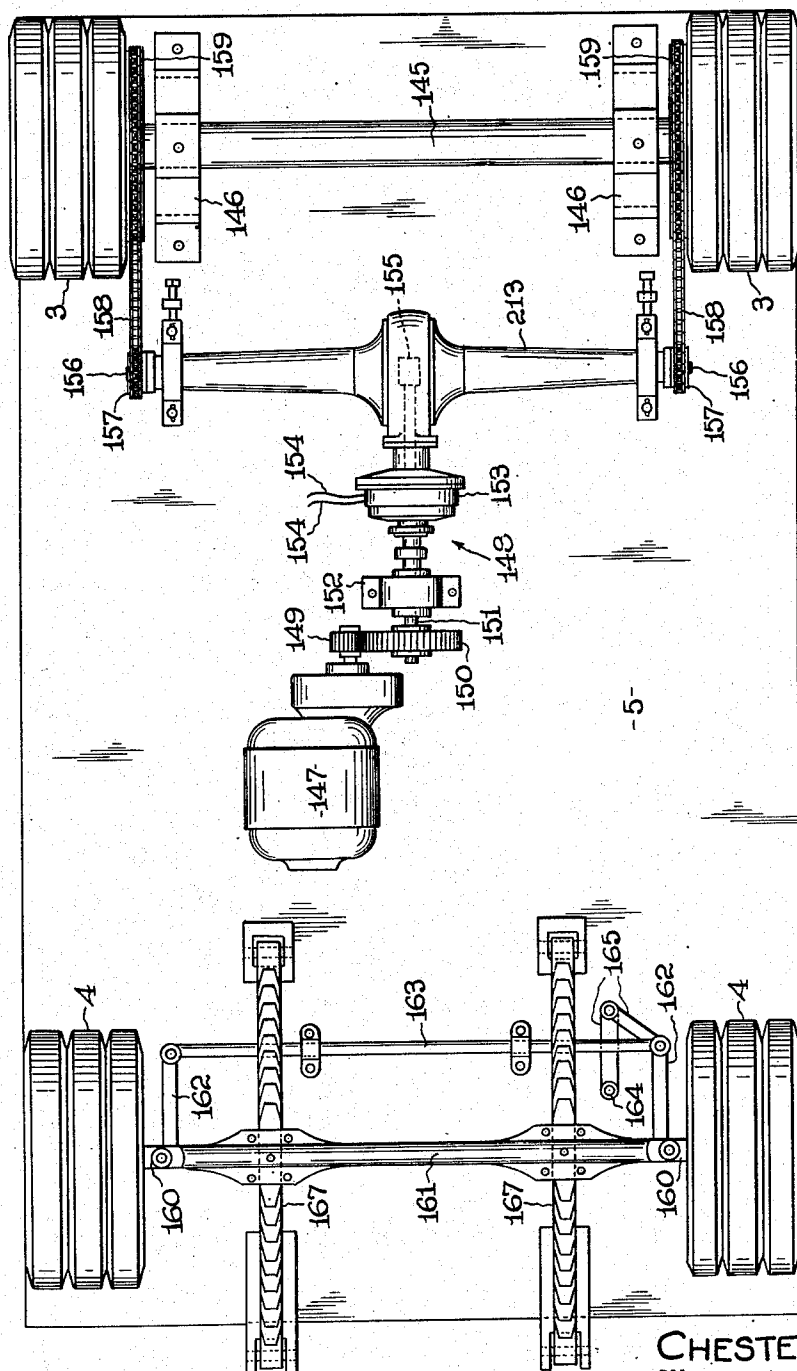


FIG. 11

INVENTOR.
CHESTER A. LEWIS
BY *Harry R. Fairfield*
ATTORNEY.

Nov. 24, 1953

C. A. LEWIS

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM STILL'S AND THE LIKE

Filed Oct. 7, 1948

8 Sheets-Sheet 8

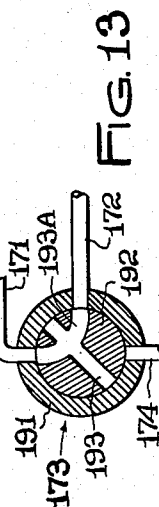
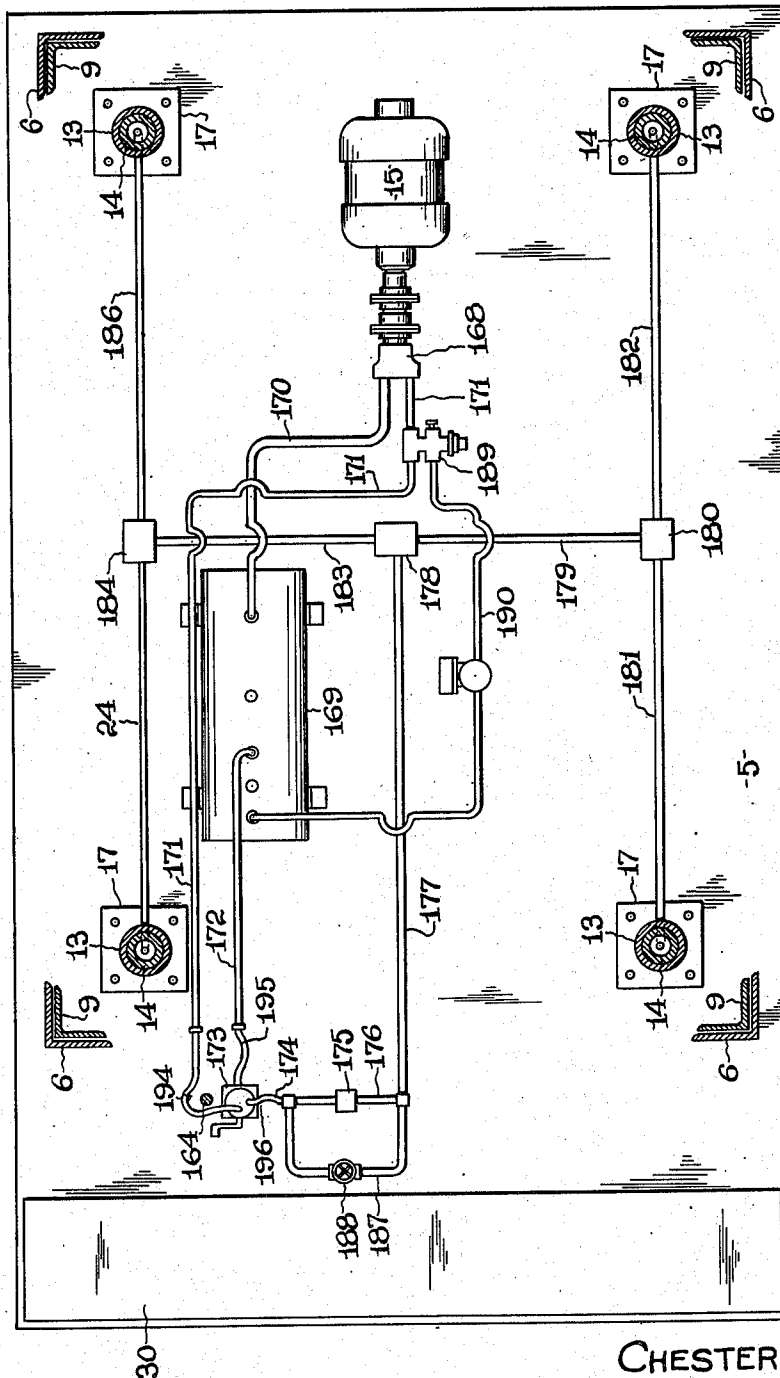


FIG. 12

FIG. 13

INVENTOR.
CHESTER A. LEWIS
BY *Harry R. Kaufeldt*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,659,916

COKE REMOVER FOR TAR AND PETROLEUM
STILLS AND THE LIKEChester A. Lewis, Cleveland, Ohio, assignor to
C. A. Lewis, Inc., Cleveland, Ohio, a corpora-
tion of Ohio

Application October 7, 1948, Serial No. 53,205

3 Claims. (Cl. 15—104.1)

1

This invention relates to machines for removing the residual coke from retorts or tanks in which coal tar, petroleum oil, and the like have been distilled.

It is common practice to distill off volatile products from coal tar, and petroleum, by putting the coal tar or petroleum in a retort and applying external heat.

The retort as commonly used in commercial production is in the form of a steel tank, and usually of large size, for example twenty feet long and nine and one-half feet in diameter; and it is supported horizontally over a furnace; the distillates being withdrawn at the top.

At the end of the process the residual coke in a tank of the above indicated size fills the tank from end to end to a depth of as much as five feet, and must be removed from the tank before the next cycle of operations can be started.

According to the present commercial practice, the tank is provided at one end near the bottom with a man-hole and a removable cover therefor; and after the coke has cooled sufficiently, the man-hole cover is removed; and common laborers, beginning at the man-hole and working into and through the length of the tank, chop and break the coke into pieces with hand tools, and shovel it out through the man-hole.

This cleaning operation is costly. The mass of coke to be removed will average twelve tons. At present day wage rates the labor cost to remove the coke will average \$2.58 per ton or \$30.96 per cleaning job.

The time consumed in doing the cleaning job by labor and hand tools, even when three men work in the tank at one time, is so long that the complete cycle of distilling a tank of tar or petroleum and cleaning out the tank requires thirty-six hours.

Due to the conditions of heat and dust under which labor must work in the tank, it has become a problem to obtain labor that will do the cleaning job; and this shortage of laborers has resulted in curtailing production throughout the industry.

The coke removed from the tank is an important by-product and commercial material, and users thereof are constantly pressing all manufacturers to increase production of this vital commodity to meet the increasing demands of our times.

It is into this environment that the present invention has been projected. The invention comprises, generally speaking, a machine for removing the greater part of the coke from the tank,

2

and requiring only a minimum of hand labor; and by its use the tank can be cleaned out at a labor cost of only \$.44 per ton or a total cost of only \$5.28. Furthermore, the time of cleaning is so reduced that the complete cycle of distilling and cleaning required only twenty-four hours; so that a further saving is effected in the greater output rate for a given installation.

More particularly, the invention comprises a machine having a power driven cutter in the form of a boring tool, fed into the retort through the man-hole, and which cuts or bores a large hole through the coke from end to end of the retort; and the tool comprises a conveyor which concurrently conveys the bored-out coke rearwardly out of the retort to a point rearwardly of the retort.

The tool and its conveyor are then withdrawn.

The depth of coke in the tank is, as mentioned, about five feet deep. The hole bored out by the cutter is about 56 inches in diameter. This leaves a thin shell of coke around the hole two inches thick at the top and bottom of the hole, and in a layer along the sides of the tank.

Labor then enters the hole and readily collapses or breaks down the shell into pieces. The tool and its conveyor are again fed into the tank and they pick up the pieces and convey them out rearwardly. This may be done twice, once for each side of the tank.

The remaining fragments of coke are then cleaned up and removed by labor.

The coke conveyed out of the tank is conveyed to a point rearwardly remote from the tank where it may be loaded on cars or trucks and transported to a delivery point for sale.

These operations of the machine remove approximately 90% of all of the coke in the tank leaving only 10% to be removed by hand labor, with the savings above described.

Preferably, the machine of the invention is in the form of a self-propelled vehicle, by which the tool including the conveyor, referred to, which evidently must be of considerable size and weight, may be stored out of the way at a point remote from the tank, and at the time of use propelled to the tank, and positioned for entrance into the tank. And the vehicle preferably comprises power operated mechanism to adjustably raise and lower the tool to adjust it relative to the man-hole; and to feed and withdraw the tool; and to drive the tool and its conveyor; and comprises operable controls by which one man, riding the vehicle, can steer the vehicle and control said movements and operations of the tool vehicle.

It is the primary object of the invention to pro-

3

vide a machine having all or at least some of the aforesaid features, and modes of operation thereof.

It is a further object to provide an improved method of cleaning out coke from a retort as 5 aforesaid.

And it is a further object to provide a machine for cleaning out coke from a retort or tank as aforesaid which will require the minimum of hand labor, whereby for the reasons mentioned, the production of coke as a salable by-product 10 commodity may be increased.

The invention is fully disclosed in the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a side elevational view of an embodiment of the invention, showing a tool thereof in operation in the process of cutting out residual coke from a furnace-fired tank-retort, the furnace being indicated diagrammatically, and a part of the tank being broken away and in section;

Fig. 2 is a top plan view of the embodiment of Fig. 1, but with the tank omitted;

Fig. 3 is a cross sectional view from the plane 3—3 of Fig. 1 with parts at and behind the section plane omitted;

Fig. 4 is a fragmentary sectional view from the plane 4—4 of Fig. 1 to a larger scale;

Fig. 5 is a longitudinal sectional view of a forward portion of the tool of Fig. 1 to larger scale;

Fig. 6 is an elevational view taken in the direction of the arrow 6 of Fig. 1 and to larger scale, with parts broken away and in section;

Fig. 7 is a fragmentary sectional view from the plane 7—7 of Fig. 6 to a larger scale;

Fig. 8 is a fragmentary sectional view from the plane 8—8 of Fig. 6;

Fig. 9 is a longitudinal sectional view of the rear or driving portion of the tool of Fig. 1, to enlarged scale;

Fig. 10 is a longitudinal sectional view of the intermediate portion of the tool of Fig. 1, to a larger scale;

Fig. 11 is a bottom plan view of the embodiment of Fig. 1;

Fig. 12 is a plan view taken from the plane 12—12 of Fig. 1;

Fig. 13 is a diagrammatic view of a valve of Fig. 12.

Referring to the drawing Figs. 1, 2, and 6, there is shown generally at 1 a main frame and at 2, generally, a boring tool and conveyor construction extending forwardly horizontally from the main frame.

The frame 1 is in the form of a vehicle supported on four ground wheels, two front wheels 3—3 and two rear wheels 4—4.

The frame comprises a main rectangular bed 5 having parallel corner posts 6—6 rising therefrom, tied together at the top by angle iron bars 7—7, and which can be otherwise braced by braces not shown. The corner posts 6—6 are preferably of angle section steel with the concave sides facing inwardly and thereby serve as corner rails to guide vertical movements of an elevator cage shown generally at 8, Figs. 1 and 6.

The elevator cage 8 is rectangular in plan and has vertical corner elements 9—9 of angle section embraced within the corner rails 6—6, as plainly shown in Fig. 12 and serving as guide rail engaging slides for the elevator.

The elevator cage 8 is a self-contained frame comprising, besides its corner slides 9—9, a floor 10 and braces such as braces 11 tying the corner

4

slides together. The floor 10 projects rearwardly between the slides 9—9 and guide rails 6, and provides a platform 12 upon which an operator may stand.

When the machine is in operation, the elevator cage 8 is stationary at a suitable elevated level; and is movable up and down adjustably and supported at any adjusted elevation by hydraulic means, comprising (Figs. 1, 6, and 12) four hydraulic cylinders 13 one at each corner upon which the floor 10 of the elevator cage rests; and four pistons 14 for the cylinders standing upon the main bed 5.

A hydraulic pressure system supported on the bed 5, and powered by an electric motor 15 will be described later in connection with Fig. 12 for supplying liquid to the cylinders and discharging it therefrom to raise and lower the cage 8.

The preferred construction, however, of the cylinders and pistons 13—14 is shown in Fig. 7. The cylinder 13 is closed at its upper end by a flange 16 supporting the cage floor 10 and cage 8. The piston 14 has a flange 17 at its lower, outer end resting upon and secured to the bed 5.

On the upper or inner end of the piston 14 is a piston head construction 19 having an upwardly open cup-shaped seal 20 fitting the inner wall of the cylinder 13, and providing a working pressure space 21 above the piston.

The piston under the head 19 is tubular having an axial bore 22 therein opening laterally at 23; and an oil pipe 24 from the hydraulic system referred to, enters the side opening 23 and passes upwardly through the bore 22 and supplies oil under pressure to the working pressure space 21 to raise the cylinder 13 and elevator cage floor 10, and hold it at any elevation, or discharges it therefrom to allow the cage to lower, by gravity.

The conveyor 2 comprises an upwardly open trough or channel 25 made from sheet metal; and has angle-iron flanges 26—26 (Figs. 2 and 6) extending longitudinally along its upper edges to stiffen it and by which it may be supported and to provide a supporting base for bearings to be described. At its rear end it is closed by a plate 27.

The conveyor trough 25 projects rearwardly part way through the frame of the cage 8; and the flanges 26—26 are secured to a transverse angle-section bar 28 on the front of the cage 8, Fig. 1; and rearwardly thereof are secured to a transverse I-section bar 29 spanning the cage frame elements 11—11, Figs. 1 and 6.

The conveyor trough 25 is thus carried by the elevator cage 8 and supported on it to extend forwardly from it.

Weight of the overhanging trough and of other parts associated with it to be described is counterbalanced by weights 30—30 on the bed 5 rearwardly of the front wheels, Figs. 1 and 12.

The lower side of the trough is circular in cross section as shown at 31, Figs. 4 and 6; and a rotary conveyor screw 32, Figs. 1 and 2, is mounted coaxially thereof. The conveyor screw comprises a tubular shaft 33 having sheet metal wound spirally and edgewise thereon to form the screw 32.

Within and coaxially of the tubular screw shaft 33 is a rotary boring tool shaft 34 carrying a boring tool 35 on its forward end adjacent to the forward end of the conveyor trough 25. Bearing constructions 36 and 37 indicated in Figs. 1 and 2 support intermediate and forward portions respectively of the screw shaft 33; and the tool

5

shaft 34 is supported at these points by bearings inside of the screw shaft; and at its rear end the tool shaft is supported by a bearing construction 38 on the elevator cage 8; and the rear end of the screw shaft is supported by a bearing construction 39 on the tool shaft. These bearing constructions will now be described in connection with Figs. 5, 9 and 10.

In Fig. 5 (and Fig. 2) a transverse hanger 40 rests upon and is secured to and bridges the conveyor trough flanges 26 (one of which is visible in the sectional showing) of the conveyor trough 25. Depending therefrom is a ring 41 of T-section. An annular housing 42 surrounding the tubular screw shaft 33 is mounted within the ring 41 by radial flanges 43 on the housing bolted to the ring 41 as at 44. The housing 42 is preferably in two parts meeting on a transverse medial plane at 45 to facilitate assembly.

Within the housing 42 are stationary outer cylindrical bearing raceways 46—46. Telescoped over the outside of the tubular screw shaft 33 are cylindrical inner raceways 47—47. Between the raceways are roller or needle bearing elements 48—48. The housing 42 is sealed to the shaft 33 by annular packing rings 49—49 surrounding the shaft and held in place by end rings 50—50 on the ends of the housing 42.

By this bearing construction, the screw shaft 33 is rotatively supported on the conveyor trough and floats endwise in the bearing.

On the inside of the screw shaft 33 are two oppositely conical outer raceways 51—52, telescoped into an enlarged diameter end portion of the shaft which provides a shoulder 53, the raceway 51 abutting upon the shoulder 53.

On the outside of the tool shaft 34 is a double cone inner raceway 54 telescoped over a reduced diameter end portion of the shaft which provides a shoulder 55.

Between the raceways 51—54 are bearing rollers 56, and between the raceways 52 and 54 are rollers 57; the axes of the rollers being inclined in opposition as shown.

A ring 58 is threaded into the open end of the screw shaft 33 and abuts the raceway 52 whereby clearance in the bearing may be adjusted, and whereby a shoulder for engagement by the raceway 52 is provided.

By this bearing construction, the tool shaft 34 is rotatively supported in and coaxially of the screw shaft 33.

The bearing construction on the elevator cage at the rear end of the tool shaft, and to be described, prevents it from moving endwise; and the double opposed cone bearing construction comprising the raceways 51—54 and 52—54 and the inclined rollers 56—57 therebetween, prevent endwise movement of the screw shaft 33 in either direction, with respect to the tool shaft 34, as will be apparent.

In Fig. 5, extending from the open end of the tubular tool shaft 34, is a stub shaft 59 having a reduced diameter shank 60 telescoped into the end of the shaft and pinned thereto by pins 61.

Upon the stub shaft 59 is keyed as at 62 the hub 63 of a rotary boring tool 35 having radial forwardly cutting blades 64—64 (see also Fig. 4).

On the forward end of the stub shaft 59 is a reduced diameter threaded shank 65 upon which is screwed a pointed or conical nose piece 66, carrying a conical pilot boring blade 67 shown in Figs. 1, 2, and 4, for boring a pilot center hole ahead of the boring tool 35.

A transverse shoulder 68 on the nose piece 66

6

abuts upon the hub 63 and holds it rearwardly to engage its inner end at 63A with the raceway 54 and clamp the raceway 54 against the shoulder 55 on the shaft 34.

The end of the tubular shaft 33 is closed and sealed by an annular sealing ring 69 surrounding a reduced diameter portion 70 of the hub 63, and retained by the ring 58.

As best shown in Fig. 10 and indicated in Figs. 1 and 2, the screw shaft 33 is in two axially aligned sections 33A and 33B coupled together at an intermediate point of the shaft, and the tool shaft 34 is likewise in two coupled sections 34A and 34B, to facilitate assembling the intermediate bearing construction 36 therewith.

The section 34A of the tool shaft 34 has a coupling pin 71 telescoped half way into it and fastened at one end by pins 72—72. The section 34B is telescoped over the free end of the coupling pin 71 and abutted against the section 34A as at 73.

Bearing retaining rings 74—75 are telescoped over the shaft section 34B with a bearing therebetween comprising an inner cylindrical raceway 76 on the shaft section 34B, and an outer cylindrical raceway 77 therearound to fit within the shaft section 33B, and rollers or needles 78 between the raceways.

Radial screws 79 are projected through the rings 74—75 and the wall of the shaft section 34B and screwed into the coupling pin 71.

The two end portions of the tubular screw shaft sections 33A and 33B have outer and inner coupling sleeves 80—81 telescoped therewith and abut at their ends at 82 and screws 83 are projected through the sleeve 80 and sections 33A and 33B and screwed into the sleeve 81 and effect the coupling.

The section 33B fits over the raceway 77 as aforesaid and supports it, to rotatively support the tool shaft 34 therein.

Around the outside of the section 33B is a housing 84 in two parts 85 and 86 meeting at a medial plane 87; and containing outer and inner raceways 88—89 with rollers 90 therebetween, and supported by radial flanges 91 bolted to the stem of a T-shaped ring 92 which is carried by a transverse hanger 93 bridging the flanges 26 of the conveyor trough, similarly as in the bearing construction 37 already described.

The bearing 88—89—90 is sealed by sealing rings 94—94 at the ends, of the housing 84, held in place by end rings 95—95.

As will be seen, at this intermediate bearing the screw shaft 33 is rotatively supported in and floats endwise in the bearing parts 88—89—90; and supports the bearing parts 76—77—78 and the latter rotatively support the tool shaft 34 and allow it to float endwise.

The bearing supports for the rear ends of the screw shaft 33 and tool shaft 34 are shown in Figs. 1, 2, and 9.

A stub shaft 96, as a continuation of the tool shaft 34, has a reduced diameter portion 97 telescoped into the rear end of the tool shaft 34; and the stub shaft is rotatably supported at its rear end and held against endwise shifting in a bearing construction 38 mounted on a bracket 98 which is supported by the elevator cage slides 9—9; the bearing construction 38 being of conventional design and for that reason not shown in detail.

The rear end of the screw shaft 33 projects through an opening 99 in the conveyor end plate

27, extends rearwardly thereof and at its end has

a plate 100 thereon, an opening 101 in which, encircles the tool shaft 34.

A ring 102 is secured on the tool shaft 34 by screws 103. A ring 104 surrounds the tool shaft 34 inwardly of the end plate 100. Between the rings 104 and 102 is a bearing construction comprising an outer cylindrical raceway 105 fitting within the tubular screw shaft 33, an inner cylindrical raceway 106, fitted on the tool shaft 34, and bearing needles or rollers 107 therebetween.

The bearing is sealed by a packing ring 108 in an annular groove of the ring 104. The screw shaft 33 thus is rotatively supported on the tool shaft 34 and floats endwise thereon.

A sleeve 109 surrounds the screw shaft 33 and is keyed thereto as at 110; and a chain sprocket 111 for driving the screw shaft 33, is keyed to the sleeve as at 112.

In Figs. 1 and 6, a chain 113 on this sprocket 111 is driven by a motor 114 through speed reduction gearing enclosed in a housing 115, on the floor 10 of the elevator cage 8.

At 212, Fig. 9, is an electromagnetic clutch between the conveyor shaft 33 and the tool shaft 34.

The sleeve 109, Fig. 9, has a flange 117, and bolted thereto as at 118 is an annular disc of electrical insulation 119.

Bolted to the disc 119 as at 120 is an annular clutch element 121, on which is mounted the field element 122 of an electromagnetic clutch actuator. The field element 122 has a tubular portion 123 over which is telescoped with clearance an electric winding 124. An actuator armature element 125, surrounds the stub shaft 96 and has a tubular portion 126 on the outside of the winding 124 and supports the windings; and an annular clutch element 127 is mounted on the tubular portion 126. Annular friction discs 128 are disposed between the clutch elements 121 and 127. Working magnetic air gaps 129 and 130 are provided at the ends of the tubular portions 126 and 123.

The armature element 125 is centered by an annular shoulder 131 thereof telescoped over an annular shoulder 132 on a collector ring carrier 133 and bolted thereto as at 134. The ring carrier 133 surrounds the stub shaft 96 and is splined thereto as at 135.

Collector rings 136—136 are mounted on the carrier 133 and are connected to the winding 124 by conductors not shown. Brushes 137—137 engage the collector rings 136—136.

The collector rings 136—136 and brushes 137 are shown somewhat diagrammatically, such arrangements being well known to those skilled in the art.

When current is supplied to the brushes 137 by wires 138—138, it energizes the winding 124; and flux in the work gaps 129—130 draws the clutch elements 121—127 toward each other and drivingly connects them through the friction discs 128, whereby driven rotation of the screw shaft 33, is transmitted through the elements 117—119—121—128—127—125—133 to the tool shaft 34 and drives it, in unison with the screw shaft 33.

Upon de-energizing the winding 124 the tool shaft 34 will remain at rest and the screw shaft 33 alone will be driven.

At the rearward end of the conveyor trough 25 and communicating with its interior and carried by the elevator cage 8, are lateral discharge spouts 139—139, Figs. 1, 2, 6, and 8, of sheet metal, downwardly laterally inclined; extending beyond the main frame for discharging rearward-

ly conveyed material. The spouts 139 each has a sheet metal sliding door or gate 140; sliding vertically in guides 141—141, normally abutting upon the lower side of the spout as at 142 Fig. 6 and shutting off discharge flow; and extending above the top wall of the spout as at 143 and provided with hand grips 144—144 by which it may be raised (or removed) to permit discharge flow.

By this means, rearwardly conveyed material can be discharged upon the ground or into a vehicle at either or both sides of the main frame.

The front wheels 3—3 are rotatively mounted on an axle 145, Fig. 11, supported on brackets 146—146 secured to the underside of the main bed 5.

They are power driven by a motor 147 and a transmission indicated generally at 148 mounted on the underside of the bed 5 as follows. The motor 147 drives a pinion 149 meshed with a gear 150 on a propeller shaft 151 supported in a bearing bracket 152 and driving one side of an electro-magnetic clutch 153 magnetically engageable and energizable by a circuit comprising wires 154—154. The other side of the clutch is connected to a pinion 155 in a differential gear and axle housing 213, of standard automotive design, the gears and their connection to the axles not shown; but the ends of the axles 156—156 are shown and have belt pulleys 157—157 thereon connected by belt 158—158 to large diameter belt pulleys 159—159 connected to the wheels 3—3.

At the rear of the bed 5, the wheel axles not shown are connected by steering knuckles 160—160 to a transverse main axle 161, the steering knuckles having arms 162—162 connected by a reach rod 163. A vertical steering wheel shaft 164 (see also Fig. 1) is connected at its lower end to linkage 165 to move the reach rod 163 transversely to "steer" the rear wheels 4—4; and extends upwardly through the bed 5 and through the elevator floor 10 and terminates in a steering wheel 166.

The main axle 161 is connected to the bed 5 through springs 167—167.

The hydraulic system for controlling oil to the elevator cylinder 13 referred to is shown in Fig. 12. It is mounted on the upper side of the main bed 5.

A motor 15 drives an oil pump 168, drawing oil out of a storage tank reservoir 169 through a pipe 170 and normally discharging it back into the tank 169 by a pipe 171 and a pipe 172, through a control valve 173 in a normal or "off" position of the valve.

Upon turning the valve to a "raise" position to raise the elevator cage 8, the oil flows from the pipe 171, through the valve 173, through a pipe 174 and a check valve 175 and a pipe 176 to a pipe 177, to a distributing head 178; thence through a pipe 179 to a distributing head 180 and thence to pipes 181—182; and from the distributing head 178 to a pipe 183, to a head 184, to pipes 184 and 186.

The pipes 181—182—24—186 supply the oil to the cylinders 13 as described for Fig. 7 operating all of them concurrently.

Upon turning the valve 173 back to the "off" position, the weight of the elevator cage 8 returns the cylinder 13 downwardly forcing the oil out and back through the pipes 181—182—24—186 to the pipe 177. Flow of the oil toward the check valve 175 in the pipe 176 now closes the check valve and diverts the oil to a pipe 187 through an adjustable needle valve

188, to the pipe 174 and valve 173 and thence by pipe 172 back to the tank 169.

As will be apparent the rate of descent of the elevator cage 8 is controlled by adjustment of the needle valve 188 and after adjustment to a preselected speed, the adjustment may be fixed.

If due to any cause upward movement of the elevator cage is obstructed, excess pressure will develop in the line 171 and open a pressure relief valve 189 and discharge oil from the line 171 through the valve 189 by a pipe 190 to the tank 169.

The operator's valve 173 may be of any suitable construction. Valve parts and pipe connections of a suitable arrangement thereof are shown diagrammatically in Fig. 13 and comprise a valve housing 191, a rotary valve element 192 therein having a diametral valve duct 193 and an arcuate valve duct 193A. In one rotary position of the valve element 192, the position illustrated, the duct 193A connects the pipes 171 and 172, and in another position connects the pipes 174 and 172; and in a third position the diametral duct connects the pipes 171 and 174.

The valve 173 may be located on the cage 8 of the elevator as shown in Fig. 1 where the valve is reproduced to avoid complications of the drawing. And as indicating that the pipes 171—172—174 of Fig. 12 may be led thereto, these pipes are shown in Fig. 12 as having flexible portions 194—195—196 broken apart and therefore of any desired length.

The pump motor 15 and the tool and conveyor driving motor 114 may have respectively start and stop push button type electric controllers 197 and 199; and the vehicle propelling motor 147 may have a start, stop and reversing controller 198; all mounted on the cage 8 as indicated in Fig. 1 within reach of the operation; and the electromagnetic clutch 212 between the conveyor screw and tool shaft, and the electromagnetic transmission clutch 153 of Fig. 11, may have respectively push button operated on and off contactors 200 and 201 on the cage 8, Fig. 1; it being thought unnecessary to show the conventional electric circuits therefor nor a cable source of current supply to the machine as a whole.

In Fig. 1 at 202 is shown a tank retort of the type and size hereinbefore referred to, mounted above a furnace indicated diagrammatically at 203. The tank man-hole is shown at 204 with its cover removed; and coke 205 is shown in the tank filling it from end to end and up to a level 206.

In the general operation of the machine and process above described, the operator mounts the floor 10 of the elevator cage 8, at 12 of Fig. 1, and by means of controller 198 starts the vehicle motor 147; and by clutch controller 201 thereafter energizes the clutch 153 to start propulsion of the vehicle and moves it out of its storage garage or the like.

By means of the steering wheel 166 he guides the vehicle to the front of the tank retort 202 Fig. 1 and positions the conveyor 2 in axial alignment with the tank extending toward the man-hole 204; and then de-energizes the clutch 153 to allow the vehicle to stop.

By means of the controller 197 he starts the pump motor 15 and by means of the valve 173, he raises or lowers the cage 8 and conveyor 2 until the boring tool 35 on the outer end of the conveyor is axially aligned and centered with the man-hole 204; this being facilitated by sighting

along the conveyor from his standing position on the cage floor at 12; and then he turns off the valve 173 and leaves the cage supported at that elevation; and then stops the pump motor.

By means of the controller 199 he starts the conveyor and tool driving motor 114; and this drives the conveyor shaft 33 and screw 32. Then he energizes the clutch 212 by the controller 200 and this drives the tool shaft 34, and boring tool 35.

He then again operates the controllers 198 and 201 and the vehicle moves forward, feeding the tool 35 into the residual coke shown at 205, Fig. 1; a suitable forward speed for the tool in the illustrative case hereof being about four feet per minute.

The boring tool bores a hole 207, Fig. 1, in the coke from the front of the man-hole to the rear of the tank; and its borings fall into the front end of the conveyor trough 25 and are picked up by the conveyor screw 32 and propelled or conveyed rearwardly and discharged therefrom laterally out at the discharge spout or spouts 139.

The borings may be allowed to fall to the ground and form a windrow along the side of the vehicle when they can be picked up by a power operated clam-shell bucket and loaded into a freight car or truck; or arrangement can be made to discharge them directly into a car or truck.

At any time, the tool can be stopped by de-energizing the clutch 212 by operating the controller 200, to allow the screw 32 to clear the conveyor.

When the tool 35 reaches the farther end of the tank, which at the speed referred to, takes about five minutes, the vehicle is reversed. This is done by operation of the reversing controller 198; and this withdraws the tool and conveyor out of the bored hole 207.

The depth of coke in the tank will in general be such that its top surface 206 is above the top of the man-hole; and the diameter of the boring tool 35 is slightly less than that of the man-hole.

Practical dimensions for a tank 9½ feet in diameter and 20 feet long are, a man-hole 60 inches in diameter and a boring tool 56 inches in diameter, boring a 56 inch hole 205. The hole therefore leaves thin shells of coke 208 and 209 two inches thick above and below it, and thicker walls of coke 210 and 211 on each side of it; this being shown in Figs. 1 and 3.

A laborer now enters the hole 207 and with hand tools breaks down the shell 208 and the wall 210 into pieces, the pieces collecting in the hole or in the path of the tool. This operation is quickly performed requiring only about five minutes.

After the laborer finishes and comes out, the vehicle is again propelled forwardly as before, the tool 35 retracing its former path and the tool bores through and deposits in the conveyor trough the pieces lying on its path. When the controller 198 is a variable speed controller, the motor 147 can be speeded up on this operation so that it can be performed in three minutes.

The tool is again withdrawn and the laborer goes in and breaks down the rest of the shell 208 and the other wall 211 as before; this operation taking another five minutes.

The tool is fed in again and bores through the pieces and loads them on the conveyor taking another three minutes; and the tool is finally withdrawn.

By this time, in the illustrative case referred to herein, approximately 90% of the coke has been

removed by the tool and conveyor. The remaining 10% including such remnants as the bottom part of the shell 209, is then shovelled out by hand labor in a mopping up operation which may take one man one hour, or two men accordingly less time.

It has been found that in some cases the clutch 212 will not be needed and that the rear end of the screw shaft 33 may be mechanically drivingly connected to the tool shaft, by means not shown, but corresponding to permanent energization of the clutch 212.

It will be understood by those skilled in the art that parts described as secured together but without the securing means shown, to avoid drawing complications, may be bolted or welded together.

Also it will be understood that the electromagnetic clutch 153 of Figs. 1 and 11 and the electromagnetic clutch 212 of Fig. 9 may be mechanical clutches; and that mechanical means instead of hydraulic means may be provided to raise and lower the elevator; such apparatus being well known and that those skilled in the art will know how to apply the same to the machine hereof without illustration or description in view of the complete description hereinbefore.

I claim:

1. A machine for preforming mass boring operations comprising: a main frame, in the form of a ground wheel-supported vehicle; an elongated conveyor comprising an upwardly open trough supported solely on the vehicle and extending forwardly therefrom, a screw in the trough to convey rearwardly material deposited in the trough; a rotary boring tool at the forward end of the trough disposed to deposit borings on the conveyor; power supplying means and power transmission means supported by the vehicle, to drive the tool and screw, and to propel the vehicle forwardly on its supporting wheels; to thereby feed the boring tool into the work to be bored and concurrently feed the trough into the hole bored by the tool; and to propel the vehicle rearwardly to thereby withdraw the tool and trough out of the bored hole; a material discharge outlet at the rear portion of the trough and spout means to direct material by gravity laterally away from the path of the vehicle wheels; steering means on the vehicle whereby an operator riding the vehicle may steer it, while being propelled from a point remote from the work to be bored, to the work, and position the boring tool and conveyor with respect to the work to be bored; and power operable elevator means on the vehicle for raising and lowering the trough and tool.

2. A machine for performing mass boring operations comprising: a main frame, in the form of a ground wheel-supported vehicle; an elongated conveyor comprising an upwardly open trough, supported solely on the vehicle frame and extending forwardly therefrom; a rotary screw in the trough for conveying rearwardly material deposited in the trough; a rotary boring tool at the forward end of the trough disposed to deposit borings on the forward portion of the trough; a tool driving shaft extending rearwardly from the boring tool; transverse bridging elements bridging the trough at the upper portion

thereof; bearings supported by the bridging elements for rotatively supporting the screw and the tool shaft; power supplying and transmission means supported by the vehicle frame, for driving the tool shaft and the screw, and for propelling the vehicle forwardly on its supporting wheels to thereby feed the boring tool into the work to be bored and to concurrently feed the trough into the hole bored by the tool, and for propelling the main frame rearwardly on its wheels to thereby withdraw the trough and tool out of the bored hole; steering means on the vehicle frame operable by an operator riding the vehicle frame to steer the vehicle to dispose the tool and conveyor in working positions with respect to the work to be bored; and power operated elevator means on the vehicle to raise and lower the tool and trough with respect to the work to be bored.

3. In a machine for performing mass boring operations, a main vehicle frame supported on ground-wheels; and comprising an elevator frame guided for vertical movements on the vehicle frame; an upwardly open elongated conveyor trough supported at a rearward portion on the elevator frame and extending forwardly therefrom; an elongated conveyor screw in the conveyor trough having a tubular screw shaft and bearings supported by the conveyor trough rotatively and axially floatingly supporting the screw shaft; a rotary boring tool at the forward end of the conveyor trough having a drive shaft extending rearwardly within the hollow screw shaft and bearings within the screw shaft rotatively supporting the tool shaft; the tool shaft having a rear end portion extending rearwardly out of the screw shaft and a bearing on the elevator frame for preventing endwise displacement of the tool shaft comprising end thrust bearing portions; one of the bearings within the screw shaft supporting the tool shaft having means for preventing axial movement of the floatingly supported screw shaft; a power supplying motor and power transmission means, on the elevator frame for rotatively driving the screw shaft and the said rear end portion of the tool shaft; an operably engageable and disengageable clutch in the line of transmission between the power supplying motor and the tool shaft; a power supplying motor and power transmission means on the vehicle frame to operate the elevator frame; a power supplying motor and power transmission means on the vehicle frame to propel the vehicle on its ground wheels, and operable by an operator riding the vehicle to steer it.

CHESTER A. LEWIS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
866,839	Brown	Sept. 24, 1907
1,113,277	Zelenay	Oct. 13, 1914
1,604,896	Foltz	Oct. 26, 1926
1,699,936	Watchorn	Jan. 22, 1929
1,835,191	Tilly	Dec. 8, 1931
2,196,260	Gatto	Apr. 9, 1940
2,205,757	Wheat	June 25, 1940
2,499,929	Nelson	Mar. 7, 1950
2,524,948	Whitney	Oct. 10, 1950