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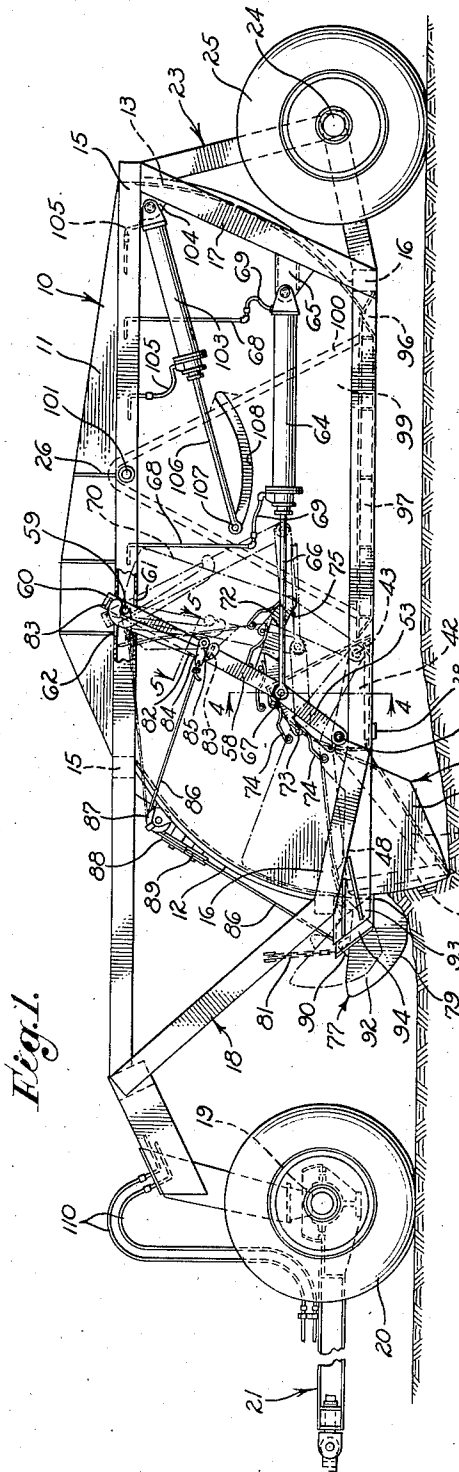
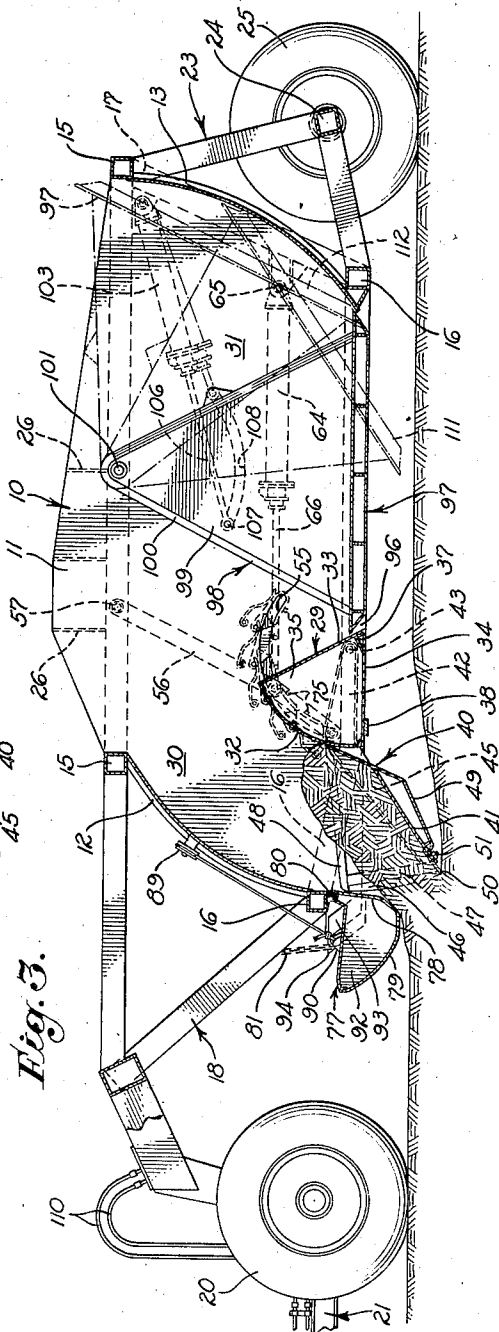
L. BERNER

2,243,831

SCRAPER

Filed May 23, 1939

2 Sheets-Sheet 1



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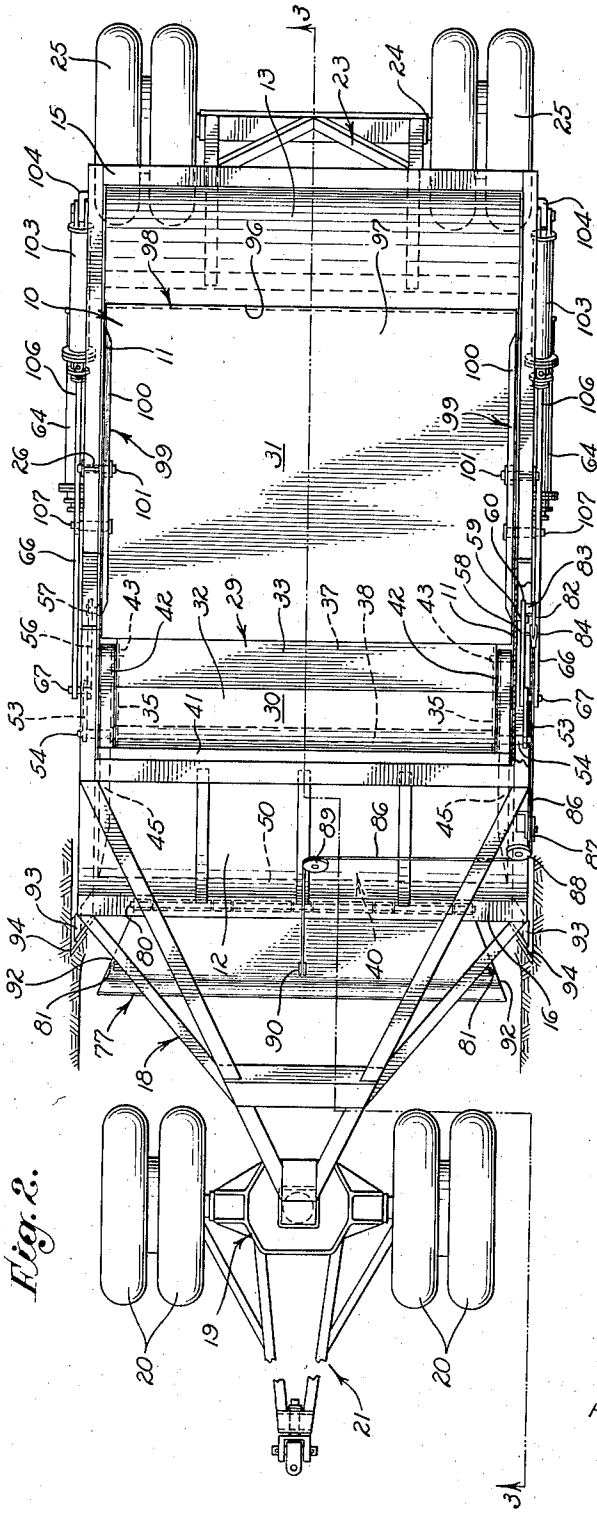
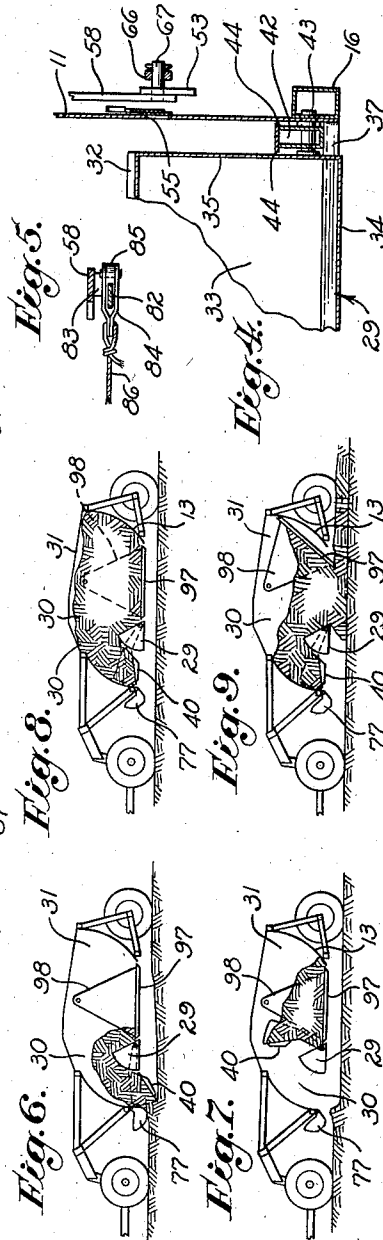
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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SCRAPER

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Application May 23, 1939, Serial No. 275,173

17 Claims. (Cl. 37-4)

My invention relates to earth-moving apparatus with special reference to scrapers and is directed specifically to an improved construction for a heavy duty scraper of large capacity.

The earth-moving cycle of a scraper comprises the following operations: digging or the scraping operation proper; the loading of the excavated earth into the bowl of the scraper; the transportation of the loaded earth in the scraper to the dumping area; and unloading the earth at the dumping area, usually the earth being spread to a desirable thickness as it is deposited. The amount of earth that will be moved in a given period of time by a given amount of available power will vary with the effectiveness with which that power is utilized in the digging operation and with the time ratio of the digging operation to the whole earth-moving cycle. The most economical scraper, then, would be one with a highly effective digging means and a relatively large storage capacity to reduce the number of trips necessary for moving a given yardage of earth.

In practice, certain difficulties have defeated attempts to attain large capacity in scrapers, increased capacity along conventional lines unavoidably involving prohibitive penalties in reduced efficiency and increased cost.

One of the most serious problems is the fact that increasing the storage capacity of a conventional scraper results in an inordinate consumption of power for loading the earth into the scraper bowl, the power so consumed being a direct deduction from the power available for the digging operation proper. This problem arises from the fact that, in the usual scraper construction, the earth is shifted from the scraper blade to storage in an inefficient manner, the earth movement into the bowl being accomplished solely by displacement resulting from earth crowding into the scraper upward from the scraper blade. All of the loading force is applied at the scraper blade and is rapidly dissipated. Internal friction of the loaded earth in the crowding action consumes energy, and packing of the earth against the side walls of the scraper with considerable pressure causes excessive resistance to the loading "flow" of the earth. This dissipation of power is unavoidable if mere crowding of the earth is relied upon for loading the conveyor and increases at an accelerated rate with increase of bowl capacity. In only a moderate sized scraper, the power consumed in forcing the earth into the scraper bowl for transportation may exceed by a large margin the power consumed in the digging

operation, per se. Since the loading operation proceeds simultaneously with the digging operation, a conventional scraper of exceptionally large capacity will often require a pusher tractor in addition to the usual pulling tractor. The employment of two tractors in such manner is not only expensive but also involves excessive stresses on the scraper that can be met only by a heavy and cumbersome scraper construction.

It may be further pointed out that relying on the sheer crowding of the earth at the blade for conveying the earth into the tractor bowl is not conducive to efficient distribution of the load nor to proper utilization of the available storage volume. Where crowding is depended upon to load the tractor, the earth must be considered as, in effect, a stream flowing from the cutting edge of the scraper blade into the bowl and no design based on the sole consideration of facilitating such flow will result in proper loading of the bowl.

The general object of my invention is to provide various improvements in a scraper construction to obviate the above difficulties and to solve the above problems in the design of a large capacity scraper. Broadly, it is my purpose to provide a large capacity scraper that may be operated effectively without excessive power requirements. I propose to provide a large capacity scraper in which the power requirements for excavation compare with the power requirements of conventional scrapers of relatively small capacity. Conversely stated, my broad object is to excavate with maximum utilization of a given available power and at the same time to provide such carrying capacity on the part of the scraper that the ratio of the digging operation to the earth-moving cycle as a whole will be relatively high.

My invention is characterized by the conception that these broad objects may be attained by concentrating substantially all of the available power on each operation of the earth-moving cycle in turn. By concentrating the available power alternately on digging and loading, I avoid the peak power loads that are inevitable when digging and loading are performed simultaneously. My invention is further characterized by the unique conception of, in effect, dividing the bowl into a receiving compartment and a storage compartment, my thought being that the earth may be conveyed into the receiving compartment by the usual crowding action with relatively little consumption of the available power if the receiving compartment is relatively small and is designed to favor flowing movement

of the earth. A new earth-moving cycle is contemplated in which the early part of the cycle consists of alternately digging with forward movement of the scraper and, with the scraper stationary, loading or transferring earth from the receiving compartment to the storage compartment. With the various problems solved by proceeding in accordance with these conceptions, I achieve a scraper of relatively large capacity that may be operated by a power unit of the same rating as employed for operating conventional scrapers of relatively small capacity. One of the important advantages of my construction is that the traction required for digging is so low that the required traction force can be delivered through pneumatic tires. The use of such tires permits high speed hauling and, of course, increases the life of the whole machine.

One object of my invention is concerned with the construction of the contemplated receiving compartment of the scraper bowl. I propose to provide for transferring earth from the receiving compartment to the storage compartment in an effective manner with minimum power and to deliver the earth to the storage compartment in a manner to utilize the full capacity of the storage compartment and to favor the subsequent dumping operation. A feature of the preferred form of my invention is that the side walls of the receiving compartment are fixed and that the scraper blade serves as the floor of the receiving compartment and is movable to lift the contents of the receiving compartment bodily into the storage compartment.

Another object in mind relates to the scraper blade, per se. In the preferred form of my invention, I propose, as above-stated, to have the blade perform the function of lifting earth bodily into the storage compartment of the scraper bowl. I propose to provide a blade design effective for both of the two purposes served by the blade and to mount the blade in a manner that will permit the required periodical loading movement and yet provide for the required blade rigidity during the digging operation. In this aspect, my invention is characterized by a novel toggle arrangement to achieve the required characteristics of blade operation, and is further characterized by the conception of a blade mounted on arms to function about a pivotal axis that is isolated from the earth being handled and, therefore, cannot be clogged or jammed by the earth.

In a scraper constructed to operate in the manner described above and having such a dual-function scraper blade, it is desirable to insure that earth or rock will not cause the blade to jam to interrupt its upward movement toward the bowl and to insure that no substantial quantity of earth will spill forward over the cutting edge of the upwardly-swinging blade to block the return downward movement of the blade. It is further desirable, for the sake of simplicity in the blade design and blade actuating mechanism, that the blade move in a simple path of reciprocation. Further objects of my invention relate to the attainment of these particular ends, and a feature of my invention is that such objects are accomplished by providing what I choose to call a "chocker member" or "chocker box" to cooperate with a pivotally-mounted scraper blade. The chocker member serves to deflect material into the receiving compartment of the scraper during the digging operation, discourages spilling of material over the cutting edge of the blade

during initiation of the loading operation, and cooperates with the blade to close the receiving compartment as the blade moves upward to transfer the content of the receiving compartment to the storage compartment of the scraper bowl. More specific objects relating to the chocker member, in my preferred construction disclosed herein, are to mount the chocker member in a yielding manner that precludes any jamming on upward movement of the blade, to provide for adjustment in the positioning and weighting of the chocker member, and to provide for automatic elevation of the chocker member to clear the ground when the scraper is ready for transportation of the excavated earth to the dumping area.

With reference to the unloading operation in the earth-moving cycle performed by the scraper, my object is to release the material substantially directly under the center of gravity of the storage body to favor rapidity of dumping, and it is my further object to provide for carrying out the unloading operation with minimum power and in a manner to result in spreading the earth efficiently in a layer of adjustable depth. A feature of the preferred form of my invention is the conception of a floor member for the storage compartment that is rotatively mounted to rock to selected dumping positions for spreading the earth to selected depths, the rocking operation being such as to consume relatively little power.

A further broad object of my invention is to provide a scraper of relatively little weight, simple operation and inexpensive construction. This broad object is readily attained under the principles of my invention since only the scraper blade, the movable floor member of the storage compartment and the chocker member are movable, the remaining elements of the scraper comprising a rigid unitary structure connected directly to the supporting wheels.

Other objects, features, and advantages of my invention will be apparent from my more detailed description to follow, taken with the accompanying drawings.

In the drawings:

Fig. 1 is a side elevation of the scraper in digging disposition;

Fig. 2 is a plan view of the scraper;

Fig. 3 is a longitudinal section, taken along the broken line 3—3 of Fig. 2;

Fig. 4 is a fragmentary section on a somewhat enlarged scale, taken along the line 4—4 of Fig. 1;

Fig. 5 is an enlarged fragmentary section, taken along the line 5—5 of Fig. 1;

Fig. 6 is a diagrammatic view on a reduced scale showing the scraper in the course of the digging operation;

Fig. 7 is a similar diagrammatic view of the scraper in the course of the loading operation;

Fig. 8 is a similar view of the scraper completely loaded and disposed for transportation to the dumping point; and

Fig. 9 is a similar view of the scraper in the course of the dumping and spreading operation.

The scraper bowl, generally designated by numeral 10 in the drawings, is an elongated receptacle fabricated from suitable metal plates and include side walls 11, a front end wall 12, and a rear end wall 13, the front and rear end walls being arcuate, as shown, for reasons that will be made apparent later. The frame structure that supports and reinforces the bowl 10 is preferably of hollow construction fabricated from steel shapes and may include a rectangular frame

member 15 surrounding the bowl near the top, a lower similar rectangular frame member 16, and a pair of inclined frame members 17 interconnecting the two rectangles at the rear corners of the bowl. A triangular assemblage of frame members, generally designated by the numeral 18, rigidly connected to the forward end of the bowl 10 supports the bowl from a suitable pivotal connection with a forward axle assembly generally designated 19, the axle assembly being supported by forward wheels 20 and being provided with the usual draft tongue or draw-bar 21. At the rear end of the bowl, the supporting structure includes an assemblage of frame members, generally designated 23, that is connected to an axle 24 carrying rear wheels 25. Preferably, the side plates 11 of the bowl extend somewhat above the level of the frame structure and are reinforced by gusset plates 26 rising from the rectangular frame member 15. It will be noted that the described frame-and-bowl construction is rigid throughout. This efficient, rugged, and yet relatively light construction is permissible because my invention does not require movement up and down of the bowl proper relative to the supporting wheels.

The preferred form of my invention includes a transverse barrier, generally designated 29, spanning the interior of the bowl 10, the barrier in effect dividing the bowl into a receiving compartment 30 and a storage compartment 31. The barrier 29 may take various forms in various practices of my invention but in the specific form under consideration here is a hollow member having an arcuate forward wall 32, an inclined rearward wall 33, a bottom wall 34, and side walls 35, the side walls, as best shown in Fig. 4, being spaced from and parallel with the corresponding side walls 11 of the bowl 10. The barrier 29 may be supported from the side walls 11 of the bowl 10 by an angle-iron 37 that extends across the bowl through the interior of the barrier near the lower rear edge thereof and by a second cross member, such as a bar 38.

My invention includes a blade assembly, generally designated 40, the essential parts of which are a scraper blade 41 and two support arms 42 that are rotatably mounted on corresponding pivot pins 43. The pivot pins 43 are at each side of the barrier 29 and are on an axis concentric to both the curvature of the forward end plate 12 of the bowl 10 and the curvature of the forward wall 32 of the barrier 29. The scraper blade 41 is so dimensioned and positioned that, as the blade is swung upward, the forward or cutting edge of the blade follows the bowl wall 12 and the rearward edge of the blade follows the barrier wall 32. It is apparent that, by virtue of such a construction, upward movement of the blade 41 may be relied upon to lift the whole content of the receiving compartment 30 bodily upward over the barrier 29 into the storage compartment 31.

In the blade construction shown in the drawings, which is to be taken as suggestive only, the scraper blade 41 is disposed at an angle relative to the arms 42 and the arms, which are of hollow construction and have overhanging upper walls 44, are continuous with corresponding reinforcement members 45 along each side of the blade, the reinforcement members tapering toward the leading edge of the blade. Side plates 46 that extend upward from each longitudinal edge of the blade 41 and are reinforced by bars 47 and 48 give the blade assembly the character of a

scoop. The blade proper, 41, is of hollow construction having a spaced lower plate 49 and is provided with a replaceable blade element 50 removably secured thereto by suitable bolts 51.

It will be noted from Figs. 1 and 3 that the scraper blade 41, in its cutting or excavating disposition, constitutes in effect the bottom wall of the receiving compartment 30. The blade may be said, then, to have three functions inasmuch as it serves as a digging member, forms a wall of the receiving compartment of the scraper bowl, and is movable to transfer the content of the receiving compartment into the storage compartment. By virtue of the overhanging walls 44, each of the arms 42 of the blade in effect spans the corresponding space between the side wall 11 of the bowl and the side wall 35 of the barrier 29, thereby forming a bottom for that space and also reducing the likelihood of earth or rock causing the arm to be jammed.

Various suitable mechanisms may be designed to actuate and control the scraper blade 41 for the performance of the various functions mentioned above. In the preferred form of my invention, by way of example, I employ a toggle mechanism and mount the mechanism on the exterior of the bowl. As shown in the drawings, on each side of the scraper bowl 10, the scraper blade assembly is connected to the lower end of a toggle link 53 by a stud or pivot post 54 that is mounted on the corresponding scraper blade arm 42 and extends through an arcuate slot 55 in the side wall 11 of the bowl, the slot being concentric to the axis about which the arms rotate. On the far side of the scraper, as viewed in Fig. 3, the upper end of the toggle link 53 is pivotally connected to the lower end of a toggle arm 56 that swings on a pivot post 57 mounted inside the frame member 15, the bottom of the frame member having a slot (not shown) dimensioned to clear the toggle arm at all positions. On the near side of the scraper bowl, as the bowl is viewed in Fig. 1, the other of the two toggle links 53 is connected to a toggle arm 58 that is similar to the toggle arm 56, the toggle arm being in like manner mounted on a pivot post 59 in the frame member 15. The toggle arm 58, however, is longer than the first toggle arm 56 in that it has an end portion 60 extending above the frame member 15, the frame member having a lower slot 61 and an upper slot 62 to clear the toggle arm at all positions.

On each side of the scraper bowl is a hydraulic jack 64 having its rear end pivotally anchored to a bracket 65 that extends forward from the corresponding frame member 17. Each of the hydraulic jacks has a forwardly-extending piston rod 66 connected to a pivot pin 67 at the juncture of the toggle link 53 and the corresponding toggle arm, and each of the hydraulic jacks is actuated and controlled through a pair of pipes 68 and flexible connecting conduits 69. It may be noted in Fig. 1 that, in the normal digging disposition of the scraper blade 41, the piston rod 66 of each of the hydraulic jacks is extended to its furthest forward position, at which position the angle between the toggle link and toggle arm approaches a 180° angle with a correspondingly highly favorable leverage ratio against the pivot post 54 on the scraper arm 42. It is apparent that only a moderate thrust by the piston rod against the toggle linkage is required to hold the scraper blade at its lowermost position in a rigid manner that precludes chattering. If the hydraulic jacks 64 on the opposite sides of the

scraper are actuated to retract the piston rods 66, the toggle links 53 are placed in tension to draw the scraper blade 41 upward and back to the extreme blade position indicated in Fig. 1 by a dashed line 70. Features of the described operating mechanism are, first, the effective locking of the scraper blade in digging disposition; second, the relatively extensive blade movement accomplished with only moderate movement of the piston rods; and, third, the relatively small range of oscillation on the part of the hydraulic jacks in the course of blade movement, this latter feature being important as minimizing the likelihood of objects adjacent the scraper interfering with the operation of the hydraulic jacks.

Since material may spill out of the bowl through the arcuate slots 55 in the side walls 11, especially if the material is dry sandy soil, I add to the preferred form of my invention suitable closure means, such as an arcuate series of overlapping plates 72. Each of the plates is pivotally mounted on a bolt 73 and is pressed downward edgewise by a leaf-spring 74 against a stop pin 75, at which position the plate covers a portion of the slot. The various plates have forward and rearward edges inclined across the slot in the path of the pivot post 54 so that the blades are successively deflected by a cam action whenever the pivot post 54 traverses the slot in the course of scraper blade movement.

In the preferred practice of my invention, it is contemplated that, periodically, the forward movement of the scraper will be interrupted for a loading operation, at which time the available power will be directed to the actuation of two hydraulic jacks 64 to swing the scraper blade 41 upward and backward for transference of material from the receiving compartment 30 to the storage compartment 31. It is desirable at such time that some means be provided to discourage the tendency of the loosened earth to spill forward over the leading edge of the scraper blade as the scraper blade is moving upward and approaches a position to cut off the lower end of the receiving compartment 30. For such purpose, I may provide what I call a "chocker member," that is generally designated 77 in the drawings. The chocker member is hingedly mounted and may be regarded as a yielding or flexible extension of the front bowl wall 12. In the preferred form of my invention, the chocker member 77 is of hollow character, being in the form of a tray or box, and may, therefore, aptly be termed a "chocker box." By virtue of this construction, the chocker member may be loaded with ballast of selected weight to provide a desired degree of inherent resistance to deflection. In the construction shown in the drawings, the chocker box 77 has a rear wall 78 that is normally in approximate alignment with the bowl wall 12 and has a lower wall 79 that is arcuate in general configuration, the wall curving upward toward the front to encourage the chocker box to ride over any rocks, earth ridges, or other relatively low obstacles on the ground. The chocker box swings on a suitable pintle rod 80 and the lowermost rotative position of the chocker box is determined by a pair of adjustable chains 81 anchored to a member of the overhanging frame assemblage 18.

In the normal excavating disposition of the scraper shown in Figs. 1 and 3, the chocker box serves as a means to deflect material into the receiving compartment 30 or conversely as a baffle to limit the forward displacement of earth

loosened by the scraper blade. When the scraper is stopped for a loading operation, i. e., transference of material from the receiving compartment 30 to the storage compartment 31, the upwardly-moving scraper blade acts as a lower jaw closing on the material at the entrance of the receiving compartment and the chocker box is, in effect, an upper jaw that is normally stationary yet is adapted to yield to any unusual force. Under ordinary circumstances, the chocker box remains substantially stationary as the scraper blade moves upward and deflects the loosened earth into the receiving compartment 30, the chocker box cooperating with the scraper blade to close off the receiving compartment at a relatively low angle of the blade to prevent earth from flowing over the blade from the receiving compartment. Should a rock, however, be entrapped between the scraper blade and the chocker box in the described jaw action, the upward movement of the scraper blade will not be blocked nor will any damage be done because the chocker box will yield by swinging outward and upward to permit the rock to escape if the rock is too heavy to be deflected inward by the resistance of the chocker box.

Since it is desirable for the chocker box to extend relatively close to the ground during digging operation, some means should be provided for swinging the chocker box to an elevated position when the scraper is used as a conveyance for transporting loaded earth to the dumping ground. A feature of my invention is that the changes in position on the part of the chocker box required for digging and subsequent transportation may be accomplished automatically. For example, the chocker box may be operatively related to the scraper blade actuating mechanism in the manner indicated by the drawings. The toggle arm 58, the longer of the two toggle arms, carries a rail 82 spaced in parallel relation thereto, the rail lying outside of the frame member 15 and being connected at its upper and lower ends to the toggle arm by webs 83. The rail 82 is loosely embraced by the two arms of a clevis 84 that carries a roller 85, the roller acting against the rear edge of the rail. A cable 86 connected to the clevis passes over pulleys 87, 88, and 89 to terminate in an anchorage fitting 90 on the chocker box 77. Since the cable 86 is disposed to pull forwardly on the clevis 84, the roller 85 will automatically seek whichever end of the rail is inclined forward. It will be noted that, since the upper end of the rail is relatively close to the pivot axis of the toggle arm 58 as soon as the toggle arm is swung rearward past vertical, the roller 85 will seek the upper end of the rail and then remain substantially stationary during the remaining rearward movement of the toggle arm. In other words, the described arrangement is such that only initial movement of the toggle mechanism in elevating the scraper blade acts upon the chocker box 77. The exact point in the cycle of toggle movement at which the chocker box will begin to swing upward will depend upon the amount of slack in the cable and may be varied in the judgment of the operator in accordance with operating conditions. Ordinarily, the upward movement of the chocker box should not be so prompt or rapid as to preclude the previously described cooperation with the scraper blade in cutting off the escape of loose earth from the receiving compartment.

In the preferred form of my invention, the side walls 92 of the chocker box converge inwardly

toward the leading end of the scraper bowl in spaced relation to side cutters 93 that extend forward from each side of the scraper bowl end. These side cutters are shown with replaceable cutting blades 94 disposed to divert material into the entrance of the scoop assembly 40 and to cut clearance for the frame along embankment slopes.

The storage compartment 31 may be constructed in any manner or provided with any means known in the art to permit discharge of material therefrom. One of the features of my invention, however, is a unique construction for the storage compartment that has outstanding advantages in the dumping and spreading of material. The fixed walls of the scraper bowl 10 form a bottom hole 96 in the storage compartment 31 that extends from one side of the scraper bowl to the other and from the barrier 29 to the bottom edge of the rear wall 13 of the bowl. A double-wall floor panel 97 normally spanning this bottom opening, as best shown in Fig. 3, is part of a dumping cradle, generally designated 98, (the dumping cradle including two triangular side plates 99 that lie closely adjacent to the corresponding side walls 11 of the scraper bowl. For strength, the edges of the side plates 99 may be bent to form inclined marginal flanges 100. The cradle 98 is rotatively carried by a pair of pivot pins 101 that extends through the material of the corresponding side walls 11 of the scraper bowl and through adjacent portions of the frame member 15. Preferably, the curvature of the rear wall 13 of the scraper bowl has the same axis as the two pivot pins 101 so that the rear edge of the floor panel 97 will follow the bowl wall 13 to loosen earth therefrom when the cradle is rocked rearward to release earth from the storage compartment 31. It will be further noted, as best shown in Fig. 1, that the marginal flanges 100 of the triangular side plate 99 of the cradle are disposed to scrape away any material adhering to the bowl walls 11, such scraping action being part of the cradle operation.

While any suitable means may be provided for actuating and controlling the cradle 98, I prefer to use a second pair of hydraulic jacks 103 mounted on the opposite outer side of the scraper bowl 10. Each of the hydraulic jacks 103 is pivotally mounted on a bracket plate 104 and is connected to a pair of hydraulic lines 105. Forwardly-extending piston rods 106 of the hydraulic jacks are pivotally connected to corresponding pins 107 that extend outwardly from each of the cradle side plates 99 through suitable arcuate slots 108 in the side walls 11 of the scraper bowl. Both the hydraulic jacks 103 for operating the dumping cradle 98 and the previously-mentioned hydraulic jacks 64 for operating the scraper blade 41 are energized by power means to which the scraper is coupled and are subject to remote control by suitable valves (not shown) within reach of the tractor operator, a plurality of hydraulic conduits 110 interconnecting the tractor and scraper for such purpose.

The operation of my invention may be readily understood from the foregoing description. In the normal digging disposition of the various movable parts, best shown in Fig. 3, the blade 41 is at its lowermost position to dig into the soil. The chocker box 77 is relatively close to the ground level and is disposed to facilitate crowding of the loosened earth into the receiving compartment 30. When a substantial quantity of earth accumulates in the receiving compartment, as

shown diagrammatically in Fig. 6, the driver will cause a loading operation to be carried out. The driver may stop the forward movement of the scraper if it is important to have the digging path continuous or he may keep the scraper in motion to build up momentum for a new digging operation. To initiate the loading operation, the operator manipulates a valve control to cause the hydraulic jacks 64 to retract the piston rods 66, whereupon the toggle links 53 are drawn backward to swing the scoop assembly 40 upward and backward. The scraper blade 41 lifts the contents of the receiving compartment 30 bodily over the barrier 29, the rearmost position of the blade, as indicated at 70 in Fig. 1 and shown diagrammatically in Fig. 7, being such as to cause substantially all the earth carried thereby to drop into the storage compartment 31.

After a few loading operations, the storage compartment 31 accumulates a capacity load and the final loading operation will consist merely in lifting the scraper blade 41 sufficiently to close the lower end of the receiving compartment 30 effectively without causing any substantial displacement of the earth upward in the receiving compartment. Although this final closing movement of the scraper blade 41 is not extensive, the operative connection with the chocker box 77 is such that the closing movement of the blade causes the chocker box to swing upward and the scraper is then ready to transport a capacity load to a dumping area, the disposition of the various movable parts being as indicated diagrammatically in Fig. 8.

To release the material from the storage compartment 31 at the dumping ground, the operator manipulates the proper valve control to cause the hydraulic jacks 103 to retract the piston rods 106, thereby causing the cradle 98 to swing rearward as diagrammatically shown in Fig. 9. It is to be particularly noted that this rearward rocking of the cradle 98 provides an exceptionally extensive opening immediately under the center of mass of the earth piled in the storage compartment 31, so that the weight of the material has maximum effect on expediting the discharge from the scraper bowl. It is to be further noted that the depth to which the discharged material is spread on the dumping ground is determined by the extent to which the cradle is rocked. It is apparent from an inspection of Fig. 3 that initial movement of the cradle to the rear causes the leading edge of the floor panel 97 to approach the ground level, but that, in the latter part of the cradle movement, the leading edge of the cradle increases its distance from the ground level. Adjustment of the depth to which the material is spread may be controlled, then, either within the earlier range of cradle movement in which the leading edge of the floor panel approaches the ground level or in the later range in which the leading edge retreats from the ground level. Preferably, the cradle is moved to operate in the latter range to provide an opening of maximum effective size for gravitation of the material to the ground, such a large opening being especially advantageous for sticky soil that will not spread thin easily. Thus, for spreading the discharged earth in a relatively thin layer, the floor panel 97 may be swung to an intermediate position 111, shown in dashed line in Fig. 3, and for spreading a layer of maximum thickness may be swung upward completely into the bowl to the dashed line position 112. When the storage compartment 31

is empty or nearly empty, the operator energizes the hydraulic jacks 64 to swing the scraper blade 41 upward for the purpose of transferring to the storage compartment 31 that portion of the load that was transported to the dumping ground in the receiving compartment 30. At the end of the dumping operation, the operator causes the various parts to return to the traveling positions shown in Fig. 8, and the scraper is returned to the excavation area to repeat the ground-moving cycle.

My disclosure in specific detail of the preferred form of my invention to illustrate the principles involved will suggest to those skilled in the art various changes, modifications, and substitutions that do not depart from my underlying inventive concept, and I reserve the right to all such alterations that properly come within the scope of my appended claims.

I claim as my invention:

1. An earth-moving machine of the character described having in combination: walls forming a relatively large scraper bowl having a forward bottom opening; and a scraper blade adapted to dig earth and to divert the loosened earth upward through said opening, said blade being mounted on pivot means spaced rearward from said opening and being adapted to swing upward and rearward through said opening into the interior of said bowl to displace accumulated earth rearward from said opening, one of said walls conforming to the arcuate path of the outer swinging edge of said blade, and another of said walls conforming to the inner swinging edge of said blade to prevent the escape of any substantial quantities of earth past said edges as the blade is swung upward past said opening.

2. In an earth-moving machine of the character described, the combination of: a bowl having a bottom opening to receive earth; a scraper blade pivotally movable from a digging disposition below said bowl into a position closing said opening; and a baffle means yieldingly mounted forward of said opening to cooperate with the swinging leading edge of said scraper blade in closing said opening.

3. A combination as set forth in claim 2 in which said baffle means is of a configuration to extend forward as well as downward from said opening to divert loosened earth into the opening when said blade is in digging disposition.

4. In an earth-moving machine of the character described, the combination of: a bowl having a bottom opening to receive earth; a scraper blade pivotally movable from a digging position below said bowl into a position closing said opening; means movably mounted on said bowl adjacent the front edge of said opening to cooperate with said blade to direct earth into said opening; means to move said blade upward to close said opening; and automatic means to elevate said movably mounted means to a ground-clearing position when said blade is lifted to close said opening for transportation of a load in the bowl.

5. In an earth-moving machine of the character described, the combination of: a bowl having a forward bottom opening; a scraper blade adapted to take a lower position below said opening to dig earth, or an intermediate position to close said opening, or to move to an uppermost position to displace accumulated earth from above said opening; means movably mounted on said bowl adjacent the front edge of said opening to cooperate with said blade in directing earth

into said opening; power-actuated means to lift the blade from said lower position either to said intermediate position or to said uppermost position; and automatic means to elevate said movably mounted means for ample ground clearance when said blade is elevated to said intermediate position to close said opening for load transportation.

6. In an earth-moving machine of the character described, the combination of: a scraper bowl having a forward bottom opening and a rearward bottom opening; a transverse barrier across said bowl between said openings dividing the bowl into a receiving compartment and a storage compartment; a scraper blade adapted to take a lower position below said forward opening to dig earth, or an intermediate position to close said forward opening for transportation, or to move to an uppermost position to force the content of said receiving compartment over said barrier into said storage compartment; means normally covering said rearward opening and movable therefrom to permit dumping there-through; and power means to move said scraper blade and covering means.

7. An earth-moving machine of the character described having in combination: a storage compartment; a vertically extensive transverse wall spaced forward from said storage compartment; side walls extending forward from said storage compartment to said forward transverse wall; an upwardly extending rearwardly curving wall between said side walls and spaced rearward of said first-mentioned wall, said curving wall leading to said storage compartment; a bottom wall extending forward from said curving transverse wall, said two transverse walls, said side walls, and said bottom wall forming a receiving compartment forward of said storage compartment, said bottom wall being adapted for digging and diverting earth into said receiving compartment; and power-actuated means to lift said bottom wall to carry material up the forward face of said curving transverse wall into said storage compartment.

8. An earth-moving machine of the character described having in combination: a storage compartment; a first transverse wall spaced forward from said storage compartment, said transverse wall being curved with an axis of curvature rearward therefrom; side walls extending forward from said storage compartment to said transverse wall; a second transverse wall spaced rearward of said first transverse wall and forward of said axis, said second transverse wall being curved concentric to said axis; a bottom wall extending forward from said second transverse wall, said first and second transverse walls, said side walls, and said bottom wall forming a receiving compartment, said bottom wall being movable upward between said transverse walls and between said side walls in a path concentric to said axis to transfer material from said receiving compartment to said storage compartment; scraper means at the forward edge of said bottom wall; and power-actuated means to move said bottom wall upward periodically.

9. An earth-moving machine of the character described having in combination: a receiving compartment having front, rear, and side walls; a separate storage compartment having front, rear, and side walls; a movable scraper blade normally at the bottom of said receiving compartment in a position to direct earth from below into said receiving compartment; and power

means to move said scraper blade periodically upward into said receiving compartment to transfer earth from the receiving compartment to said storage compartment.

10. An earth-moving machine of the character described having in combination: a receiving compartment closed at the sides and open at the top; an adjacent storage compartment open at the top; a barrier separating said compartments; a relatively movable lower wall normally in a fixed position forming the bottom of said receiving compartment adapted to move upward to displace earth in the receiving compartment over said barrier into said storage compartment; and power means to actuate said movable wall periodically when earth accumulates in said receiving compartment to substantially fill the receiving compartment.

11. An earth-moving machine of the character described having in combination: a receiving compartment having a rear wall, side walls, and an upwardly and rearwardly curving front wall; a storage compartment to the rear of said receiving compartment; a scraper blade positioned to serve as a bottom wall of said receiving compartment, said scraper blade being mounted to swing upward in a rearwardly curved path along the inner face of said front curved wall of the receiving compartment to move material from the receiving compartment into said storage compartment; and power means to actuate said scraper blade.

12. An earth-moving machine of the character described having in combination: a scraper bowl having a bottom opening; a scraper blade adapted to dig earth and crowd the loosened earth upward through said opening; means pivotally supporting said blade from a point spaced from said opening and adapted to carry said blade in an arcuate path upward through said opening into the bowl to displace earth accumulated above the opening; and wall means separating the path of movement of said blade-supporting means from the interior of said bowl to prevent earth in the bowl from interfering with the pivotal movement of said blade-supporting means.

13. An earth-moving machine of the character described having in combination: a scraper bowl having a bottom opening; a blade normally in a digging position below said bowl to crowd earth upward through said opening; movable means supporting said blade and adapted to carry the blade bodily upward through said opening to displace accumulated earth from above said opening; and walls adjacent the edges of said blade conforming to the path of said upward movement to prevent any substantial quantity of earth to escape downward past the upward moving blade after the blade passes through said opening, one of said walls serving as a barrier to divide the bowl into a receiving compartment and a storage compartment.

14. In an earth-moving machine, the combination of: a bowl having a bottom opening; a

scraper blade pivotally movable from a digging position upward through said opening into the bowl to displace earth accumulated above the opening; a toggle-linkage operatively connected to said scraper blade for raising and lowering the blade, said toggle-linkage being above the digging position of the scraper blade and adapted to take a position of maximum leverage when said blade is in digging position whereby the toggle-linkage prevents chattering of the blade during digging operation; and power means to actuate said toggle-linkage and thereby said blade.

15. An earth-moving machine as set forth in claim 14 in which said toggle mechanism includes an arm pivoted to swing about a fixed axis near its upper end, and includes a link pivoted to the lower end of said arm, said link being connected to said blade, and in which said power means exerts its actuating force rearward to raise the blade.

16. An earth-moving machine of the character described having in combination: a storage compartment; a vertically extensive transverse wall spaced forward from said storage compartment; side walls extending forward from said storage compartment to said transverse wall; an upwardly and rearwardly extending transverse wall between said side walls and spaced rearward from said first-mentioned transverse wall, said upwardly and rearwardly extending transverse wall leading to said storage compartment, said two side walls and said two transverse walls forming a receiving compartment forward of said storage compartment; a blade element disposed to loosen earth from the ground towards the forward end of said receiving compartment; wall means rearward of said blade element normally disposed to serve as a bottom for said receiving compartment and to direct earth loosened by said blade element into the receiving compartment, said wall means being movable upwardly; and power means operatively connected to said wall means to lift the wall means and thereby force earth up said upwardly and rearwardly extending transverse wall into said storage compartment.

17. In an earth-moving machine, the combination of: a bowl having a bottom opening; a scraper blade pivotally movable from a digging position upward through said opening into the bowl to displace earth accumulated above the opening; a toggle-linkage operatively connected to said scraper blade for raising and lowering the blade, said toggle-linkage being above the digging position of the scraper blade and adapted to take a position of maximum leverage against said blade when the blade is in digging position; and a hydraulic ram adapted to actuate said toggle-linkage for raising and lowering the blade and adapted to exert continuous pressure on the toggle-linkage at the lower position of the blade to prevent chattering of the blade during digging operation.

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