Sept. 10, 1935. C. H. DUPREE ET AL 2,013,750

EXCAVATING APPARATUS

Filed Oct. 3, 1933 3 Sheets-Sheet 1

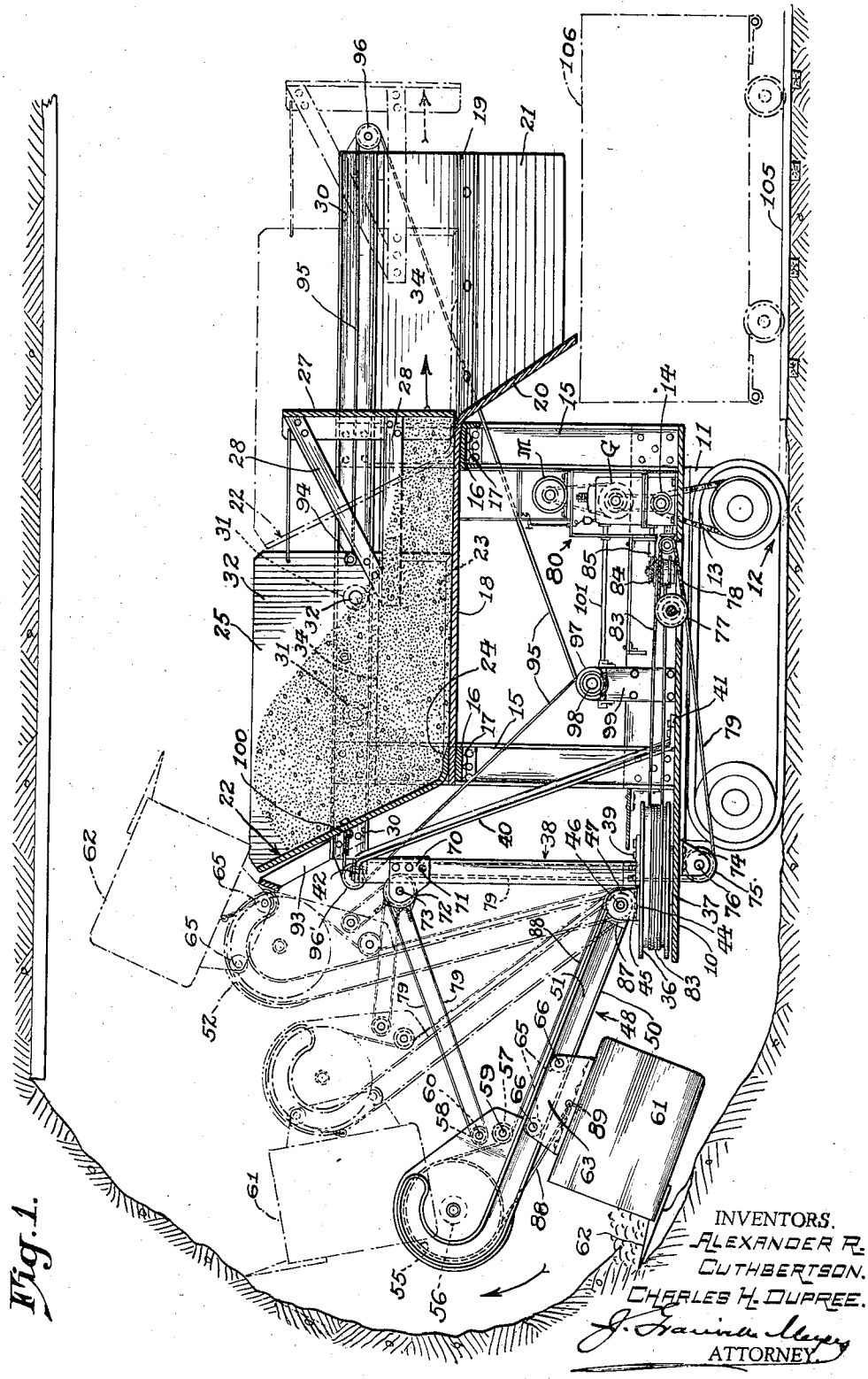


Fig. 1.

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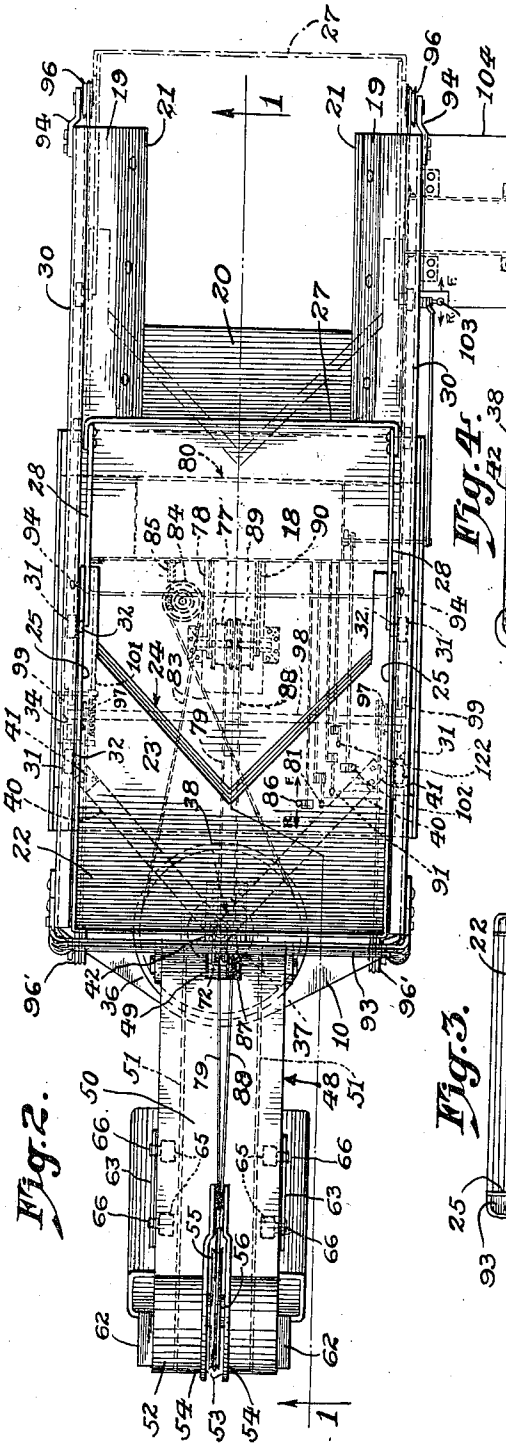


Fig. 2.

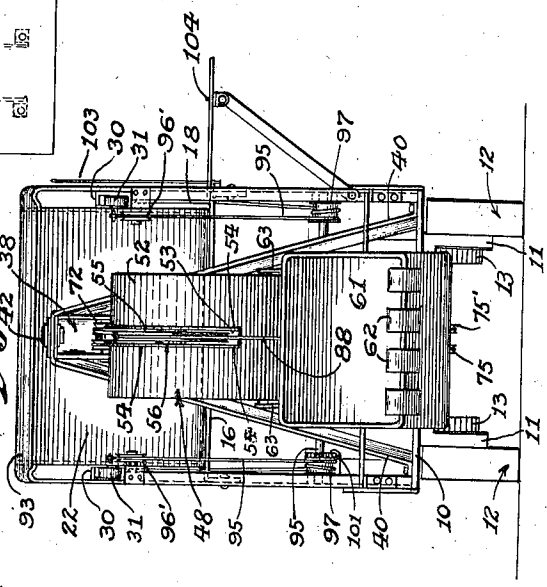


Fig. 4.

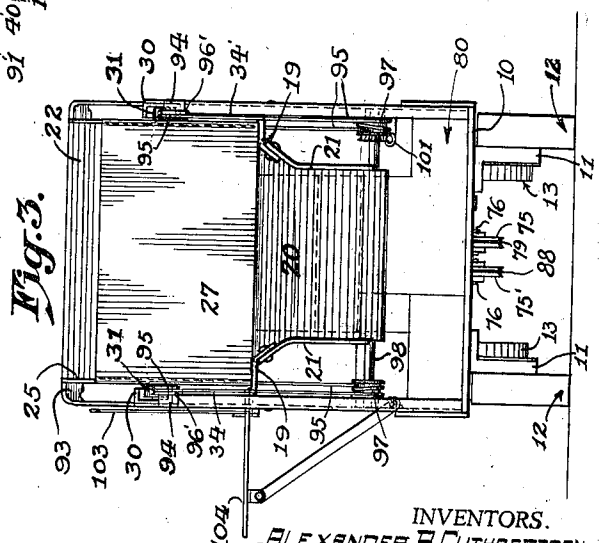


Fig. 3.

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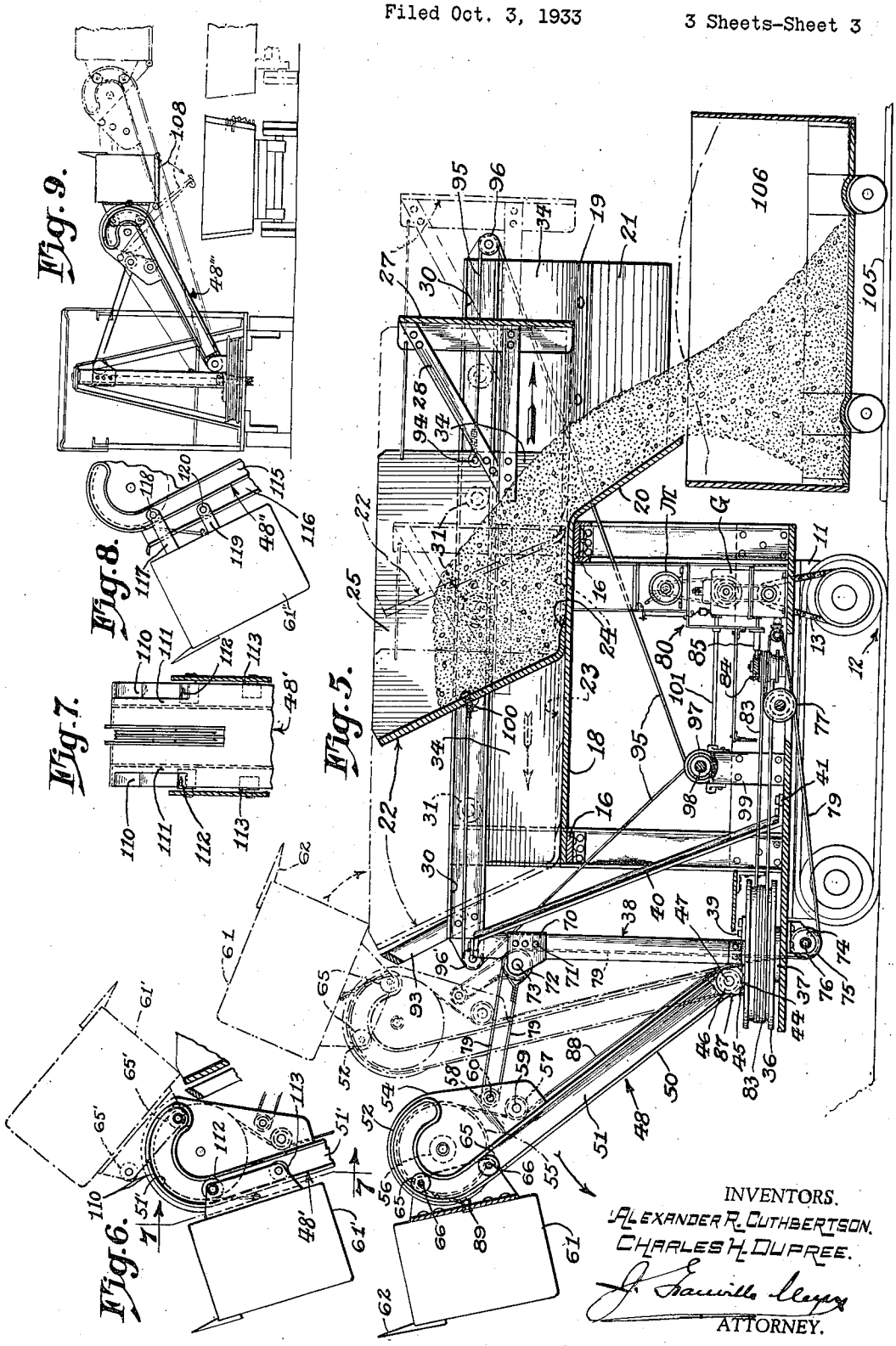


Fig. 9.

Fig. 8.

Fig. 7.

Fig. 5.

Fig. 6.

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2,013,750

EXCAVATING APPARATUS

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9 Claims. (Cl. 214—90)

Our invention relates to excavating, and particularly to apparatus for scooping, and/or digging and discharging rock, dirt and the like; and is particularly useful in tunnel and ditch work where the walls of the excavation must be preserved and inherently limit lateral movements of parts of excavating apparatus. However, we do not limit the invention to such work for reasons, and illustrations of other possible uses, hereinafter given.

The general objects of the invention include the provision of a carrier or boom and a scoop or shovel thereon operable to effect scooping of rock, dirt or the like longitudinally, as well as vertically and at intermediate angles; and means for effecting dumping or discharge of the rock, dirt or the like at the rear of the apparatus in tunnel and ditch work.

The first general object stated above is accomplished by providing a boom or carrier having one end pivotally mounted preferably on a drum or turntable on the floor of the cab of the machine, and its other end curved upwardly and rearwardly, the said curved end and substantially straight portion of the boom between its ends being provided with guides along which the scoop-bucket moves. The bucket may have digging or scooping movement on either or both portions of the boom, that is, it may scoop dirt, rock or the like while moving along the substantially straight portion of the boom, and when filled the boom may be raised to elevate the curved end so that subsequent movement of the bucket therealong will result in dumping toward the rear or reversely to its digging movement. Such would be the action in digging or scooping on the floor or bottom of an excavation. In digging or scooping along an inclined or vertical wall, the bucket may be moved to positions on the curved end to adjust its angle to the surface, after which it may be moved along the remainder of the curved end to effect dumping to the rear, although I will hereinafter describe a modification in respect to the dumping. In general the bucket depends on the carrier or boom for guided movement, and generally digs or scoops under force independent of the movements of the boom or carrier, although it may move with and under force imparted by movement of the boom in certain instances.

In connection with the second general object mentioned above, that is, the discharge of the rock, dirt or the like, a hopper is provided preferably on top of the cab and into which the dirt is dumped from the bucket. This hopper is movable to positions to discharge its contents into cars or trucks at the rear of the machine; and certain details, such as its scraper action, cushioning effect for the material dumped therein, adjustable discharge capacity, will be described in detail later. At present we would only state that the relative capacities of the bucket and hopper are preferably such that the latter may contain several loads from the bucket, so that whether or not a car or truck be available at certain times the scooping or digging and dumping operation may continue, and also the hopper may be discharging even while the bucket is digging or scooping.

All of the objects and advantages of the invention and the details of construction and operation by which they are accomplished will be pointed out and referred to during the course of the following detailed description of the accompanying drawings, in which

Fig. 1 is a longitudinal vertical sectional view through apparatus embodying the invention taken on the line 1—1 of Fig. 2;

Fig. 2 is a top plan view of the apparatus shown in Fig. 1;

Fig. 3 is a rear elevation of the said apparatus;

Fig. 4 is a front elevation of the said apparatus;

Fig. 5 is a view similar to Fig. 1 showing certain parts in different positions;

Fig. 6 is a fragmentary side elevation of a modification in the boom or bucket carrier;

Fig. 7 is a view taken on the line 7—7 of Fig. 6;

Fig. 8 is a view similar to Fig. 6 showing a further modification in the boom or bucket carrier; and

Fig. 9 is a small front elevation of excavating apparatus showing further modification particularly in regard to the bucket dumping means.

In the drawings, particularly in Figs. 1–5, the numeral 10 designates the floor of the cab, which is mounted on supports 11 carried by a crawler tractor 12, the rear wheels of which are driven by chains 13 trained around sprocket 14, in turn driven by mechanism hereinafter referred to. The floor 10 has at the four corners thereof, uprights 15 rigidly connected thereto at their bases in any suitable manner, and between the front pair of uprights and also the rear pair of uprights below their upper ends are cross bars or plates 16, rigidly connected at each end to the uprights as by rivets or bolts 17. The cross bars 16 support the roof 18 of the cab, and which in effect, as will be hereinafter explained, constitutes the fixed floor of what will be termed a

scraper hopper. A portion of the floor 18 extends beyond the rear uprights 15, and as shown best in Figs. 2 and 3, is cut along lines providing marginal portions or rearwardly extending tracks 19, and a downwardly inclined portion 20 provides a discharge chute. To the side extensions 19 are secured downwardly inclined plates 21, the forward ends of which meet the portion 20.

The scraper hopper comprises a front wall 22 which is inclined from beyond and above the uprights 15 downwardly toward the front of the floor 18. The hopper has a bottom 23 which normally covers only a portion of the floor 18 at the front thereof, due to the fact that the said bottom of the scraper hopper is preferably substantially V-shaped, as indicated by the numeral 24 in Fig. 2. Side walls or plates 25 are coextensive with the height of front wall 22 and length of the bottom 23, and are secured to both by any suitable means. The scraper hopper also includes a rear plate or upstanding wall 27 normally located adjacent the top edge of the chute 20 and connected to struts or braces 28 which in turn are also connected to the side walls 25. Channel strips 30 are connected to the upper ends of the uprights 15, there being one at each side of the carriage or frame and extending forwardly beyond the front pair of uprights and rearwardly beyond the rear pair. Rollers 31 are rotatably supported on studs 32 connected to the sides 25, the rollers being disposed in the channels of the members 30.

Summarizing the structure and parts of the scraper or discharge hopper, the same includes the inclined front wall connected to side walls of lesser length than the floor 18, (which is the cab roof) and a preferably substantially V-shaped bottom connected between the said and front side walls 21 and 25 respectively. The substantially V-shaped bottom 23 is of lesser area than floor 18, so that there is a space or area on the floor 18 which is not covered. There is also a space between the ends of the side walls 25 and rear wall 27, which is covered by side plates 34. These plates 34 may conveniently be formed by bending up the sides of the bottom 18 inside of the uprights 15 and outside of the side walls 25 of the scraper hopper. Obviously, the scraper hopper has sliding, and/or rolling movement along the floor 18, which will be hereinafter described.

Boom or bucket carrier structure

At the forward end of the floor 10 preferably forwardly of the front uprights 15 and beneath the front 21 of the scraper hopper, a drum or turntable 36 is rotatably mounted on a bearing 37. In the center of the drum or turntable 36 is mounted a vertical mast 38, the bottom of which has flanges 39, rigidly secured to the top of the turntable, so that the mast will rotate with the turntable. A pair of struts 40 having flanges 41 at their bottoms rigidly secured to the floors as by means of bolts or the like, are inclined upwardly and forwardly, converging toward each other. A projection 42 on top of the mast 38 is mounted through openings in the tops of the struts. Thus, the mast is rotatably supported in an upright position for rotation with the drum or turntable 36.

A plate 44 is also rigidly secured on the drum or turntable in front of the mast 38, as by means of bolts 45, engaging into the drum, said plate having upstanding sides 46 through which and the inner end of the boom is a shaft or pin 47 pivotally securing the boom, which is designated generally by the numeral 48 in Fig. 1, on the drum. In view of the rigid connection of the plate 45 to the drum, the boom of course is rotatable with the drum. The said inner end of the boom as shown in Fig. 2, is bifurcated providing a notch 49 for a reason presently explained. The boom comprises a relatively wide straight portion or arm 50 provided in each side with a channel 51, and the outer end of the boom is curved upwardly and then inwardly toward the mast 38, providing a hook-shaped end, the curvature being either arcuate or parabolic. The channels extend around the sides of the curved or hook-shaped end 52. The said end 52 is also bifurcated providing a space 53, on each side of which are plates 54, the outer ends of which conform substantially to the curvature of the said end of the boom and the inner ends of which taper downwardly toward the straight portion 50. A sheave 55 is mounted in the space 53 for rotation on a stub-shaft 56 secured between the plates 54, and a second and smaller pair of sheaves 57 and 58 are mounted between the inner ends of the plates 54 on stub-shafts 59, 60, respectively, also secured between plates 54.

The bucket 61 may be of any form, preferably rectangular and provided at its forward end on the lower wall with teeth 62. A U-shaped frame or plate 63 is rigidly connected to the top wall of the scoop and rollers 65, disposed within the grooves 51 of the boom, are rotatably mounted on pins or bolts 66 secured to the opposite sides of the said frame 63.

A U-shaped bracket 70 embraces the mast 38 and is secured thereto as by bolts or rivets 71 adjacent its top. The side arms of the bracket extend beyond the mast and a double sheave 72 is rotatably secured between the arms of the bracket on a pin or bolt 73. Another bracket 74 is attached to the bottom of the floor 10 beneath the mast 38 and a pair of sheaves 75, 75', are rotatably mounted in said bracket on a pin or bolt 76. A drum 77 (see also dotted indications Fig. 2) is supported on a suitable bearing on the floor 10 and is driven by any suitable gear and rod or other driving connection 78 from motor or engine of known type and in known manner. A cable 79 is secured to and wound around the drum 77 and then passes around sheave 75 through an opening in the floor 10 and turntable 36 upwardly over one of the grooves and sheaves 72 down around sheave 58 and back around the other groove in the sheave 72, and there is secured to itself as by splicing or clamping.

Operation of the boom

A plurality of levers controlling clutches, not shown, located within the engine or motor box designated generally by the numeral 80 in Fig. 1, are located adjacent the front platform 10 so that the operator may manipulate them to control the different operations about to be described, including the raising and lowering of the boom. One such lever is designated by the numeral 81 in Fig. 2 and controls the rotation of the drum 77 and consequently the winding and unwinding of the cable 79. Obviously, with the boom in the full line position of Fig. 1, the cable would be partially unwound from the drum 77, and, of course, when the operator manipulates the lever 81 to cause mechanism for driving or rotating the drum 77, the cable will be wound onto the said drum and due to the pull between the sheaves 72 and 58 will raise the boom. Re-

verse movement of the drum will of course let the cable out, so that the boom will move down.

The boom may also be turned from side to side with the turntable, around which is wound a cable 83, also wound around drum 84 located on floor 10 and rotated by a suitable gear mechanism 85, also driven by the engine or motor and controlled by lever 86.

Scoop-bucket operating means and operation

A cable 88 is fastened to an anchor 89 on the scoop bucket and passes around the sheave 55 and then downwardly and under the sheave 57 over sheave 87, and under sheave 75' to a drum 89 similar to and adjacent the drum 75 and which is driven by suitable means, such as sprockets and chain 90 from the main power shaft of the engine or motor, the operation of the drum 89 being controlled by a suitable lever 91 in known manner. Obviously, when the boom is in substantially horizontal position and the bucket is retracted or near the turntable 36 or inner end of the boom, the boom may be turned to bring the bucket into alinement with the rock, dirt or the like to be scooped. The lever 91 is then manipulated to cause the drum 89 to wind the cable 88 exerting a pull on the bucket moving it forwardly on the boom until it is filled. This explanation applies only to scooping of loose rock or leveling ground. When the bucket is filled, it may be near the curved end 52 of the boom. To effect dumping of the bucket, the lever 81 is manipulated to cause the boom to pass from the full line position of Fig. 1 through the intermediate dotted line position of the same figure into the final dotted line position with the curved ends of plates 54 abutting the stop 93 at the front of the hopper, and the end of the curved or hook shaped portion of the boom pointing down. Lever 91 is again manipulated to cause further pull of the cable 88 on the bucket, so that it passes around the curved end of the boom and is inverted, dumping its contents into the scraper hopper. The levers 81 and 91 are then actuated to cause the boom to be lowered and the bucket to be retracted along the boom for a repetition of the scooping and dumping operation.

Operation of the scraper hopper

The scraper hopper has attached adjacent the rear edge of each of the sides 25, brackets 94 to which are secured the ends of cables 95 which pass around sheaves 96 located at the rear of the channels 30 and rotatably supported at that point. The cables 95 also pass downwardly on opposite sides of the chute 20 to drums 97 rotatably supported at opposite ends of the shaft 98 journaled in bearings provided on uprights 99, and then the cables after being wound around the drums pass upwardly around sheaves 96' rotatably supported on the forward ends of the channels 30 and are secured to the front of the scraper hopper, as indicated by the numeral 100. The shaft 98 and drums 97 are rotated to the left or right by suitable drive connection 101 such as chain and sprocket driven by the main motor or engine. The operation of the shaft 98 may be controlled optionally by lever 102 located adjacent the front of the platform 10, as well as by a lever 103 located against a platform 104, which may be provided on the upper part of the frame adjacent the chute 20. In other words, an attendant may manipulate the boom and shovel from the front as well as operate the discharge of the hopper, or a second attendant may operate the discharging of the scraper hopper, and he would preferably be located immediately above the chute where he could observe the position and contents of the car or truck.

In digging tunnels as illustrated in Fig. 1, as the rock and dirt are loosened and scooped and removed tracks 105 may be laid on the floor of the tunnel and over which cars 106 may run to and from beneath the discharge chute 20 to the exterior. With the foregoing in mind, the attendant on platform 104, when a car is beneath the chute and the scraper hopper contains a considerable quantity of the rock, dirt or the like, operates lever 103 to cause rotation of the drum in a direction to pull on the anchor points 94 at the rear of the scraper hopper by winding that portion of the cables between sheave 96 and drum 97 on the drum, and unwinding or lengthening that portion of the cable between sheaves 96' and the front of the hopper. As the hopper moves rearwardly, the V-shaped bottom moves across the roof 18, as shown in full and dotted lines in Figs. 1, 2 and 5, and the rock or dirt is moved backward as the hopper moves to the rear, at which time the open portion of the bottom of the scraper hopper comes out across the chute 20 so that the dirt runs down the chute and into the car or truck. The manner in which the dirt or rock piles up in the hopper under the construction and arrangement hereinbefore described is shown in Fig. 1, where the greatest quantity is at the front of the hopper and a lesser quantity at the rear. In actual operation the front of the hopper is never automatically completely emptied and a quantity of the rock or dirt remains on the portion 23 of the bottom of the hopper forming a cushion for the rock or dirt, which is dumped from the bucket after the hopper is returned to the full line position of Fig. 1, from the dotted line position, which is accomplished by reversing the direction of rotation of the drums 97 in obvious manner.

Vertical digging

We have explained hereinbefore, that in scooping rock or dirt on a horizontal surface, the boom serves as a guide for the movement of the bucket and the cable 88 imparts the scooping movement to the bucket. In digging upwardly, as on an inclined or vertical bank or wall of an excavation, the bucket is set at a selected position on the boom and then the boom may be raised to impart the digging movement to the bucket. It will be understood that the bucket may be set at any desired angle by having one or both of the rollers located in the curved portions of the guides 51 to bring the teeth into engagement with the point where the digging is to start, according to the angle of the bank or wall. The boom is then raised to force the teeth into the dirt. Such digging may be on various portions of walls or banks, intermediate the full line position of Fig. 1 and the full line position of Fig. 5. Also, the cable 88 may be utilized to move the bucket during vertical digging to chip or shave off uneven surfaces on the bank or wall. Of course, the dumping could be accomplished in the manner previously described, but to illustrate that the curved end of the boom can serve not only to accomplish dumping of the bucket, but also the vertical digging apart from such dumping, we have illustrated in Fig. 9 a construction and arrangement identical with Fig. 1 except that the bucket has a hinged bottom 108 of known type which can be maintained closed dur-

ing a digging operation, and after the boom has been swung around with the turntable to bring it over a trunk the bottom 108 may be opened to dump the contents.

Modifications

In Figs. 6 and 7, we have shown a modification in the structure of the guides or channels in the boom, particularly at the curved end, and wherein the outer walls of the channels 51' are cut away over a portion of the arc of the curved end, as indicated by the numeral 110, leaving a relatively narrow portion 111 from adjacent the point where the boom begins to curve to a point intermediate the ends of the curve of the said outer wall. The front rollers 12 on the bucket carrier are substantially the same width as the channels 51' but the rear rollers 113 are not as wide as the notch 110 in the outer wall of the channels. Therefore, when the bucket is raised to the end of the boom and is drawn around the curved end, the rollers 112 pass across the notches 110 and substantially around the curved end, at which time the narrow rollers 113 move away from the boom as the forward end of the bucket is beginning to tilt down and the bucket assumes the dotted line position of Fig. 6 dumping its contents. The final tilting of the bucket is sudden due to the shifting of the weight relative to the center of gravity and facilitates the dumping. When the boom begins to lower, the rollers 113 fall back against the inner wall of the channels through the notches 110 and again enter the channels 51' along the straight portion of the boom as the bucket is lowered or retracted.

The purpose of the construction shown in Fig. 8 is the same as that shown in Fig. 7, namely, to facilitate dumping of the bucket at the curved end of the boom when the same is elevated. In such construction there are two pairs of channels along the straight portion of the boom, an upper channel 115 corresponding to the channel 51 of Figs. 1–5 and a lower channel 116. At the upper end or mouth of the bucket there are attached arms 117, each carrying a roller 118 in the grooves 115. Below the arms 117 are arms 119 carrying rollers 120 in the grooves 116. The grooves or channels 116 are preferably entirely straight and parallel with the straight portion of the channels 115 and terminate adjacent the beginning of the curvature of the channels 115. Obviously, when the bucket is pulled upwardly the rollers 120 eventually ride out of the channels 116, but the rollers 118 remain in the channels 115 and act as a pivot for the tilting of the bucket, the same as explained in connection with the construction of Fig. 6. When the boom is lowered, the bucket falls back and the rollers 120 again ride in the grooves 116.

In Fig. 5, I have shown an electric motor M located in housing in the cab of the apparatus and therebelow a gasoline engine G. Although it is possible to have both the gasoline engine and an electric motor, it is also optional to have one or the other. For instance, in tunnel work it would not be desirable to have the gasoline engine operating because of the fumes from the exhaust, but in general outside work a gasoline or steam engine may be used. These features, as well as the drives and clutches for the drums operating the turntable, boom, and shuttle form no part of the invention, and we do not deem it necessary to make a detailed disclosure, as any standard type of equipment for these purposes may be used. We have shown a lever 122 (Fig. 2) for controlling the motor or engine.

We claim:

1. In excavating apparatus including a platform, a boom pivotally mounted at one end on said platform, means to swing said boom up and down on said pivot, a hopper on top of the cab, the outer end of said boom being curved upwardly and rearwardly, a scoop bucket carried by said boom, and means to move said scoop bucket along said boom and said hooked shaped end to dig or scoop, and to reverse the position of its digging end to effect dumping of its contents into said hopper when the boom is elevated and the bucket reaches said rearwardly extending portion of the curved end by continuing said same moving means.

2. In excavating apparatus including a cab, a boom support on the cab, means to rotate said support, a boom pivotally connected at one end to said support for rotation therewith, the other end of the boom being surved upwardly and inwardly toward the cab, a scoop bucket carried by said boom and having guided movement therealong and along said curved end, means to raise and lower said boom, means independent of said last means to move said scoop bucket along said boom toward and along said curved end to dig or scoop, and a hopper on top of the cab into which the scoop bucket dumps when it travels around the curved end of the boom when the boom is elevated.

3. In excavating apparatus including a cab, a boom support on the cab, means to rotate said support, a boom pivotally connected at one end to said support for rotation therewith, the other end of the boom being curved upwardly and inwardly toward the cab and the intermediate portion being substantially straight and elongated, a scoop bucket carried by said boom and having guided movement along said intermediate portion and along said curved end, means to raise and lower said boom, means independent of said last means to move said scoop bucket along said intermediate portion and curved end, a hopper on top of the cab into which the scoop bucket dumps when it travels around the curved end of the boom when the boom is elevated, and means to discharge the material from the hopper into conveyors.

4. In excavating apparatus including a platform, a boom pivotally supported at one end on said platform, means to swing said boom up and down on said pivot to raise and lower its other end, said other end of the boom being curved, tracks along said boom and said curved end, a scoop bucket, brackets connected to said bucket and carrying rollers disposed in said tracks, there being forward and rear pairs of rollers, and means to cause said rear rollers to leave their tracks when the forward pair are adjacent the terminus of their tracks at the curved end when the boom is elevated whereby the bucket tilts around said forward rollers to effect dumping.

5. In excavating apparatus including a cab, a boom pivotally supported at one end of said cab, means to swing said boom up and down on said pivot to raise and lower its other end, said other end of the boom being substantially hook-shaped, a scoop bucket carried by said boom and movable therealong to said hook-shaped end, a hopper supported on top of the cab and movable therealong forwardly and rearwardly to receive material from the scoop bucket when said bucket is on the curved end of the boom and the boom

is elevated, and to discharge material at the rear of the cab.

6. In excavating apparatus including a platform, a boom pivotally mounted on the platform, a scoop bucket movable on said boom to discharge its contents when the boom is in elevated position, a roof supported above the platform, a hopper slidable along said roof and having the rear portion of its bottom open exposing the surface of the roof, a chute at the rear of the roof, and means to reciprocate said hopper on said roof to discharge contents thereof through said open portion of its bottom and chute.

7. In excavating apparatus including a support, a boom pivotally mounted at its inner end on said support, said boom comprising a relatively long member having its outer end curved upwardly and inwardly and a substantially straight portion between said curved end and inner end, a scoop bucket on said boom, means to move said boom on its pivot from substantially horizontal to substantially vertical positions, and means to move said scoop bucket along said straight portion of the boom to effect scooping of materials and onto said curved end for dumping the scooped materials, said last means being effective to establish said bucket on said curved end of the boom at desired angles relative to the straight portion and to firmly hold the bucket at said desired angles during upward swinging movement of the boom to also effect digging or scooping on upright surfaces.

8. In excavating apparatus including a support, a boom pivotally mounted at its inner end on said support, said boom comprising a relatively long member having its outer end curved upwardly and inwardly and a substantially straight portion between said curved end and inner end, a scoop bucket on said boom, means to move said boom on its pivot from substantially horizontal to substantially vertical positions, means to move said scoop bucket along said straight portion of the boom to effect scooping of materials and onto said curved end for dumping the scooped materials, said last means being effective to establish said bucket on said curved end of the boom at desired angles relative to the straight portion and to firmly hold the bucket at said desired angles during upward swinging movement of the boom to also effect digging or scooping on upright surfaces, and means to rotate said support to swing the boom.

9. In excavating apparatus including a support, a boom pivotally mounted at its inner end on said support, said boom comprising a relatively long member having its outer end curved upwardly and inwardly and a substantially straight portion between said curved end and inner end, a scoop bucket on said boom, means to move said boom on its pivot from substantially horizontal to substantially vertical positions, means to move said scoop bucket along said straight portion of the boom to effect scooping of materials and onto said curved end for dumping the scooped materials, said last means being effective to establish said bucket on said curved end of the boom at desired angles relative to the straight portion and to firmly hold the bucket at said desired angles during upward swinging movement of the boom to also effect digging or scooping on upright surfaces, and means above said support to receive the contents of the scoop bucket when the bucket is substantially at the terminus of the curved outer end of the boom and when the boom is in elevated position.

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