April 7, 1953 H. E. CRINER ET AL 2,634,006

CLAMP-OPERATING MECHANISM FOR ROTARY CAR DUMPERS

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Fig. 8.

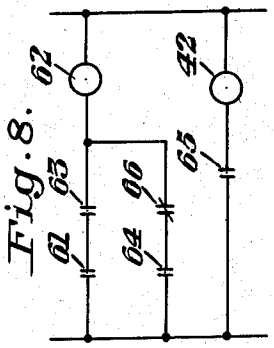


Fig. 1.

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Fig. 3.

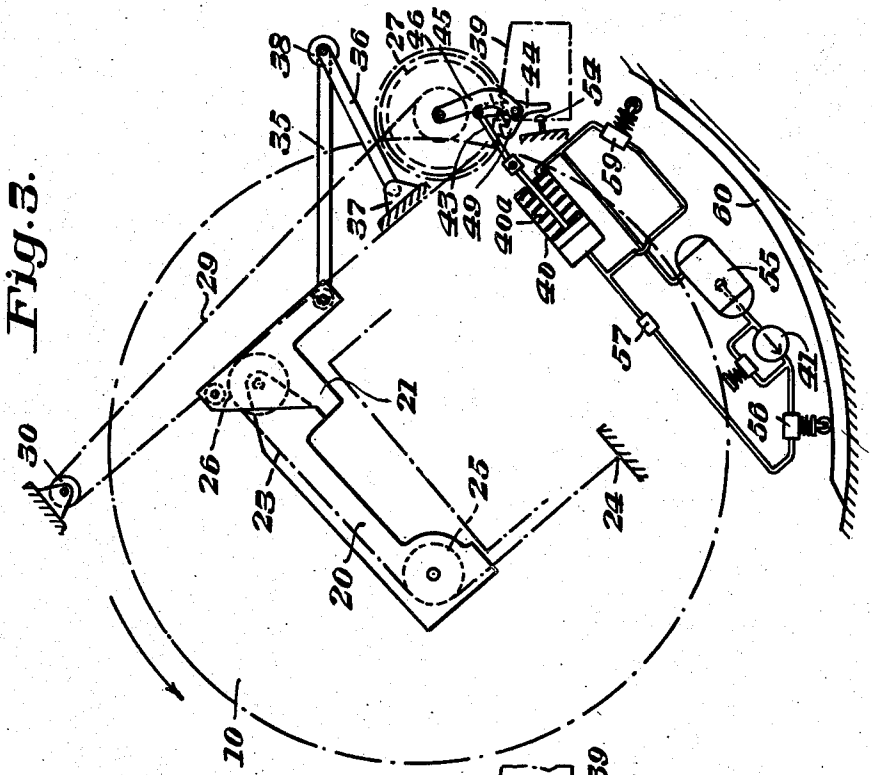
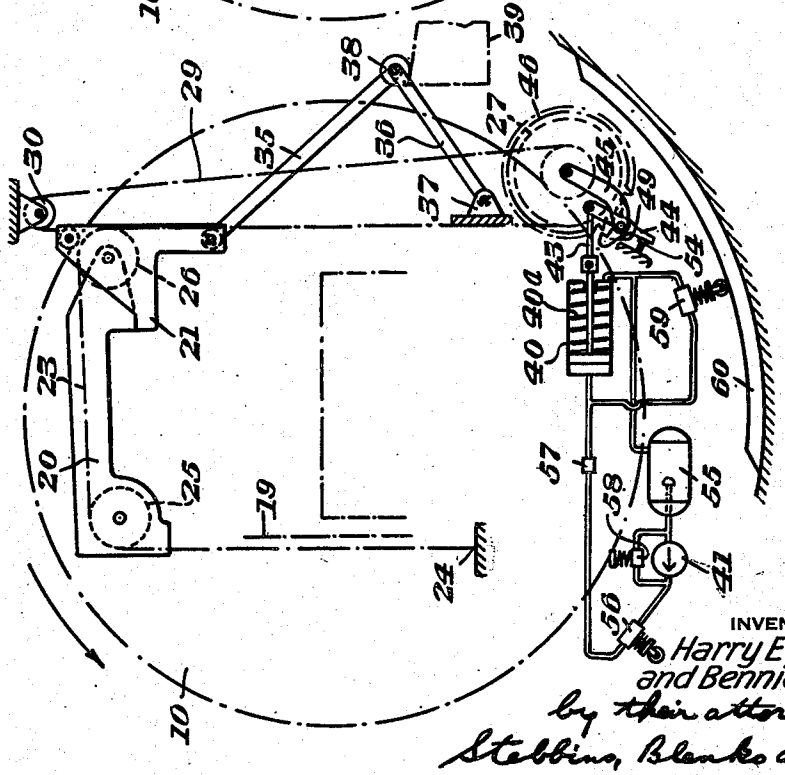


Fig. 2.



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Fig. 5.

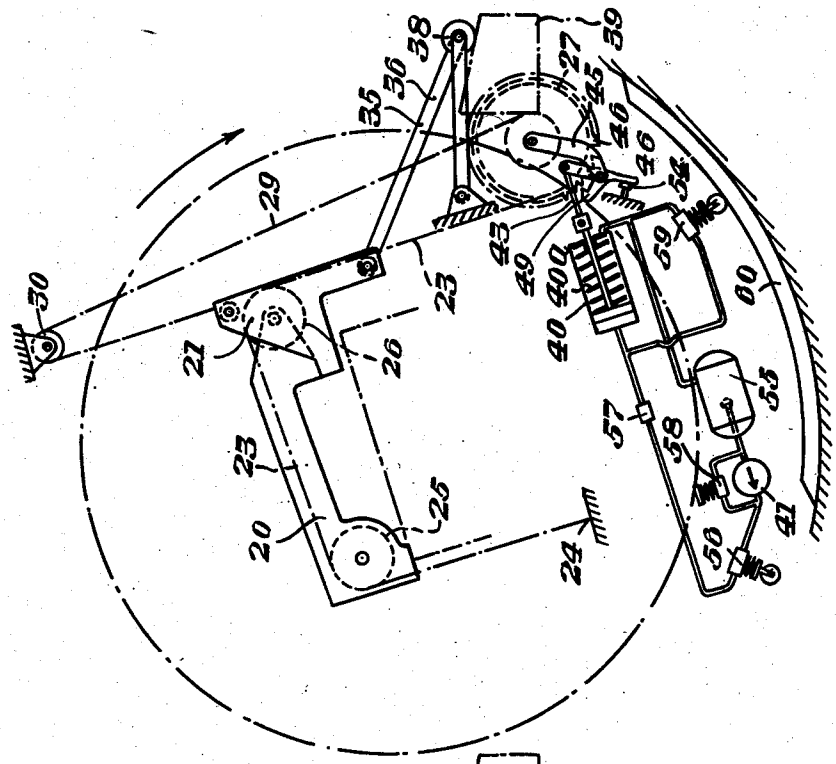
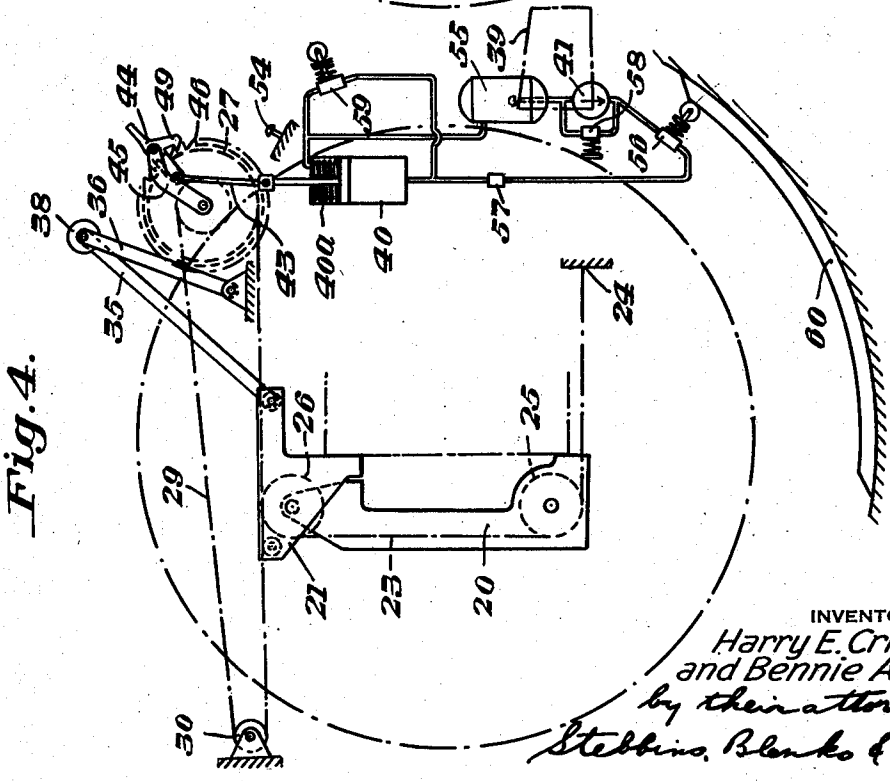


Fig. 4.



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CLAMP-OPERATING MECHANISM FOR ROTARY CAR DUMPERS

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Fig. 7.

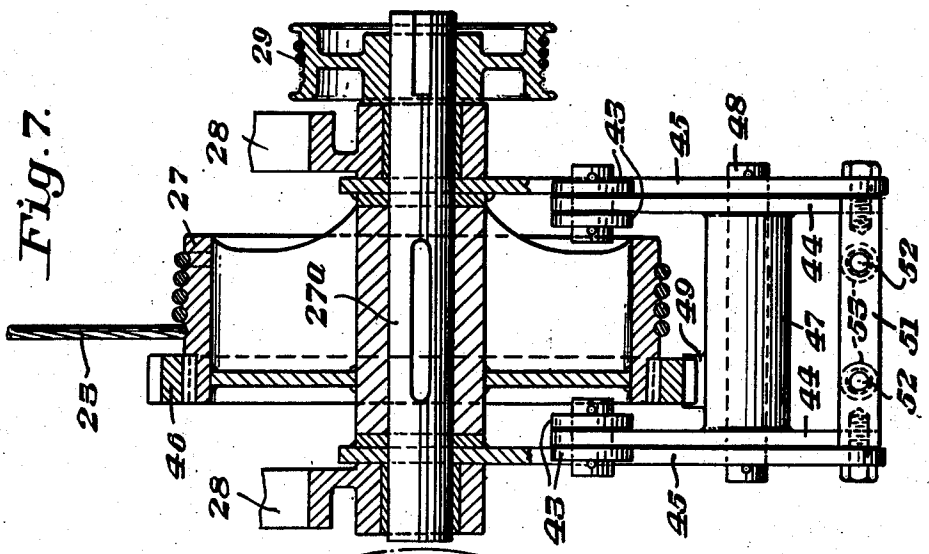
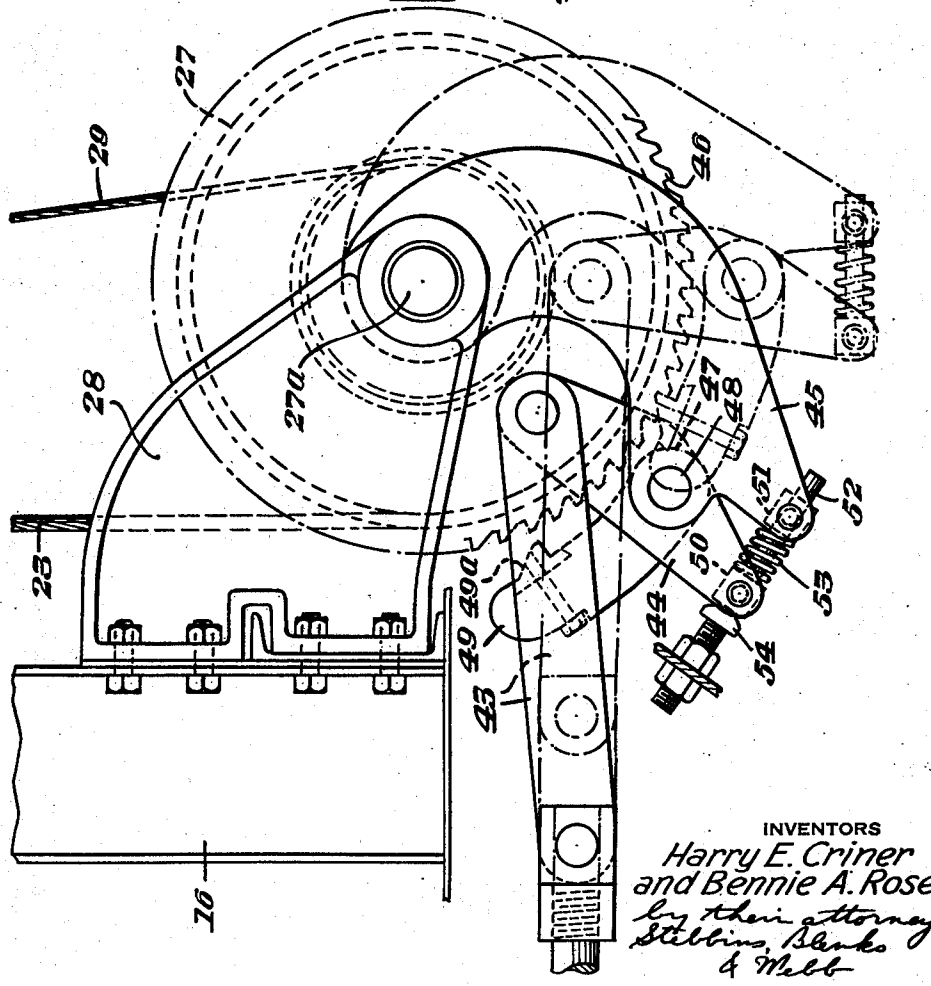


Fig. 6.



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UNITED STATES PATENT OFFICE

2,634,006

CLAMP-OPERATING MECHANISM FOR ROTARY CAR DUMPERS

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Application January 31, 1947, Serial No. 725,592

9 Claims. (Cl. 214—55)

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This invention relates generally to rotary car dumpers and, in particular, to means for controlling the ropes usually employed to hold the car clamps in engagement with the sides of an open-top car.

Rotary car dumpers as constructed heretobefore have commonly included car clamps in the form of beams pivoted at one end, extending across the usual car-receiving cradle and spaced longitudinally thereof, the clamps being slidable vertically in the cradle. The clamps are usually held in engagement with the car, after the cradle starts to turn, by ropes suitably controlled. It has also been proposed to provide power means separate from the clamp-operating means for pulling the clamps down through the surcharge above the level of the car sides into solid engagement with the latter. In respect to these features, known car-dumper constructions are costly and complicated and lack certainty and safety in operation. We have invented improved mechanism for operating the car clamps of a rotary dumper which overcomes the aforementioned objections to such devices as previously designed and, in addition, permits the car springs to lift as the load is removed therefrom on rotation of the cradle, before finally securing the clamp-holding ropes. This facilitates the release of the clamps when the dumper has been restored to erect position and limits the pressure exerted by the clamp on the car sides.

In a preferred embodiment, we provide the clamp beams of a car dumper with a toggle linkage for controlling them as the cradle turns toward dumping position and later when it is restored to erect position. We employ a winding drum for taking up the slack in the clamp-holding rope as the clamp descends when the cradle starts to turn toward dumping position. We also provide power means engageable with the take-up drum for driving the drum to pull the clamps through the surcharge and into contact with the sides of the car. This power means includes a hydraulic motor. Automatic means actuated by rotation of the cradle causes the starting of a motor-driven pump supplying the hydraulic motor. After sufficient rotation of the cradle to permit unloading of the car springs, the hydraulic motor is automatically locked against reversal, thus positively holding the car clamps and preventing the car from leaving the rails of the cradle as it is inverted. After the car has been dumped, the reverse rotation of the cradle releases the locking means for the hydraulic motor permitting the clamps to be raised to free the car for removal.

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Specifically, we employ a release valve and a locking valve to control the hydraulic motor. These valves are mounted in circumferentially spaced relation on the cradle for operation in sequence by a fixed cam rail. The motor driving the pump is interlocked with the control for the main driving motor of the dumper, whereby the pump motor is energized only during a portion of the forward or dumping stage of the complete cycle of operations.

A complete understanding of the invention may be obtained from the following detailed description and explanation thereof which refer to the accompanying drawings illustrating the preferred embodiment. In the drawings,

Figure 1 is a transverse section through the cradle of the car dumper, showing the operating mechanism for one of the car clamps in elevation;

Figure 2 is a diagrammatic view corresponding to Figure 1 showing the details of the hydraulic control system;

Figure 3 is a view similar to Figure 2 illustrating the positions of the parts after partial rotation of the cradle;

Figure 4 is a similar view showing the positions of the parts after further forward rotation toward the dumping position;

Figure 5 is a similar view showing the positions of the parts after the cradle has returned almost to starting position;

Figure 6 is a partial elevation showing the mechanism by which the power means operates the take-up drum to pull the clamp through the surcharge;

Figure 7 is a vertical section through the drum with parts in elevation; and

Figure 8 is a schematic diagram showing the interlocking between the pump motor and the control for the main cradle-rotating motor.

Referring in detail to the drawings, a dumper according to our invention comprises a pair of spaced end rings 10 rotatably mounted on pairs of bearing rollers 11 mounted on a suitable foundation 12. The end rings are connected by longitudinal members 13 and 14. Columns 15 and 16 extend upwardly from beams 17. A platen 18 having rails adapted to receive a car travels transversely of the cradle along the beams 17, to bring the side of the car into engagement with a spill plate 19 on the dumping side of the cradle. Car clamps extending between the columns 15 and 16 are spaced along the length of the cradle. Each clamp comprises a beam 20 pivoted to a slide 21 movable vertically in guides carried by the column 16.

The free end of the beam travels between guides 22 on the column 15. A clamp-holding rope 23 is dead-ended on the cradle at 24. It extends upwardly around a sheave 25 on the free end of the beam 20, thence around a sheave 26 and downwardly to the larger-diameter portion of a differential take-up drum 27 mounted on a shaft 27a journaled on the cradle in bearing brackets 28. A drum-operating rope 29 dead-ended on the slide 21 extends around a sheave 30 on the member 14 and downwardly to the smaller-diameter portion of the drum 27. The cradle is operated toward the dumping position indicated by the arrow in Figure 1 and returned therefrom by operating ropes or chains 31 secured to the end rings and driven by sheaves or sprockets on a common shaft 32. The shaft 32 is driven by a motor 33. The ropes 31 travel over idle guide sheaves on shafts 32a.

The construction described so far is largely conventional practice in the art of rotary car dumpers. The novel features to which our invention relates are the mechanism for lowering and raising the car clamps at the beginning of the rotation of the cradle and at the end of the reverse movement thereof and means for actuating the drum 27 to pull the car clamps downwardly through the surcharge into solid engagement with the car sides and, after a predetermined rotation of the cradle, hold them against reverse movement until the dumping has been completed and the cradle returned almost to erect position.

Toggle links 35 and 36 are pivoted together at one end. The other end of the link 35 is pivoted to the slide 21. The other end of link 36 is pivoted to a bearing bracket 37 secured to the column 16. A roller 38 journaled on the common pivot of the links 35, 36 is adapted to engage a fixed abutment 39. It will be understood that the mechanism described for operating the clamps shown in Figure 1 is duplicated for each of the clamps along the length of the cradle. In a typical dumper, there may be three such clamps. It will be evident from Figure 1 that, as the cradle is turned in the dumping direction, the clamp 20, 21 being held up only by the engagement of the roller 38 with the abutment 39, descends under its own weight until it engages the surcharge or portion of the load in the car above the sides thereof. The descent of the clamp unwinds the rope 29 from the drum 27, thereby causing the latter to take up the slack simultaneously created in the rope 23. The larger-diameter portion of the drum is twice as large as the smaller-diameter portion because when the clamp moves in either direction the length of rope 23 drawn in or payed out by the drum must be twice the length of the rope 29 payed out or drawn in by the drum, due to the fact that the rope 23 passes over the clamp and is dead-ended on the cradle whereas the rope 29 is dead-ended directly on the clamp. When the clamp engages the surcharge, downward movement thereof is temporarily arrested and, on continued rotation of the cradle, the roller 38 is lifted from the abutment 39.

We provide means for forcibly pulling the clamp downwardly through the surcharge until the slide 21 and the free end of the beam 20 engage the car sides firmly. This means includes a hydraulic motor such as a cylinder and piston 40 mounted on the beam 17. Operating liquid is supplied to the cylinder by a pump 41 driven by a motor 42 both mounted on the beam 17. While the pump and motor 42 may most conveniently be located on the cradle as shown, they may alternatively be located on any suitable stationary support in which case the pump would be connected to the cylinder 40 by flexible hose. The piston rod of the cylinder is connected by a link 43 to a lever 44. This lever is pivoted to a lever 45 journaled on the shaft 27a and is adapted to engage a ratchet wheel 46 keyed to the drum 27. The details of the levers, ratchet wheel and take-up drum are shown clearly in Figures 6 and 7. As there shown, the lever 45 includes a pair of spaced arms journaled on the shaft 27a and the lever 44 similarly comprises a pair of spaced arms connected by a tube 47. A pivot pin 48 passes through this tube and the arms of the lever. A pawl arm 49 extending from the tube 47 is provided with a removable tooth 49a adapted to mesh with the teeth of the ratchet wheel 46. Bars 50 and 51 are pivoted between the lower ends of the spaced arms forming the lever 44 and lever 45, respectively. Pins 52 extend between the bars and are secured thereto. A compression spring 53 on each pin tends to urge the bars apart, thereby forcing the tooth 49a against the face of the ratchet wheel 46.

An adjustable stop 54 on the cradle is engaged by the bar 50 just before the piston rod of the cylinder 40 reaches its fully retracted position. When the piston is fully retracted, the springs 53 are compressed and the pawl is tilted so that the tooth 49a clears the teeth of the ratchet wheel, leaving the drum 27 free to be actuated by the ropes 23 and 29. As already stated, the cylinder is operated to actuate the pawl linkage and thereby turn the ratchet wheel to pull the car clamp through the surcharge, only after a predetermined forward rotation of the cradle sufficient to permit descent of the clamp into engagement with the surcharge and lifting of the roller 38. It will be apparent that when liquid under pressure is supplied to the cylinder, the piston thereof will be advanced. As the lever 45 is moved counterclockwise, the springs 53 throw the tooth 49a into engagement with the teeth of the ratchet wheel as soon as the bar 50 disengages the stop 54. Continued advance of the piston rod causes the drum to be turned through a partial revolution. This pulls down the clamp-holding rope 23 and seats the car clamp on the sides of the car. We also provide means for locking the cylinder 40 with the piston in its extreme forward position, to prevent movement of the car clamp away from the bottom of the cradle, thereby holding the car safely when the cradle is fully inverted for dumping.

Figure 1 illustrates the starting or erect position of the cradle. Figure 2 corresponds to Figure 1 but shows the structure only diagrammatically. It does, however, show the complete circuit for the power liquid operating the cylinder 40 and the control means therefor. Figures 3 and 4 show succeeding positions of the cardle in the forward rotation or dumping stage and Figure 5 illustrates the latter portion of the reverse rotation or righting stage of the complete operating cycle. Referring to Figure 2, when the motor 42 is energized, the pump 41 draws operating liquid such as oil from a reservoir 55 mounted on the cradle and delivers it through a locking valve 56 and a pressure switch 57 to the cylinder 40. A relief valve 58 by-passes the cylinder in case abnormal pressure develops in the delivery line. This pro-

vides means for limiting the total force exerted by the clamps on the car sides.

In the erect position of the cradle, the cylinder 40 is by-passed by a release valve 59 held open by engagement of its operating roller with a fixed cam rail 60. The locking valve 56 has a similar operating roller for holding it open on engagement with the cam rail after partial revolution of the cradle in a manner to be explained shortly. The motor 42 is not energized in the erect position of the cradle but only after partial rotation thereof. With the parts in the positions shown in Figures 1 and 2, the motor 33 is operated to turn the cradle in the counterclockwise or dumping position after a car has been run in onto the platen 18. As soon as the cradle starts to turn, the platen rolls down the beams 17 as they become inclined, until the side of the car engages the spill plate 19. Simultaneously, the car clamp 20, 21 descends into engagement with the surcharge on the car as already explained.

When the cradle has turned through about 30°, the motor 42 is started by the closure of a trigger switch 61 (see Figure 8). This trigger switch is actuated by the cradle as it turns and may be of any suitable type which closes its contacts momentarily and then opens them. The closure of the switch 61 completes a circuit for the operating coil 62 of a contactor controlling motor 42. This circuit includes an interlock 63 which is closed only when the controller for the motor 33 is in forward position. Energization of the coil 62 operates a contactor and closes a holding circuit therefor through an auxiliary contact 64. It also closes the main contacts 65 of the circuit supplying current to the motor 42. The holding circuit for the coil 62 includes a normally closed trigger switch 66, the operation of which will be explained later. At the 35° position, the roller of release valve 59 leaves the cam rail 60. The motor 42 having been started, the pump 41 then delivers oil to the cylinder 40 and the forward stroke of the piston rod commences. As already explained, the lever 44 engages the ratchet wheel 46 to turn the drum 27 and forcibly pull the car clamp through the surcharge until it engages the car sides.

The roller of the locking valve 56 engages the cam rail 60 shortly before the roller of the release valve leaves it. When the piston rod has reached its extreme forward position, it is held there merely by continued application of pressure to the oil by the pump 41. As the cradle continues to rotate, the car springs expand as they are relieved of the load of the weight of the car body and its contents. This causes a slight reverse movement of the drum 27 accompanied by a partial retraction of the piston in the cylinder 40 which is permitted because the force exerted by the car springs easily overcomes the pressure in the cylinder.

When rotation of the cradle has continued to the point where the roller of locking valve 56 leaves the cam rail 60, as shown in Figure 4, the oil remaining in the cylinder 40 will be trapped and further retraction of the piston prevented. By this time, the car springs will have been fully extended. Thereafter, the clamp-holding rope 23 is firmly locked and the clamp safely holds the car against leaving the rails when the dumper reaches its final position in which the car is substantially inverted.

The trigger switch 66 is operated when the cradle reaches about the 100° position, thus breaking the circuit for the coil 62 and opening contacts 65 of the motor 42. The motor is thus deenergized until the next forward rotation of the dumper.

After the contents of the car have been dumped, the controller for the motor 33 is moved to the reverse position and the cradle is thereby rotated back toward its erect position. When the cradle has returned from the fully inverted position to the position shown in Figure 4, the locking valve 56 is opened by engagement of its operating roller with cam rail 60. At this position of the cradle, there is little or no load on the clamp-holding ropes and correspondingly little tendency to retract the piston rod of the cylinder 40. While such retraction could be effected, it would require that the oil pass through the pump while stationary. Since this is a high-resistance path, considerable opposition is offered to the retraction of the piston. Reverse rotation of the cradle continues until the roller of release valve 59 engages the cam rail as shown in Figure 5. This opens the by-pass around the cylinder and permits the oil trapped behind the piston to be forced back to the reservoir, the piston being retracted by a restoring compression spring 40a in the cylinder 40. The levers 44 and 45 are thereby returned to the positions shown in Figures 1 and 2, freeing the drum 27. Shortly after the opening of the release valve 59, the roller 38 engages the abutment 39 and lifts the clamp from the car. During this lifting, the drum 27 pays out the rope 23 and takes up the rope 29. All the parts are thus returned to starting position and the apparatus is ready for another dumping cycle as soon as the empty car is removed and replaced by a loaded car.

The pressure switch 57 is interlocked with the controller for the cradle-driving motor 33 in such a manner as to stop the motor when the cradle reaches the 90° position, unless the pump 41 has started and built up sufficient pressure to operate the cylinder 40 properly so as to hold the car against leaving the rails on further rotation of the cradle and closing of the check valve. This prevents the possibility of damage resulting from lack of sufficient oil in the cylinder to hold the car safely when the cradle is inverted.

It will be apparent from the foregoing that the invention provides clamp-operating mechanism for car dumpers having numerous advantages over the apparatus used previously for this purpose. In the first place, the control of the car clamps is entirely automatic, being actuated by rotation of the cradle itself. The operator need concern himself, therefore, only with the controller for the cradle-driving motor and rapid dumping is thereby permitted. Complete safety is likewise obtained. The control apparatus is simple in construction and, therefore, not likely to get out of order, yet is positive in its operation.

The car springs are permitted to expand fully under a condition of substantially no load before the car clamps are locked preparatory to turning the cradle past the 90° position for completion of the dumping. This renders the release of the car clamps an easy matter when the dumper approaches the erect position on reverse rotation and renders the car top less liable to damage because of excessive clamp force, i. e., more than that required to hold the empty car. Since the release valve and locking valve are closed sequentially in the dumping operation and opened in the reverse sequence on reverse rotation of the dumper, a single cam rail suffices

to operate them both. The pump motor, furthermore, is automatically controlled so that it operates only during a portion of the dumping cycle in which pressure is required to cause extension of the piston of cylinder 40.

Although we have illustrated and described a preferred embodiment of the invention, it will be recognized that changes in the details of construction disclosed may be made without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. Mechanism for operating a winding drum for the flexible clamp-holding member of a car dumper, comprising an actuating wheel on said drum and means engageable therewith, a hydraulic piston and cylinder for actuating said means into engagement with said wheel and then turning the wheel, a pump delivering liquid to said cylinder, a motor for driving said pump, means actuated by rotation of the dumper for causing the motor to be energized only after partial forward rotation of the dumper, a valve for locking liquid in said cylinder, a release valve for said cylinder, and a cam rail for holding the release valve open until after a predetermined forward rotation of the dumper, and for opening the locking valve at a predetermined point in the return rotation of the dumper.

2. Mechanism for operating a winding drum for the flexible clamp holding member of a dumper for a car having springs which support the principal weight of the car and its load while the car is upright, comprising an actuating wheel on said drum and means engageable therewith, a hydraulic piston and cylinder for actuating said means into engagement with said wheel and then turning the wheel, a pump delivering liquid to said cylinder, a motor for driving said pump, means actuated by rotation of the dumper for shutting off the motor after sufficient rotation of the dumper to unload the car springs, a valve for locking liquid in said cylinder, a release valve for said cylinder, and a cam rail for holding the release valve open until after a predetermined forward rotation of the dumper, and for opening the locking valve at a predetermined point in the return rotation of the dumper.

3. A rotary dumper for an open topped car having springs which normally support the principal weight of the car and its load and which tend to expand with a force corresponding to said weight as the car is rotated in the dumper through the initial ninety degrees, comprising a clamp movable to engage the top of the car, a hydraulic piston and cylinder, means connecting said piston and clamp, said connecting means being adapted to move the clamp toward the car top as the piston is moved in one direction and to hold the clamp against reverse movement when the piston is stationary, a pump to supply fluid under pressure to the cylinder to move the piston in said one direction, said pressure being sufficient to move the clamp through a surcharge to seat the clamp on the car top, and a valve to relieve back-pressure from the cylinder in excess of the pump delivery pressure as the car springs expand during the initial ninety degree rotation of the car, whereby during said initial ninety degree rotation the clamp may be pressed toward the car top with sufficient force to overcome a surcharge while simultaneously permitting movement of the clamp in the opposite direction to relieve pressure from the expanding car springs in excess of said force.

4. A rotary dumper for an open topped car having springs which normally support the principal weight of the car and its load and which tend to expand with a force corresponding to said weight as the car is rotated in the dumper through the initial ninety degrees, comprising a clamp movable to engage the top of the car, a hydraulic piston and cylinder, means connecting said piston and clamp, said connecting means being adapted to move the clamp toward the car top as the piston is moved in one direction and to hold the clamp against reverse movement when the piston is stationary, a valve to lock fluid in the cylinder to hold the piston stationary against pressure urging reverse movement of the clamp, a pump to supply fluid under pressure to the cylinder to move the piston in said one direction, said pressure being sufficient to move the clamp through a surcharge to seat the clamp on the car top, a valve to relieve back-pressure from the cylinder in excess of the pump delivery pressure as the car springs expand during the initial ninety degree rotation of the car, whereby during said initial ninety degree rotation the clamp may be pressed toward the car top with sufficient force to overcome a surcharge while simultaneously permitting movement of the clamp in the opposite direction to relieve pressure from the expanding car springs in excess of said force, and whereby the clamp may then be positively locked to support the car during rotation of the car past ninety degrees to inverted dumping position.

5. A rotary car dumper comprising a clamp movable to engage the top of an open topped car in the dumper, a cable associated with the clamp to draw the clamp against the car top, a rotatable drum on which the cable is wound, a ratchet wheel rigidly secured to the drum, a pawl engageable with the ratchet wheel to rotate the ratchet wheel in a direction to draw the clamp toward the car top and to hold the ratchet wheel against counter-rotation, a hydraulic piston and cylinder, connecting means between said piston and pawl whereby movement of the piston in one direction causes the pawl to engage the ratchet wheel, a pump to supply fluid under pressure to the cylinder to move the piston in said one direction, means yieldably urging opposite movement of the piston to disengage the pawl from the ratchet wheel and control means comprising a valve for locking fluid in the cylinder and means to relieve fluid pressure in the cylinder, whereby the locking valve and releasing means may be selectively operated to cause the clamp to be drawn against the car top, to cause the clamp to be locked against movement in the opposite direction, and to cause the clamp to be released from the car top.

6. A rotary dumper for an open topped car having springs which normally support the principal weight of the car and its load and which tend to expand with a force corresponding to said weight as the car is rotated in the dumper through the first ninety degrees, comprising a clamp movable to engage the top of the car, a hydraulic piston and cylinder, means connecting said piston and clamp, said connecting means being adapted to move the clamp toward the car as the piston is moved in one direction and to hold the clamp against any reverse movement when the piston is stationary, a pump to supply fluid under pressure to the cylinder to move the piston in said one direction, a valve to relieve back pressure from the cylinder in excess of the pump delivery pressure as the car springs ex-

pand during the initial ninety degrees of rotation of the car, a valve to lock fluid in the cylinder to hold the piston stationary against pressure transmitted from the car top to the clamp, means to release the clamp from control of the hydraulic piston and cylinder, a cam rail, a cam follower adapted to move along said rail during rotation of the car from upright position to an inclination of about thirty-five degrees and adapted to cause said release means to release the clamp from control of the hydraulic piston and cylinder only while said follower is on the cam rail, and a cam follower adapted to move along said rail while the car is rotated from about thirty-five to ninety degrees of inclination and adapted to cause the last mentioned valve to remain open while said last mentioned cam follower is on the rail and to close and thereby lock fluid in the cylinder to hold the piston stationary when the said last mentioned follower is not on the rail, whereby the clamp is free to move without interference from the hydraulic piston and cylinder during about the first thirty-five degrees of rotation of the car, then the clamp is yieldingly pressed toward the car top while the car springs are allowed to expand during rotation of the car from about thirty-five to ninety degrees, and then the clamp is positively locked to hold the car's weight during rotation of the car from an inclination of about ninety degrees to inverted dumping position.

7. In a car dumper including a rotatable cradle and a car clamp slidable in the cradle toward and from the top of a car in the cradle, a toggle-linkage comprising a rigid link pivotally secured to the clamp and a rigid link pivotally secured to the cradle, said links being also pivotally secured to each other, a fixed abutment independent of the cradle, and a roller carried by the said links adjacent their pivotal connection with each other to engage and roll on said abutment during the initial forward rotation and final return rotation of the cradle, whereby the movement of the clamp toward and from the car top is controlled by said toggle-linkage and abutment during the said initial and final periods of rotation of the cradle.

8. A rotary car dumper for an open-topped car, comprising a clamp movable to engage the top of a car, a cylinder, a piston in the cylinder connected to control movement of the clamp toward and away from the car top, a pump, a conduit connecting the pump to the cylinder for supplying actuating fluid to the piston for moving the clamp against the car top through a surcharge of material in the car, controls actuated by rotation of dumper for causing the piston to move the clamp against the car top during the initial ninety degrees of rotation of the dumper and to lock fluid in the cylinder to hold the clamps for supporting the car during the remainder of the rotary dumping movement, a motor connected to rotate the dumper, a pressure switch connected to said conduit, and responsive to a predetermined pressure in the conduit sufficient to move the clamp through the surcharge against the car top during the initial approximately ninety degree rotation, and means effective during a late portion of the initial approximately ninety degree rotation of the dumper to connect said pressure switch to said motor to stop rotation of the dumper if there should then be less than the said predetermined pressure in the conduit.

9. In a car dumper including a cradle adapted to receive a car, means to rotate the cradle between the position in which the car enters and leaves it and the position in which it dumps the car, a car clamp mounted in the cradle for movement toward and from the top of a car in the cradle, means to operate the clamp to hold the car as the cradle rotates to and from dumping position, and means for controlling the movement of the clamp when the cradle is adjacent its position for receiving and discharging a car, the last-mentioned means comprising a rigid link pivotally secured to the clamp and a second rigid link pivotally secured to the cradle, said links being pivotally connected to form a toggle linkage for raising the clamp above a car in the cradle as the acute angle between the links is increased, means carried by the toggle linkage and movable to spread the links, and a fixed abutment positioned to engage and move the last mentioned means to spread the links until the clamp is spaced above a car in the cradle when the cradle is in its car-receiving or discharging position.

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