# United States Patent

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[73] Assignee **said Bispo by said Perra**


[54] **EJECTION SYSTEM FOR ELEVATOR SCRAPER**
**3 Claims, 14 Drawing Figs.**


[52] **U.S. Cl.** ..... **37/8,** 37/129
[51] **Int. Cl.** ..... **B60p 1/36**
[50] **Field of Search** ..... 37/7, 8, 124, 126 A, 129



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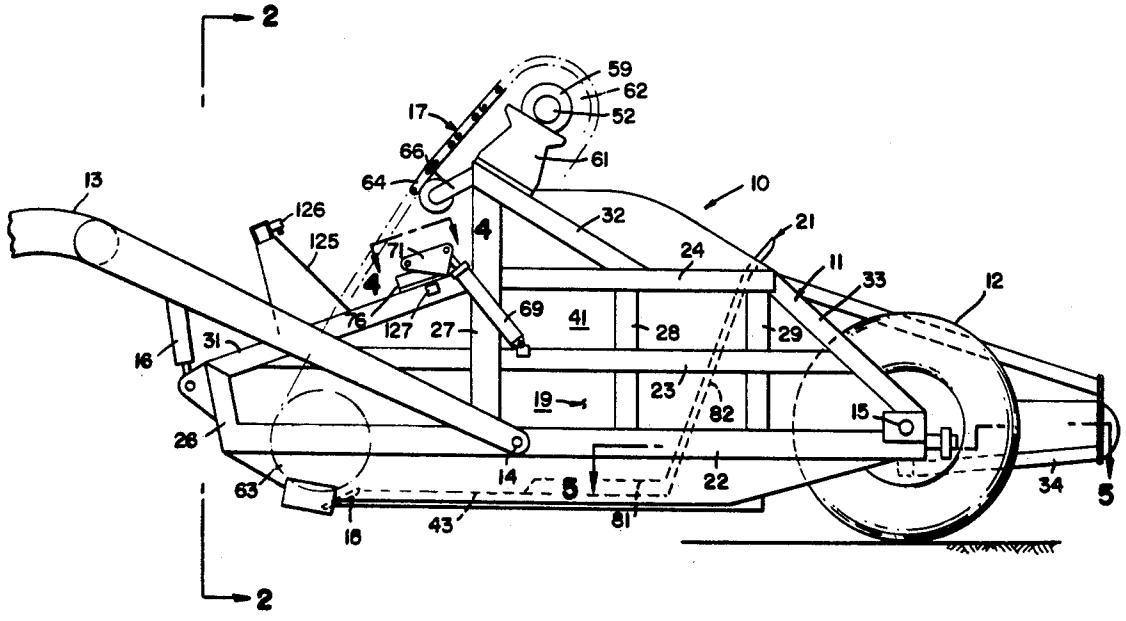
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**ABSTRACT:** A bowl-equipped earth-moving machine having an endless conveyor with its lower end disposed adjacent an earth cutting blade is disclosed. A fixed floor portion is arranged immediately rearwardly of the blade and a rolling floor portion with an upstanding ejection gate is arranged to first move together over the fixed floor followed by the ejection gate moving over the rolling floor for expelling earth from the bowl when the lower end of the endless conveyor is shifted to an out-of-the-way position. Fluid power is employed to drive and shift the endless conveyor and to power the earth-expelling mechanism. Interlocks are included in the fluid power circuit to prevent earth expelling prior to placing the conveyor in its out-of-the-way position and a resilient safety mechanism is arranged on the conveyor to permit sudden upward movements when the conveyor encounters large, hard to move objects.

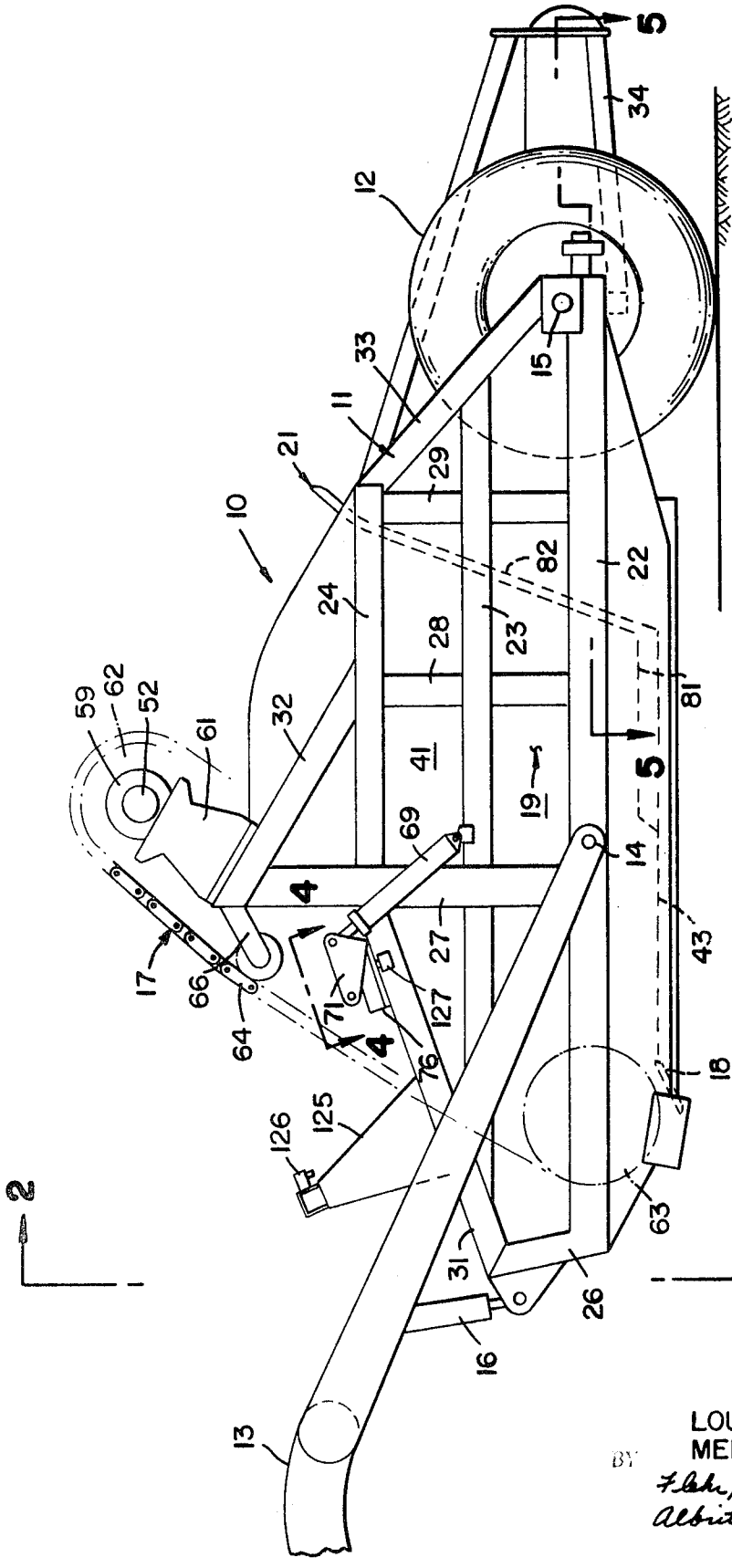



FIG_1

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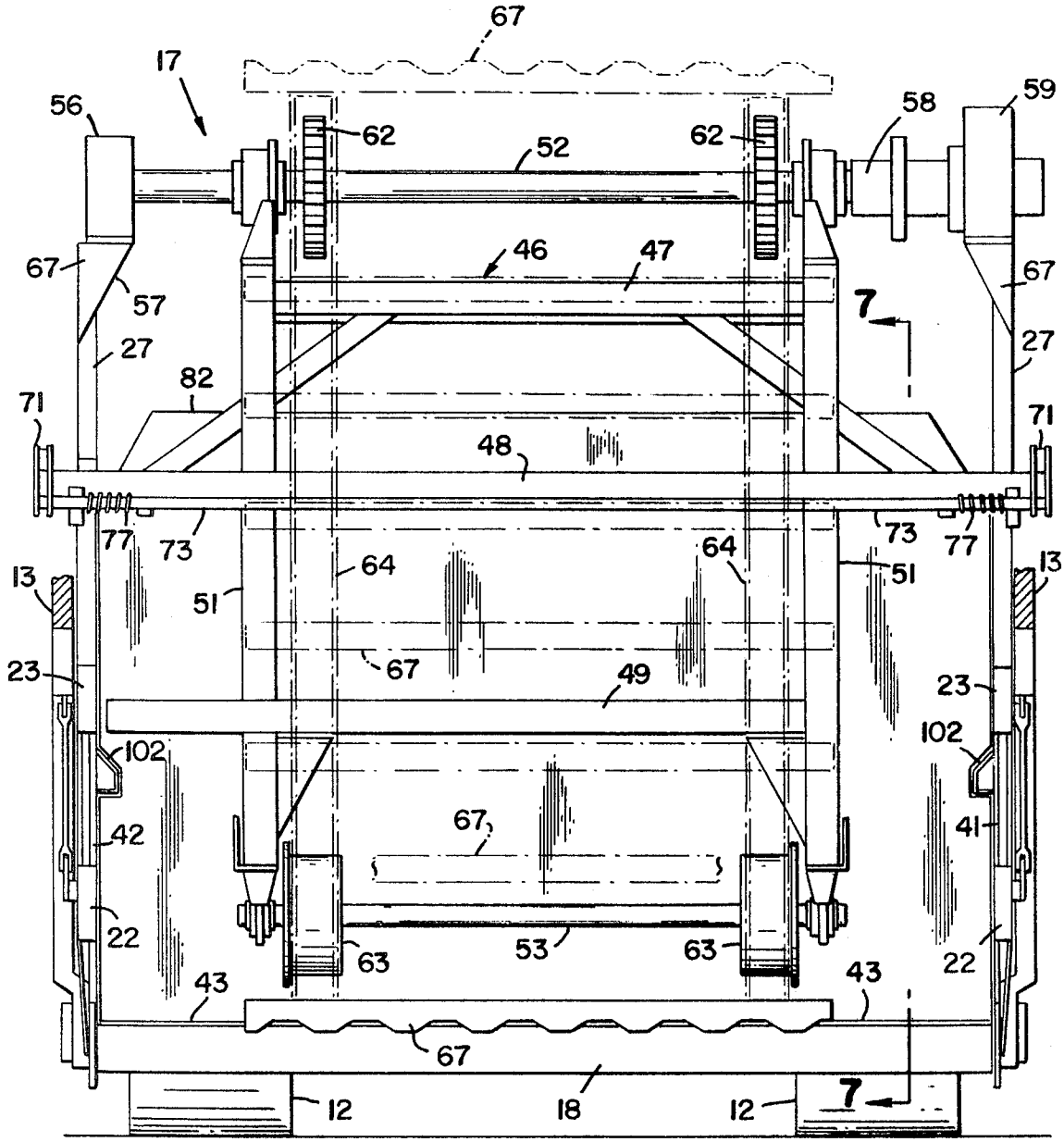



FIG_2

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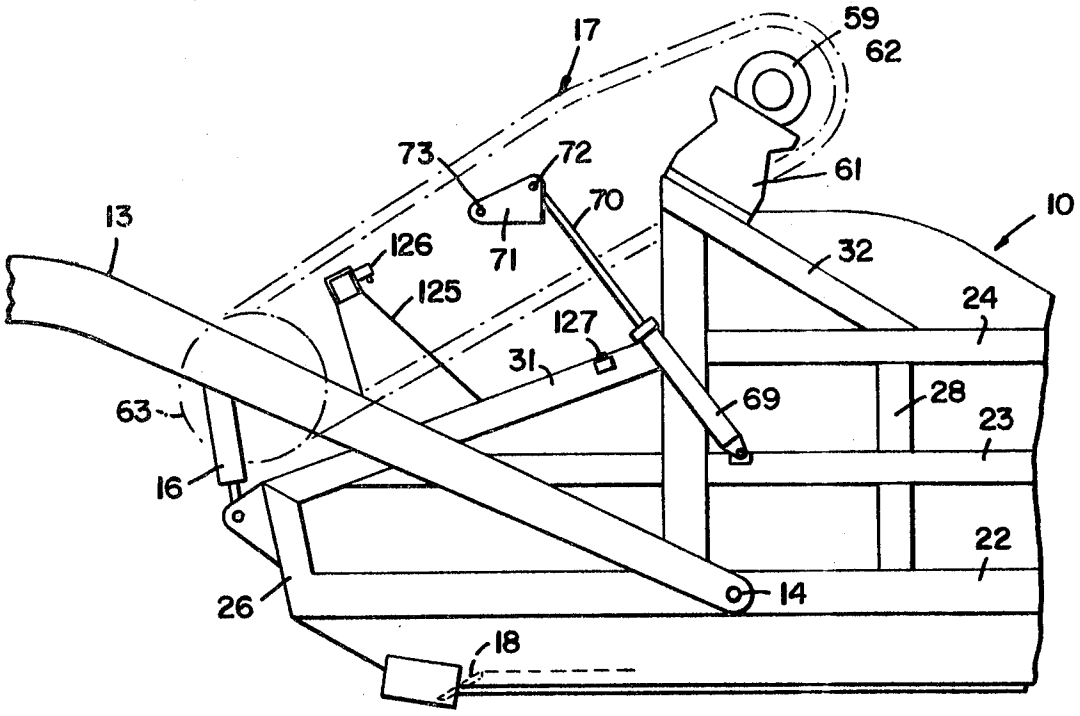



FIG_3

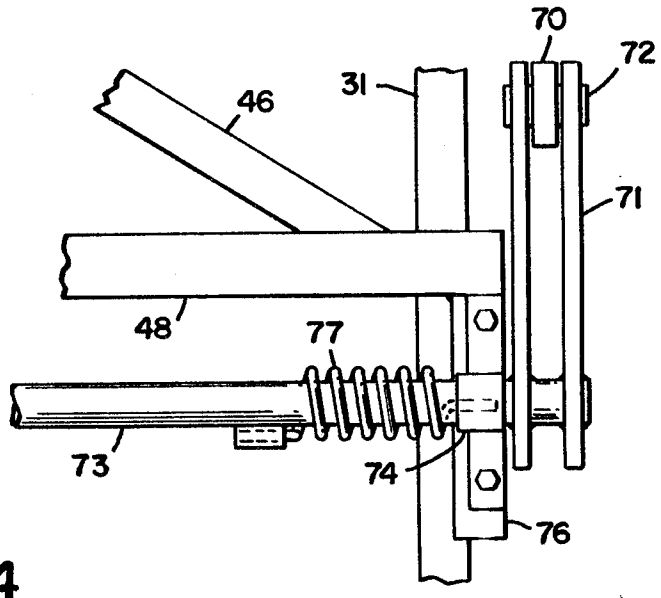



FIG_4

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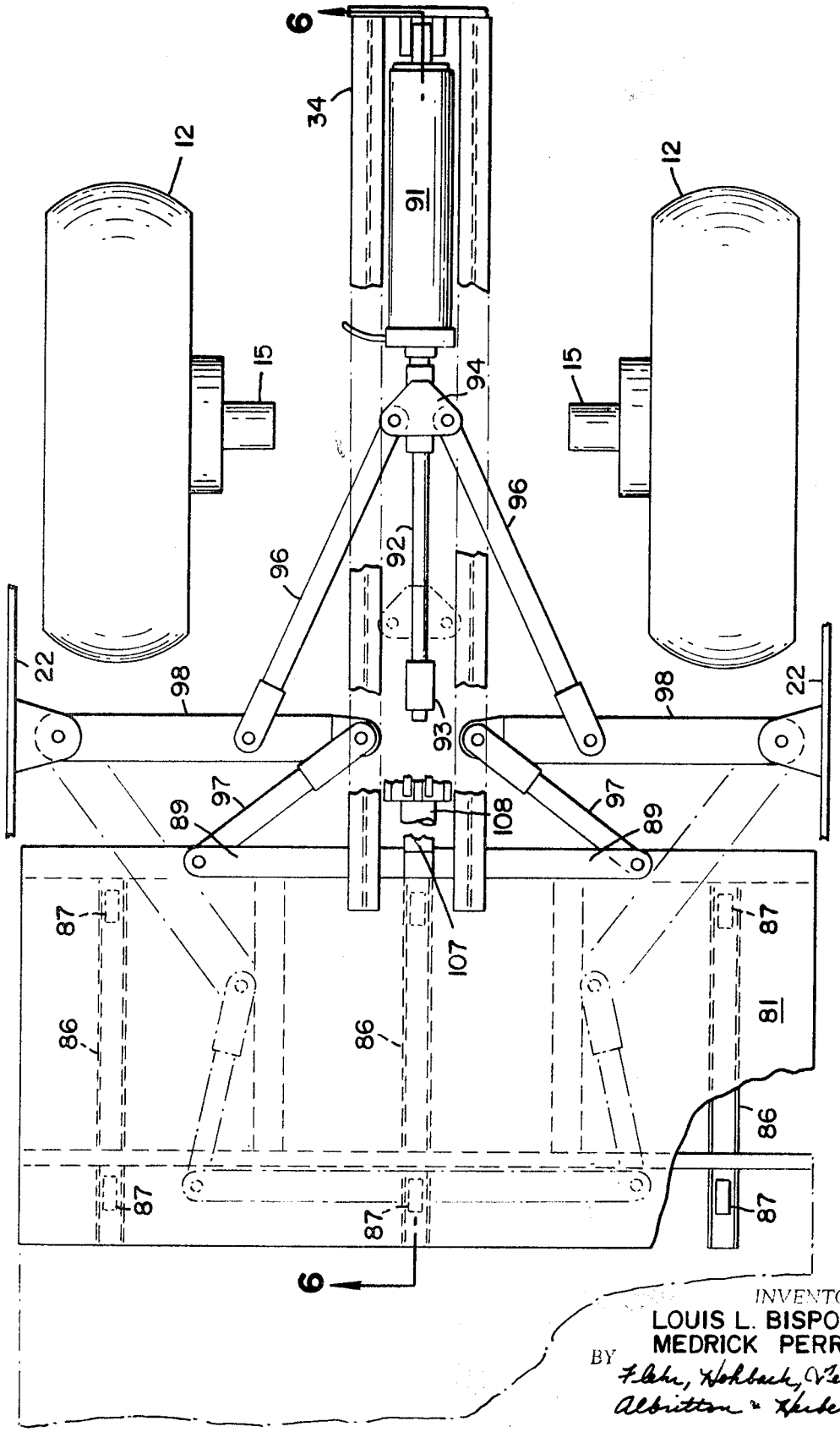



FIG_5

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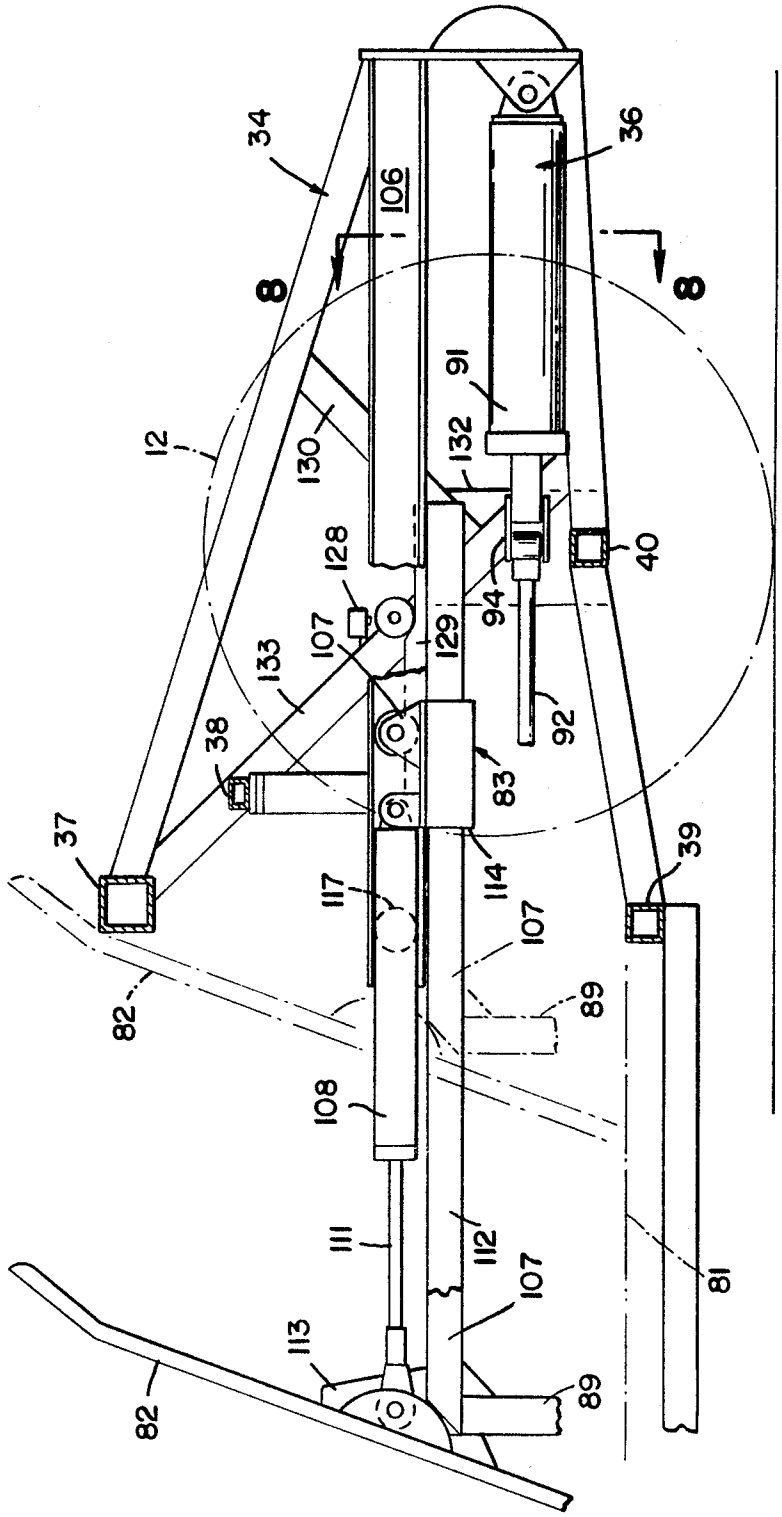
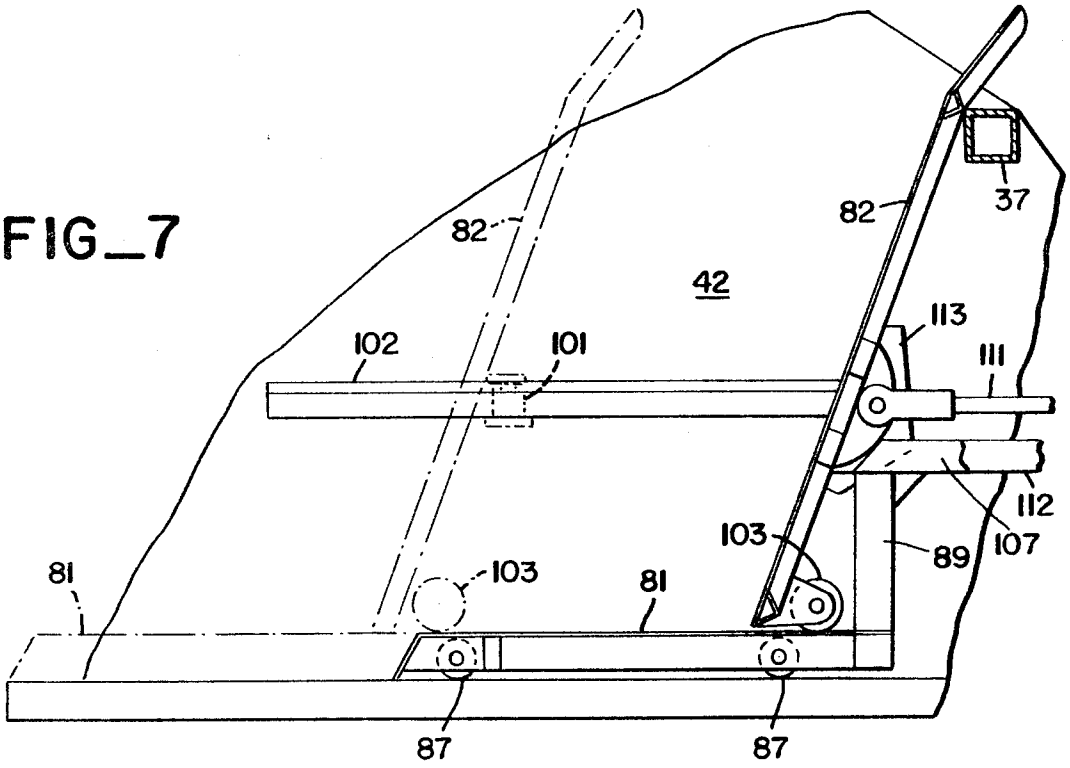



FIG_6

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FIG_7



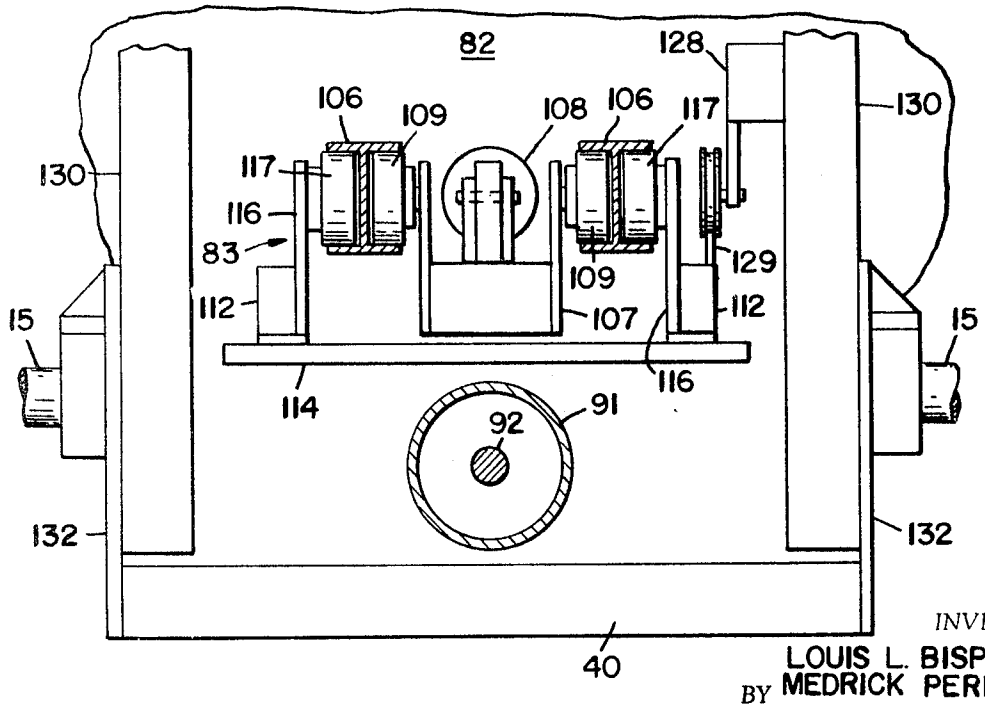




FIG_8

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FIG_10

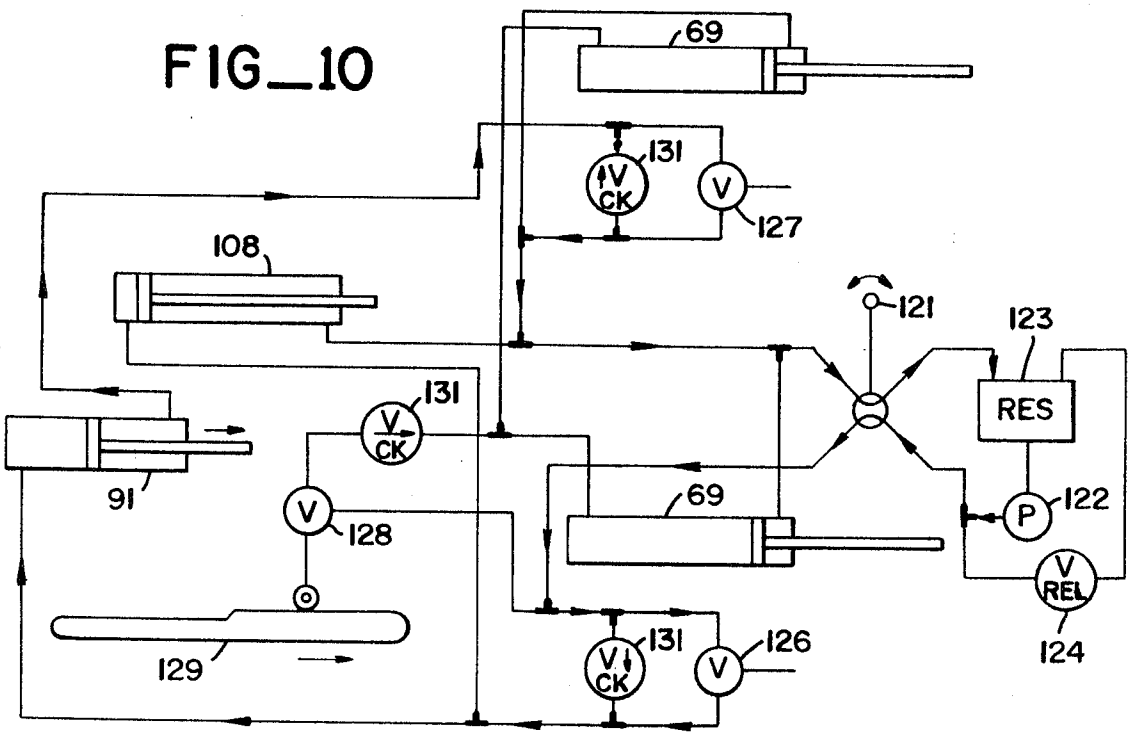
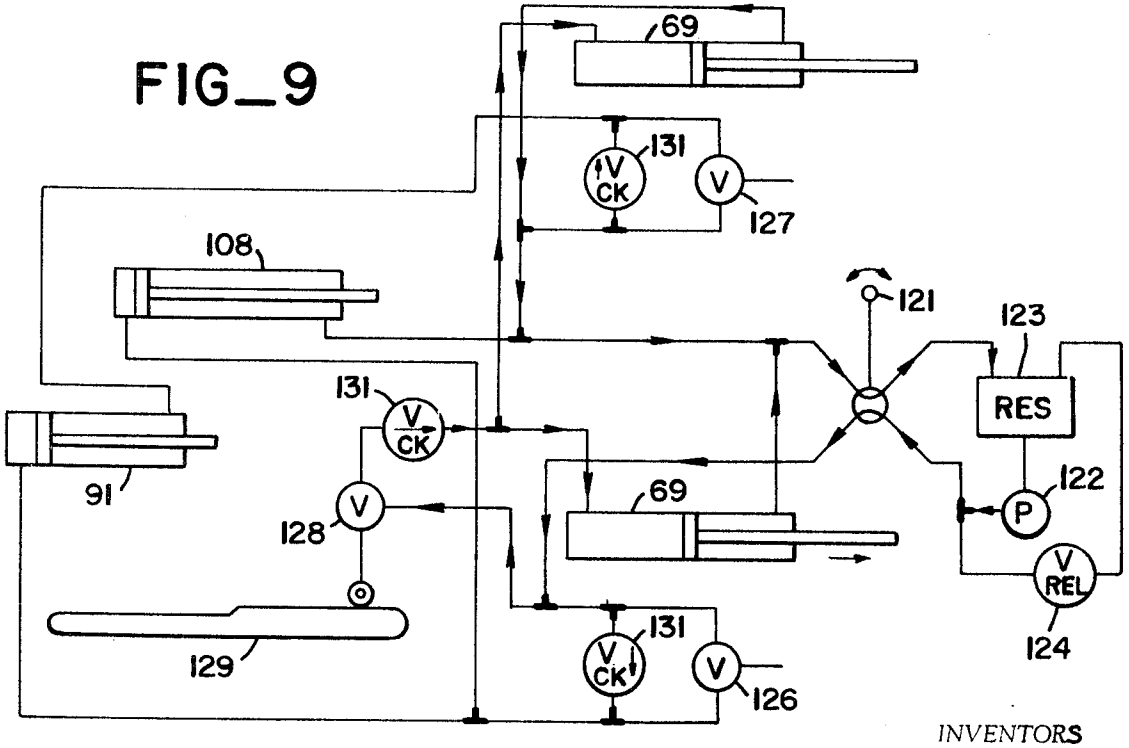



FIG_9




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FIG_12

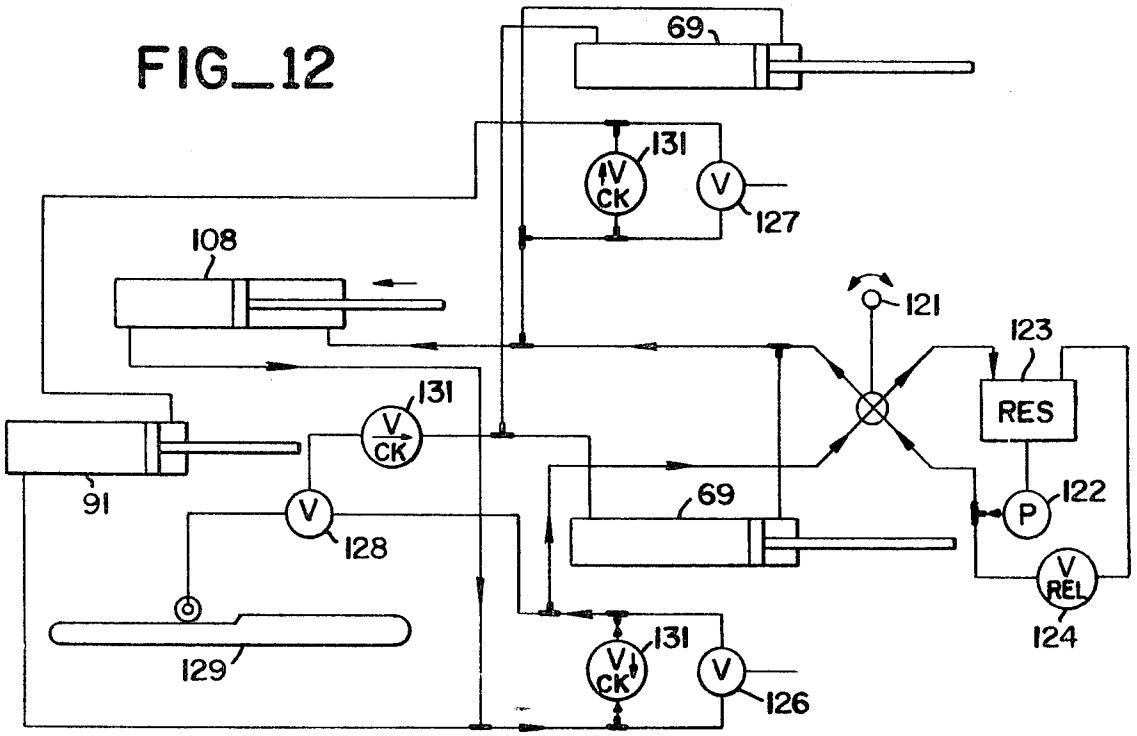
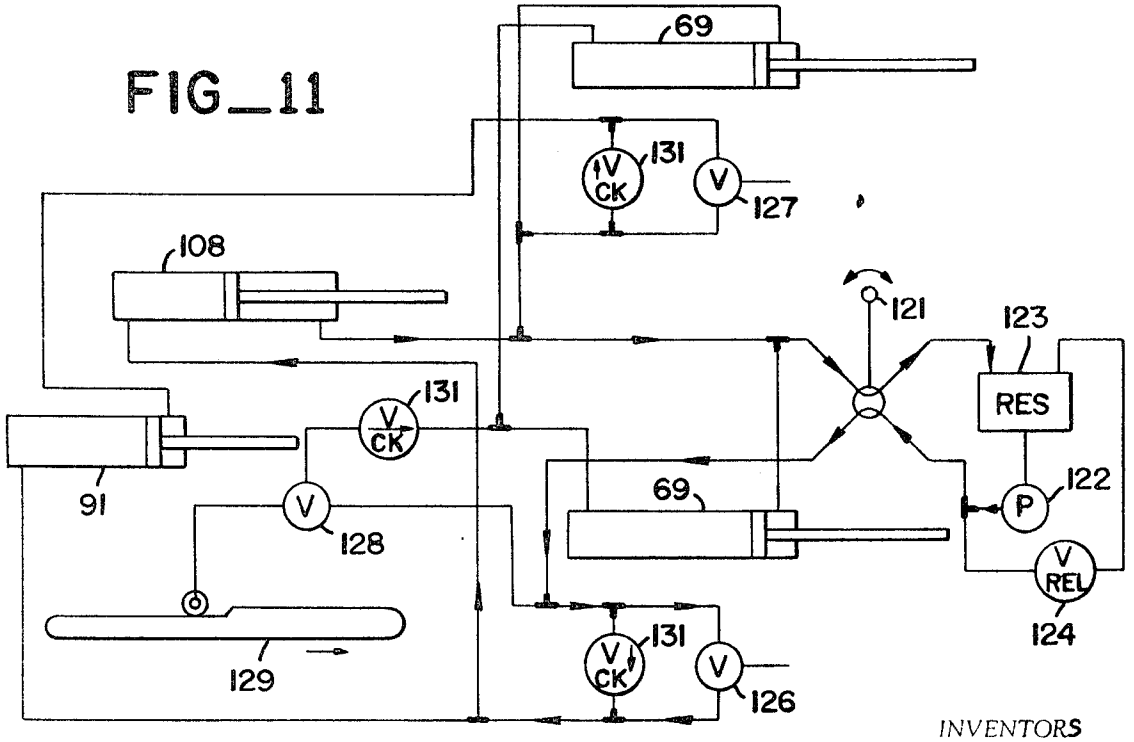



FIG_11




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FIG_14

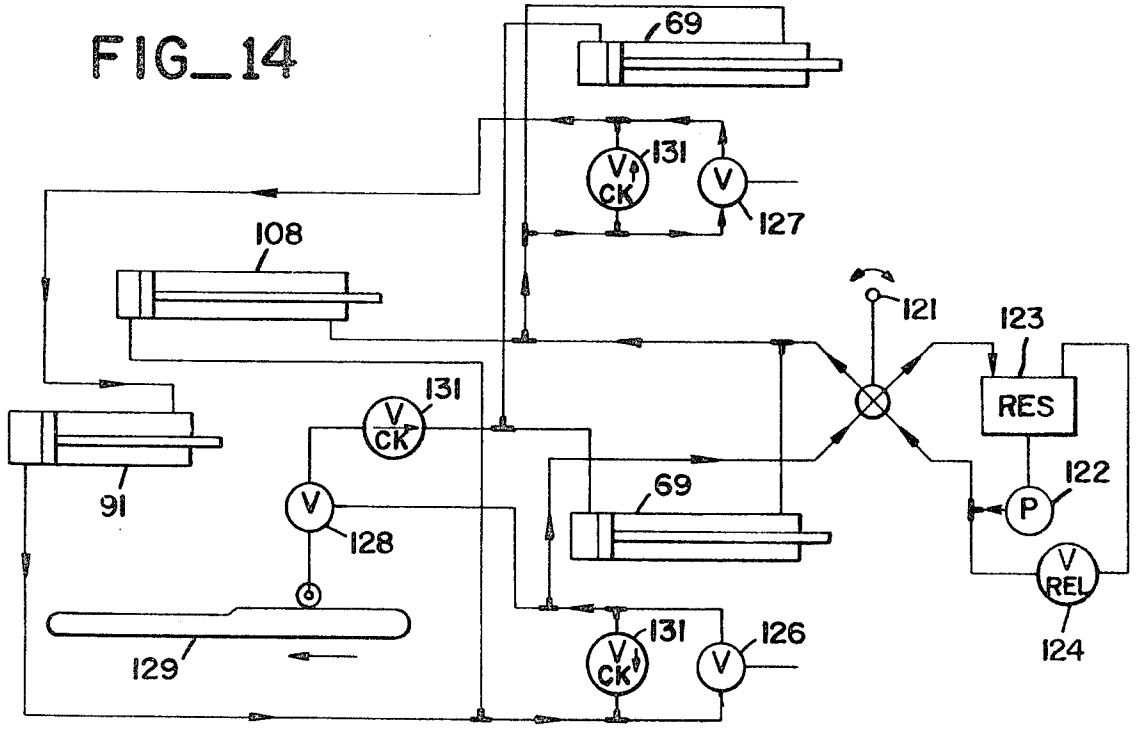
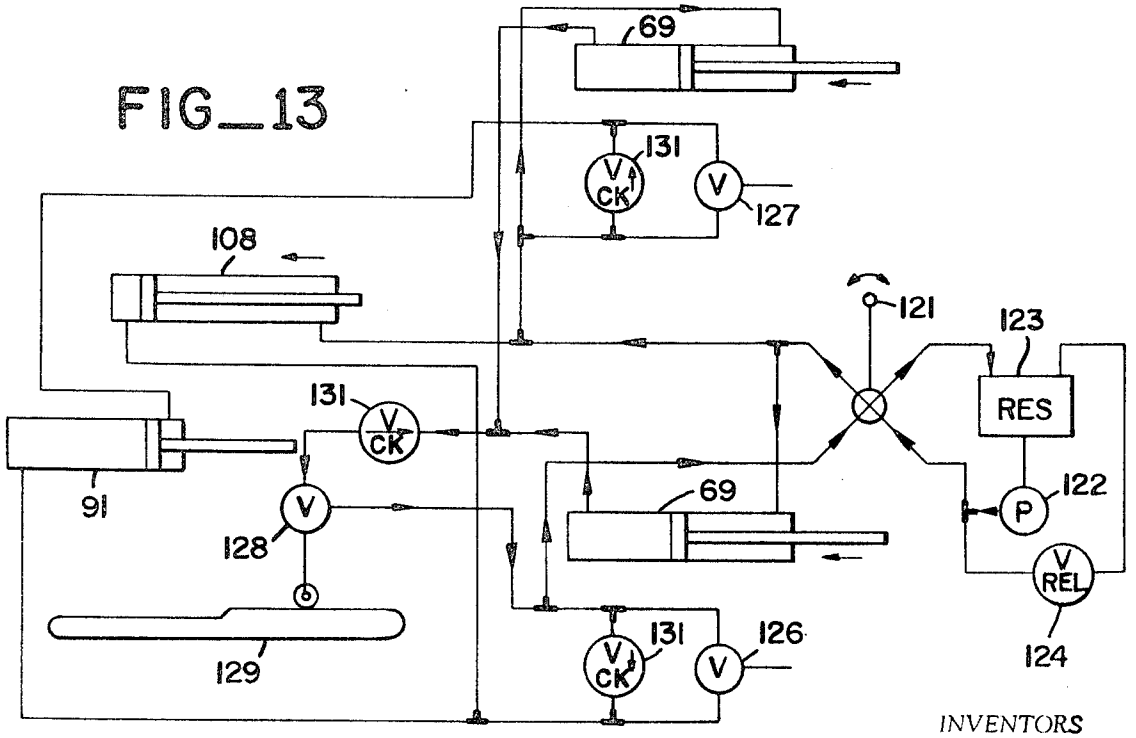



FIG_13




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# EJECTION SYSTEM FOR ELEVATOR SCRAPER

## BACKGROUND OF THE INVENTION

This invention pertains to an improved elevator scraper having forced ejection of earth from a scraper bowl over the scraper blade.

Elevator scrapers are well known in the art, both those which are of the bottom unloading type and those of the front unloading type as shown respectively in U.S. Pats. No. 2,988,832 issued June 20, 1961 to J. E. Hancock et al. and 2,956,353 issued Oct. 18, 1960 to A. W. Hanner et al. However, in the prior art elevator scrapers loading of the scraper bowl was not in all cases efficient in that the elevator, an endless conveyor, and the earth-receiving portion of the bowl were positioned in a fixed relationship with respect to each other during the earth-loading operation. Thus, the elevator would generate a mound of earth within the bowl, the mound sloping from its peak to the bowl sidewalls. It has not been possible to load the bowl evenly and fully to capacity with prior elevator scraper structures.

In an elevator scraper wherein earth is forcibly ejected from the scraper bowl over the earth-cutting blade, it is desirable to provide for removing the proximately positioned elevator conveyor to an out-of-the-way position during ejection while yet providing the elevator with a mounting which will permit abrupt, sudden upward movement when large, difficult to move objects are encountered so as to preclude damage to the elevator. By way of contrast, in bottom unloading elevator scrapers, such as shown in U.S. Pat. No. 3,048,934, issued Aug. 14, 1962, to J. E. Hancock, the elevator during earth ejection is not moved to an out-of-the-way position, but rather remains mounted in a substantially fixed position and does not interfere with the operation of earth unloading through the bottom of the scraper. In this type of scraper it is practical to include elevator mounting structures secured to the lower portion of the elevator and to arrange a safety device with the low positioned mounting structure, all of which may be positioned closely adjacent to the scraper blade. In scrapers having forced unloading over the blade this arrangement is not practicable.

## SUMMARY OF THE INVENTION AND OBJECTS

In summary, this invention is an improved earth moving machine which includes a bowl structure with spaced sidewalls and a forward earth cutting blade extending between the sidewalls. A floor section is fixedly secured with respect to the sidewalls rearwardly adjacent the cutting blade, and an earth ejection apparatus is provided which is movable over the fixed floor section from a rearwardly disposed earth holding position to a forwardly disposed earth expelling position. The earth ejection apparatus includes a rolling floor and an ejection gate movable across the rolling floor for expelling earth therefrom. Fluid power means are mounted on the earth ejection apparatus for shifting the ejection gate across the rolling floor, the power means being operable to retract the ejection apparatus incrementally to the rear position to permit full loading of the bowl by the endless conveyor.

An object of this invention is to provide in an elevator scraper an improved earth loading and ejection mechanism.

Another object of the invention is to provide in an elevator scraper an improved safety mechanism for the elevator or endless conveyor.

Another object of the invention is to provide in an elevator scraper an improved arrangement for ejecting earth therefrom whereby in the sequence of earth ejection the elevator conveyor is moved to and held in an out-of-the-way position until the earth ejection cycle is completed.

Another object of the invention is to provide in an elevator scraper having forced over-the-scraper-blade earth ejection from the scraper bowl an improved arrangement permitting the scraper bowl to be loaded to full capacity.



These and other objects and advantages of the invention will become apparent in the following description taken in connection with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational side view of the elevator scraper of the present invention;

FIG. **2** is an enlarged transverse sectional view in the direction of the arrows **2–2** of FIG. **1**;

FIG. **3** is a fragmentary elevational view, like FIG. **1**, and showing in broken lines an endless conveyor structure with its lower end disposed in an elevated condition;

FIG. **4** is an enlarged sectional view in the direction of the arrows **4–4** of FIG. **1** and showing structures safeguarding the endless conveyor during impacts with hard to move objects;

FIG. **5** is a fragmentary longitudinal sectional view in the direction of the arrows **5–5** of FIG. **1** and showing an earth ejection apparatus and linkage in the present invention;

FIG. **6** is a vertical sectional view in the direction of the arrows **6–6** of FIG. **5**;

FIG. **7** is a detailed, fragmentary vertical sectional view in the direction of the arrows **7–7** of FIG. **2** and showing in broken lines the earth ejection position of the rolling floor and ejector gate;

FIG. **8** is an enlarged detail, vertical sectional view in the direction of the arrows **8–8** of FIG. **6**;

FIGS. **9—14** are diagrammatic views of the hydraulic system showing schematically the positions of the various hydraulic cylinders and valves in the course of the earth expelling and return cycles.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

One embodiment of the invention is present in the elevator scraper **10** shown in FIG. **1**. The earth-moving machine or scraper **10** includes a frame **11** having mounted at the rear thereof rubber tire equipped wheels **12** upon axles **15**. A yoke **13** is connected to the frame **11** at a pivot **14** and a pair of bowl lift cylinders **16** are provided at the forward end of the frame for varying the angle of attack of a fixed scraper cutting blade **18** with respect to the earth. The end of the yoke (not shown) may be mounted directly to a prime mover such as a tractor. On the other hand, the end of the yoke may be mounted upon a wheeled dolly which in turn is connected to the prime mover and both of these means of attachment are well understood in the earth moving art.

The scraper **10** is also equipped with an elevator **17** in the form of an endless conveyor, mounted for moving earth from the scraper blade **18** into a scraper bowl **19** which has arranged therein a positive earth expelling mechanism **21** for urging the earth from the bowl over the fixed scraper blade **18**.

The frame **11** of the scraper is composed of structural members including the longitudinally extending frame members **22, 23** and **24**, which are interconnected to the upstanding frame members **26, 27, 28** and **29**, and the obliquely disposed members **31, 32** and **33**. Referring to FIG. **6**, a rearward extension **34** of the frame which includes frame members **130, 132** and **133** is provided for mounting an earth ejection power mechanism **36** and the wheel axles **15** (FIG. **8**). Suitable cross-members **35, 37—40** are arranged on the frame to provide a rigid structural unit.

The bowl **19** of the scraper includes the spaced-apart sidewalls **41** and **42**, FIG. **2**, a fixed floor portion **43** which extends rearwardly of the scraper blade **18**.

The earth-expelling mechanism **21** which is shiftable over the fixed floor section **43** defines the rear wall and rear floor portion of the bowl.

## ELEVATOR

The elevator **17**, comprising an endless conveyor, is shown in FIGS. **1—4**, and is mounted for pivotal movement about an elevated axis such that the lower end or run of the conveyor may be moved from a position proximate the scraper blade **18**,

shown in FIG. 1, to an out-of-the-way, elevated position shown in FIG. 3 during earth-expelling operations of the scraper or when the scraper is being used in operations wherein the elevator is not needed.

The elevator 17 is provided with a frame 46 including the cross members 47—49, each being rigidly connected to a spaced pair of side members 51 at the upper ends of which is mounted a power shaft 52. At the lower ends of the side members there is journaled a conveyor idler shaft 53. One end of the power shaft 52 is journaled in a pillow block 56 mounted on a pedestal 57 fixedly secured to the vertical frame member 27. The other end of the power shaft 52 is connected to a breakaway clutch 58 which in turn is connected to a suitable motor 59, such as an hydraulic motor arranged to receive fluid power from a pump provided on the tractor which pulls the scraper 10. The motor 59 is mounted upon a pedestal 61 arranged on the vertical frame member 27. A pair of drive sprockets 62 are secured to the power shaft 52 and flanged idler rollers 63 are suitably arranged on the idler shaft 53. Over each set of sprockets and rollers 62, 63 there is threaded the endless chains 64 which are maintained at a desired tension by a chain tensioning mechanism 66, FIG. 1. A plurality of flights 67, generally "L" shaped in cross section, extend across the elevator frame 46 and are attached to the pair of endless chains 64 so that as the chains are driven through the drive sprockets 62 by the motor 59, the flights traverse the conveyor moving towards, on the lower end, the scraper blade 18 so as to move earth therefrom rearwardly into the conveyor bowl. The flights 67 along their outer edge are scalloped in an alternate pattern reducing the contact area of the flight blade with the earth thereby reducing the power consumption for the endless conveyor, while at the same time removing earth at the desired rate from the zone of the scraper blade.

On each side of the frame 11 there is mounted an elevator power cylinder 69 serving to pivot the elevator about the axis of the shaft 52 so that the lower run of the conveyor may be moved from a working position proximate the blade 18, FIGS. 1 and 2, to an out-of-the-way position, FIG. 3, so that earth may be ejected from the bowl. Further it is desirable in certain scraper operations to have the elevator in an out-of-the-way position (i.e. to operate as an elevatorless scraper) and the present scraper is flexibly adapted to this end.

## ELEVATOR PROTECTIVE DEVICE

The lower end of each power cylinder 69 is mounted to the longitudinal frame member 23 and the cylinder rod 70 is pivotally connected to an end of a double-plate link member 71, through a pin 72, FIG. 4. The other end of the link 71 is rigidly secured, as by welding, to a transversely extending bar 73 similarly connected to the link 71 on the opposite side of the scraper, FIG. 2. Inwardly of each link 71, a pillow block 74 is rotatably mounted on the bar 73, the pillow block 74 being fixedly secured to a frame horn 76 which is rigid with the transverse elevator frame cross member 48.

As the elevator power cylinders 69 are extended from the retracted position of FIG. 1 to the position shown in fig. 3, the cylinder rods 70 move the elevator frame 46 upwardly through the link 71, bar 73, pillow block 74 and horn 76, these being an interconnected lifting unit. To permit rapid movement of the lower conveyor run away from the scraper blade 18 when a large, hard to move object is encountered and without applying lifting power to the elevator power cylinders 69, a resilient connection is provided between the elevator frame 46 and the power cylinder mechanism.

More specifically, referring to FIGS. 2 and 4, there is mounted about each end of the transverse bar 73 a coil spring 77, the inner end of which is anchored to the bar 73 and the outer end is anchored to the pillow block 74. Thus an upward thrust upon the lower run of the endless conveyor will be transmitted through the shaft 53 to the elevator frame 46 serving to move the pillow block 74 rotatably around the bar 73 against the bias of the spring 77. It will be understood that the link 71 is pivotally connected by the pin 72 to the cylinder rod 70 whereby the link will move angularly with respect to the rod 70 from its usual disposition. The cylinder rod 70 is retained in position during this event, which is quite rapid, by pressure within the cylinder 69. In this way the elevator may be shifted upwardly quickly in a much more rapid fashion than could be achieved by actuation of the power cylinders 69 thereby to protect from damage the endless conveyor 17.

## EARTH-EXPELLING MECHANISM

The earth-expelling mechanism 21 includes a rolling floor 81 movable over the fixed floor portion 43 and the upstanding ejector gate 82, movable over the rolling floor 81, FIGS. 5—7. The rolling floor and ejector gate are connected to a movable carriage operatively associated with the earth ejection power mechanism 36 disposed in the rear extension 34 of the frame.

Arranged longitudinally along the bottom of the scraper frame are three floor track-ways 86 the working surface of which is flush with the fixed floor section. The underside of the rolling floor 81 to roll with a full load of earth thereon in the track-ways 86 from a rear position shown in full lines in FIG. 7 to a forward position shown therein in broken lines.

Along the rear transverse edge of the rolling floor there is provided an upstanding strut 89 which serves as an anchor point for linkage extending between a rolling floor fluid power cylinder 91 the end of which is mounted to the frame extension 34, FIGS. 5 and 6. The rolling floor fluid power cylinder 91 includes an extra long cylinder rod 92 supported at the distal end by a guide 93. A yoke 94 is arranged for movement with the rod 92 as indicated in broken lines in FIG. 5.

The linkage for transferring power from the cylinder 91 to the strut 89 of the rolling floor includes a first pair of linkage arms 96 pivotally connected at one end of the yoke 94 and the second pair of linkage arms 97 pivotally connected at one end to the strut 89. An intermediate pair of linkage arms 98 are pivotally connected at their outer ends to the scraper frame as at member 22, the inwardly disposed ends of the intermediate arms 98 being pivotally connected to the second linkage arms 97. The first pair of linkage arms 96 are pivotally connected to the intermediate arms 98 at a point about one-third the distance from the inwardly disposed pivot points on the arm 98, shown best in FIG. 5.

The arrangement of linkage is such that in the retracted or rearwardly disposed position of the rolling floor, the linkage occupies a minimum of space as may be seen from the full lines of FIG. 5. On the other hand, the linkage is capable of extending the rolling floor and ejector gate forward a substantial distance, the linkage straightening out as indicated by broken lines in FIG. 5. It will be understood that the ejection gate, engaged by the strut 89 on the rear edge of the rolling floor, FIGS. 6 and 7, is carried forward with the rolling floor in response to movement of the cylinder rod 92.

## EJECTOR GATE MECHANISM

The ejector gate 82 is provided with guide rollers 101 along each side edge thereof which engage a track 102 extending longitudinally of the sidewalls 41, 42 of the bowl. FIGS. 2 and 7, to maintain the ejector gate in transverse alignment as it moves from a rearwardly disposed position adjacent the rear edge of the rolling floor to a forward position disposed proximate to the scraper blade 18. At the lower edge, the ejector gate 82 is equipped with wheels 103 to facilitate smooth movement over the rolling floor, FIG. 7.

To provide support and guidance for the movement of the carriage 83, the rear extension 34 of the frame is equipped with a spaced pair of longitudinally extending H-beams 106, FIGS. 6 and 8. Disposed between the carriage ways 106 is a rolling abutment 107 serving to carry an ejector gate power cylinder 108. The rolling abutment 107 is equipped with rollers 109, the abutment 107 being connected to the rolling floor at the strut 89 and movable therewith. It will be understood that the ejector gate power cylinder 108 is movable

with the rolling abutment, the cylinder **108** including a cylinder rod **111** suitably connected to the ejector gate **82**.

Mounted for rolling movement along the outwardly opening portions of the carriage ways **106** is an ejector gate guide mechanism including guide struts **112** rigidly secured at their forward ends to a lug **113** on the gate **82**. At the rearwardly disposed ends a crossmember **114** connects the guide struts **112** and a vertically arranged mounting member **116** serves to mount rollers **117** for movement along the ways **106**. It will be understood that movements of the rolling floor through actuation of the rolling floor power cylinder **91** serves to move the ejector gate cylinder **108** and struts **112** along the carriage ways **106**. Application of power to the ejection gate power cylinder **108** serves to move forwardly the struts **112** along the ways **106**, the cylinder **108** reacting against the moving abutment **107** interconnected with the rolling floor mechanism.

## OPERATION

The elevator scraper **10** includes fluid power circuitry shown in FIGS. **9—13** which permits operation of the scraper in various conditions with actuation of but a single control. More particularly, a control valve **121** mounted in the cab of the tractor (not shown) permits the scraper to be operated in either the loading or unloading mode by simply reversing the position of the valve plug. Associated in the circuitry with the valve **121** on the tractor is a hydraulic pump **122**, a fluid reservoir **123** and a pressure relief valve **124**. Suitable hydraulic fluid intercoolers may be provided to maintain the working fluid within a desired temperature range.

Three sequence valves are included in the circuit, an elevator-up sequence valve **126**, an elevator -down sequence valve **127** and a rolling floor-forward sequence valve **128** arranged in the circuit as shown. The elevator-up sequence valve **126** may be mounted as shown in FIGS. **1** and **3** upon a pedestal **125** arranged on the right-hand side of frame member **31**, the valve **126** having a downwardly projecting actuator adapted to be engaged by the right-hand extension of the elevator frame crossnumber **49**, FIG. **2**. The elevator-down sequence valve **127** may be mounted upon the left-hand scraper frame member **31** with the valve actuator projecting upwardly for engagement with the elevator frame horn **76**, FIG. **1**. The rolling floor-forward sequence valve **128** is arranged in the rear extension **34** of the scraper, FIG. **6**, and is equipped with an actuating roller for engaging a cam bar **129** fixedly secured to the right-hand ejector guide strut **112** so that when the rolling floor is in a predetermined position actuation of the valve **128** will be achieved.

Suitable spring biased check valves **131** are arranged in the circuit and conduits are provided as shown.

The sequence of operations can be best understood by reference to FIGS. **9—13** wherein in FIG. **9** the elevator scraper is in the condition with the elevator in the lower position as shown in FIG. **1**. It will be recognized that hydraulic power for the elevator is now shown in these drawings being that it is operated from an independent circuit controlled from the tractor. In FIG. **9** the rolling floor is in the rearward condition. Through appropriate movement of the lever of the control valve **121** fluid power is supplied to the elevator power cylinders **69** to raise the elevator. Sequence valves **126** and **127** are in the closed condition while valve **128** is in the open condition.

In FIG. **10** the elevator is in the elevated condition, as illustrated in broken lines in FIG. **3**, and movement of the lever of the control valve **121** is continued to place the scraper in the earth-expelling condition moving the rolling floor and ejector gate to the position shown in broken lines in FIG. **7**. The elevator-up sequence valve **126** is in the open condition as is the rolling floor sequence valve **128**, thus permitting fluid to enter the rolling floor power cylinder **91** for moving the floor to a forward position.

FIG. **11** illustrates the application of power to the ejector gate power cylinder **108** to move the ejector gate forward across the rolling floor for expelling earth over the scraper blade. The elevator-up sequence valve **126** is in the open condition while the rolling floor sequence valve **128** is closed in response to movement with respect to the cam of the cam bar **129** which is carried forward with the rolling floor.

FIG. **12** shows the condition of the first recovery stage wherein the lever of the control valve **121** is reversed, reversing application of pressure first to the ejector gate power cylinder **108**. The elevator is maintained in the raised position and the rolling floor is in the forward condition. Sequence valves **127** and **128** are in the closed condition, valve **126** being open.

FIG. **13** illustrates the condition for receiving earth on the rolling floor, the ejector gate being shifted back therealong. It will be appreciated at this juncture that the ejector gate may be shifted along the rolling floor incrementally. Further, the rolling floor and ejector gate may together be shifted over the fixed floor portion incrementally thereby permitting a squared-off load to be contained within the bowl of the scraper. As shown in FIG. **13**, sequence valves **126** and **127** are closed while the cam actuated sequence valve **128** is open, permitting fluid to flow for bringing the elevator into operative position with respect to the scraper blade by applying fluid to the cylinder **69**. In this condition fluid flows from the elevator cylinders **69**, through the spring biased check valve **131** against the bias of the valve spring. This arrangement of the valve **131** in the hydraulic system serves a counterbalance function permitting controlled and gradual lowering of the elevator being that the arrangement affords a low pressure differential across the elevator cylinders **69**.

FIG. **14** illustrates the final recovery condition of the elevator scraper wherein the rolling floor is retracted by supplying fluid to the cylinder **91**. The ejector gate is in the rearward most position and the elevator is in the lowered condition, opening sequence valve **127**. Sequence valve **126** is in the closed condition, valve **128** being open.

It will be understood from the foregoing that while there has been illustrated and described one form of the present invention, it is not to be limited to this specific form or arrangement of parts herein described and shown except insofar as such limitations are included in the claims below.

We claim:

**1.** In an earth-moving machine the combination comprising, a frame, a bowl structure rigidly mounted on said frame including a fixed floor section extending between spaced sidewalls, an earth cutting blade arranged at the forward portion of said fixed floor section, a carriage including an upstanding ejection gate and a floor portion movable along said frame, carriage power means fixedly mounted with respect to said frame and connected to said floor portion and being operable to move said carriage between a rearwardly disposed earth holding condition and a forwardly disposed intermediate earth-expelling condition, carriage guide means on said frame serving to guide the carriage movement between said conditions, said guide means including first strut means disposed rearwardly of said ejection gate and rigid with said frame and extending parallel to the path of carriage movements, and second guide means rigid with said floor portion of said carriage and disposed parallel with said first strut means, means slidably interconnecting said first and second strut means, and ejection gate power means fixedly mounted with respect to said second strut means and connected to said ejection gate and operable to move said ejection gate across the floor portion of said carriage.

**2.** The apparatus as in claim **1** and including linkage means comprising a first pair of arms pivotally mounted on said carriage power means and operable therewith, a second pair of arm pivotally mounted on said frame, and a third pair of arms pivotally mounted on said carriage and movable therewith, each said first and third pair of arms being pivotally connected to said second pair of arms.

**3.** In an earth-moving machine the combination comprising, a bowl structure including a forwardly disposed fixed floor

section, an earth-cutting blade rigidly attached to said bowl at the forward portion of the fixed floor section, an endless conveyor serving to move earth from said blade into said bowl structure, said endless conveyor being mounted with respect to said bowl structure for pivotal movement, earth ejection means serving to expel earth from said bowl structure over said cutting blade and including a movable floor portion shiftable over said fixed floor section and an upstanding ejection gate, said earth ejection means being shiftable forwardly along said bowl from a rearwardly disposed earthholding condition to a forward intermediate earth expelling condition, said ejection gate being shiftable along said movable floor portion from the intermediate earth-expelling condition to a more forward terminal earth expelling condition proximate said blade, conveyor power means on said machine serving to pivot said conveyor such that the lower end portion is moved upwardly from a position proximate said cutting blade to a raised out-of-the-way position, earth ejection power means for shifting said earth ejection means between said earthholding and intermediate earth-expelling conditions, ejection gate power means for shifting said gate between the intermediate and the forward terminal earth expelling conditions, and control means operatively connected to said conveyor, earth ejection, and ejection gate power means, said control means being operable in an earth ejection cycle to first actuate said conveyor power means for moving and holding said conveyor in the out-of-the-way position during the ejection cycle, then to actuate said earth ejection power means serving to shift said earth ejection means including said ejection gate and movable floor portion forwardly from the earthholding to the intermediate earth-expelling condition, and then to actuate said ejection gate power means serving to shift said ejection gate forwardly over said movable floor portion from the intermediate to the forwardly disposed terminal earth-expelling condition, said control means being operatable in a cycle to return said machine to an earth-receiving condition, said control means serving first to actuate said ejection gate power means for shifting said ejection gate rearwardly over said movable floor between the terminal and the intermediate earth-expelling condition, then to actuate said conveyor power means for moving said endless conveyor from said out-of-the-way position to a position for moving earth from said earth cutting blade into said bowl permitting earth to be received into said machine while the earth ejection means is returned to the fully retracted condition, and then to actuate said earth ejection power means serving to retract said earth ejection means from the intermediate condition to the rearwardly disposed earthholding condition, said control means including an hydraulic circuit having therein a manually actuatable valve controlling fluid flow in two directions, and wherein said earth ejection power means and ejection gate power means are arranged in the hydraulic circuit to operate in series such that in the earth ejection cycle fluid under pressure is first supplied to said earth ejection power means serving to move said earth ejection means to said intermediate earth-expelling condition and then fluid under pressure is supplied to said ejection gate power means for moving said ejection means to the forwardly disposed terminal earth ejection condition.