Jan. 8, 1946. J. D. RUSSELL ET AL 2,392,697

LOADING MACHINE

Filed Sept. 6, 1943 4 Sheets-Sheet 1

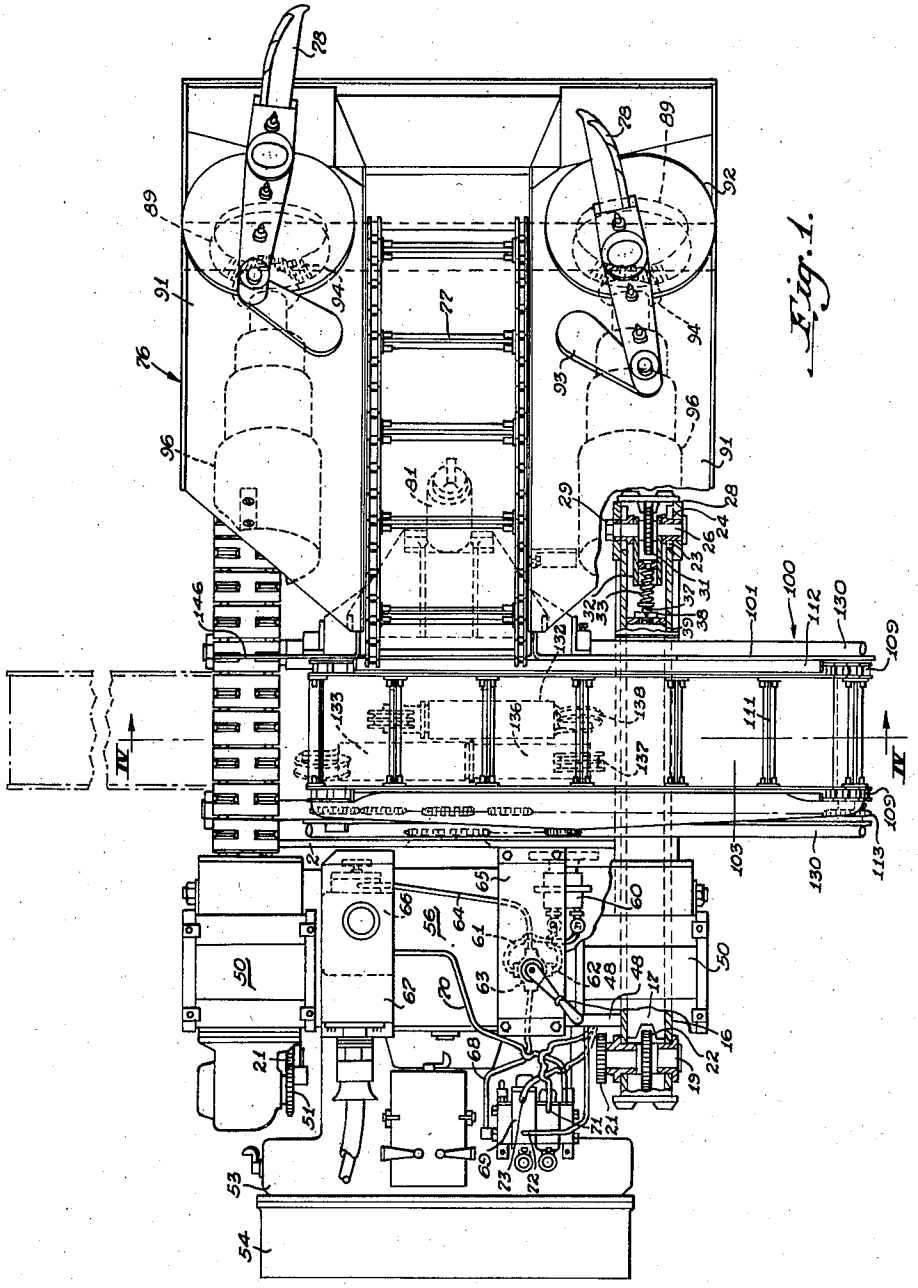


Fig. 1.

INVENTORS

John D. Russell, Charles F. Ball, & Thurston A. Knigen

BY

Brown, Critchlow & Flick

their ATTORNEYS.

WITNESSES.

E. J. Maloney

V. A. Peckham

Jan. 8, 1946. J. D. RUSSELL ET AL 2,392,697

LOADING MACHINE

Filed Sept. 6, 1943 4 Sheets-Sheet 2

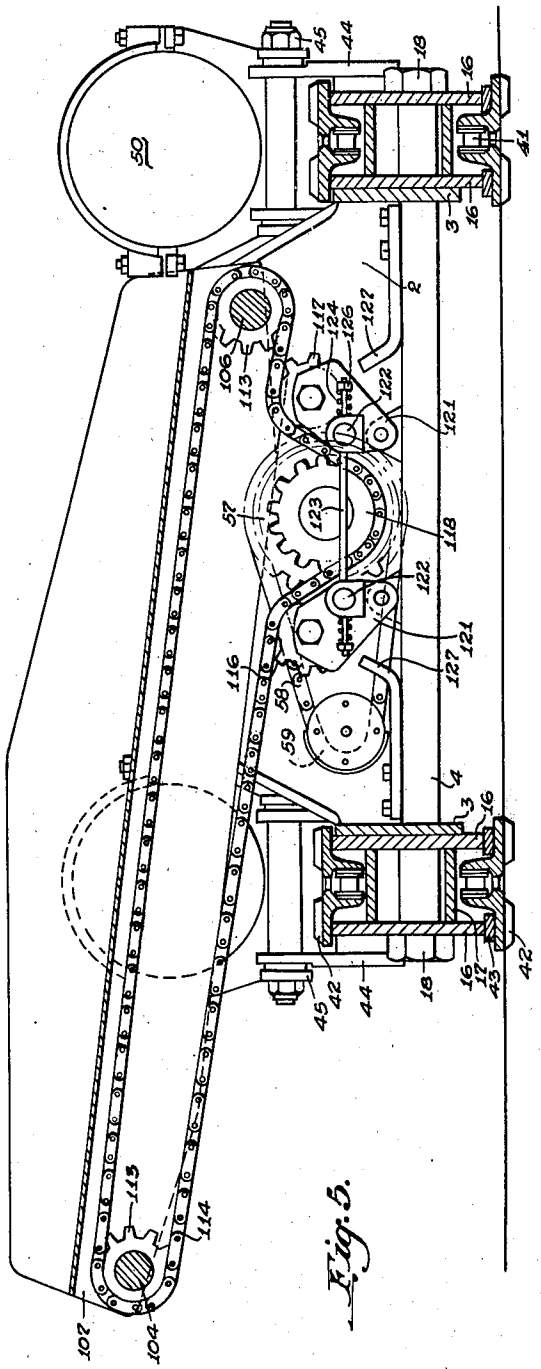


Fig. 5.

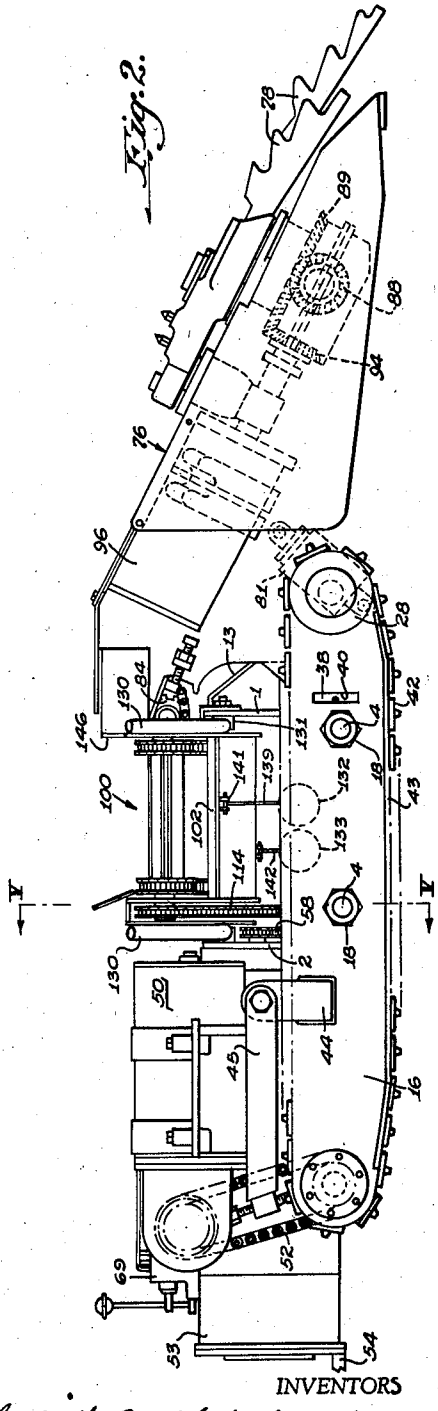


Fig. 2.

INVENTORS

WITNESSES.
E. J. Maloney.
V. A. Peckham.

John D. Russell, Charles F. Ball, & Arthur S. Kroigen
BY
Brown, Critchlow & Flick
their ATTORNEYS.

Jan. 8, 1946. J. D. RUSSELL ET AL 2,392,697

LOADING MACHINE

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Fig. 3.

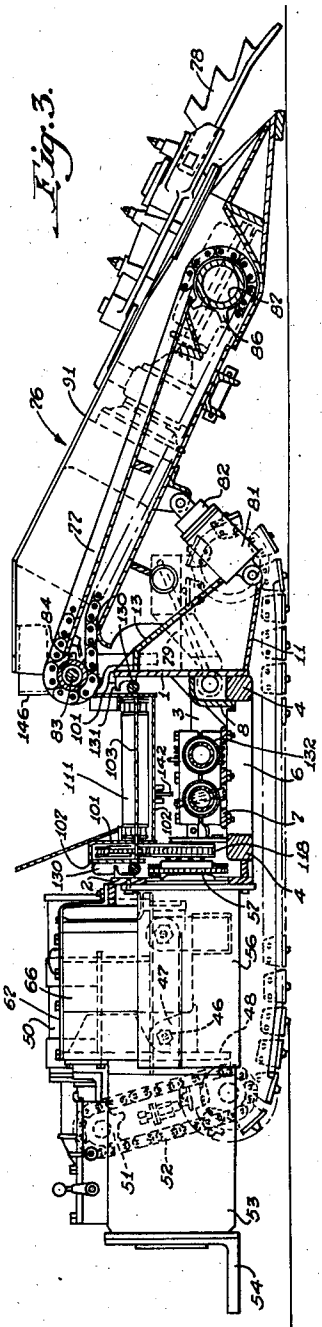
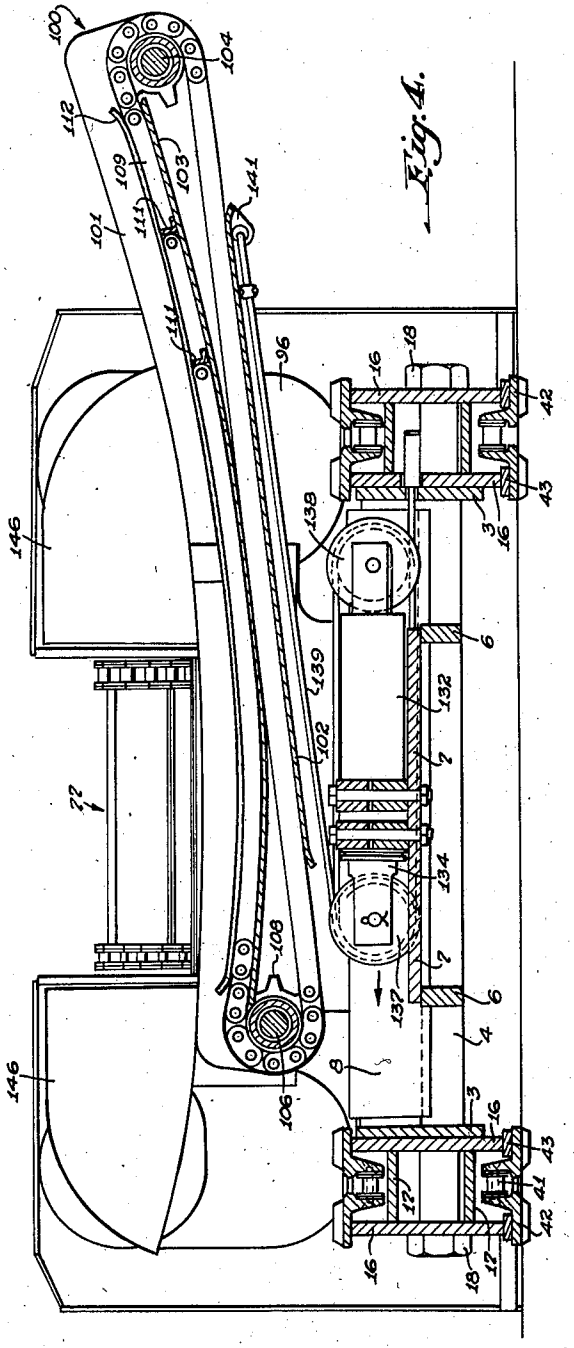


Fig. 4.



INVENTORS

John D. Russell, Charles F. Ball, & Archer S. Knoizen

BY

Brown, Critchlow & Flick

their ATTORNEYS.

WITNESSES.

E. J. Maloney.

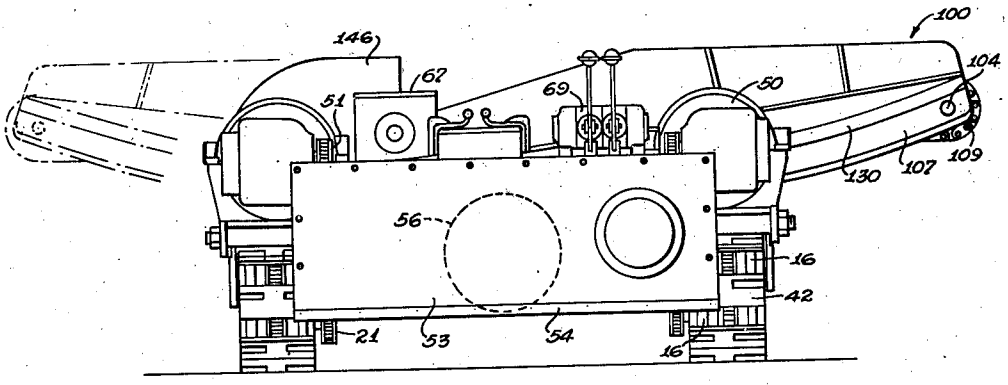
V. A. Peckham

Jan. 8, 1946. J. D. RUSSELL ET AL 2,392,697

LOADING MACHINE

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Fig. 6.



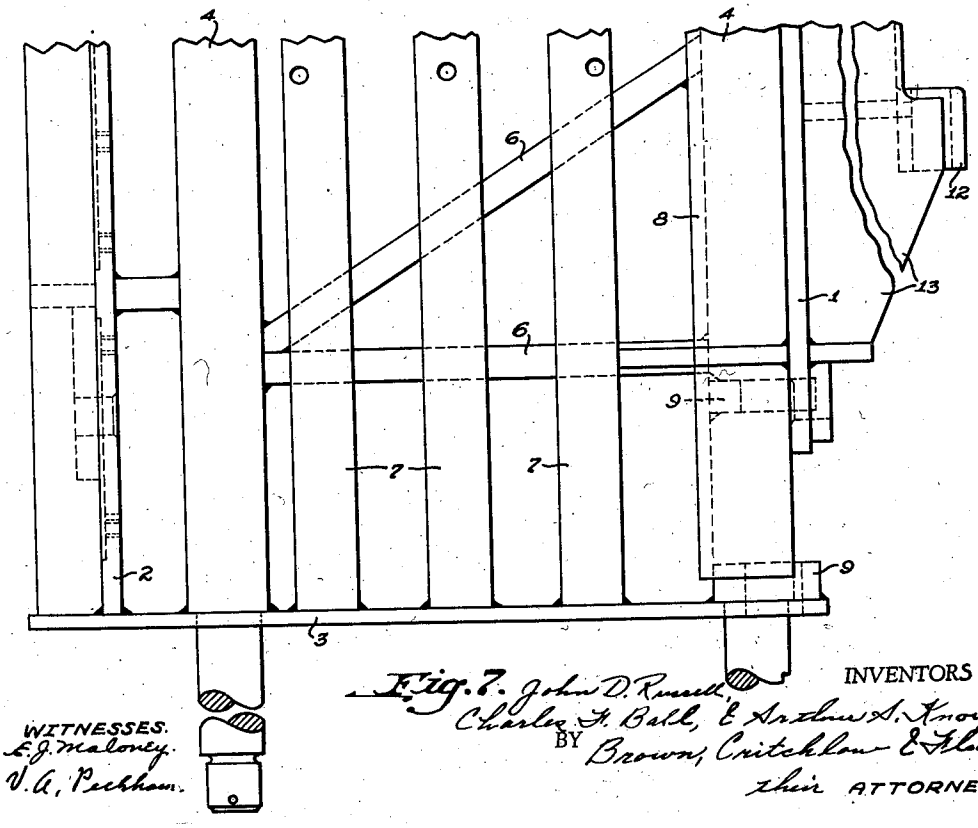


Fig. 7.

INVENTORS

John D. Russell,
Charles F. Ball, &
Arthur A. Knoigen
BY Brown, Critchlow & Flick
their ATTORNEYS.

WITNESSES.
E. J. Maloney.
V. A. Peckham.

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UNITED STATES PATENT OFFICE

2,392,697

LOADING MACHINE

John D. Russell, Charles F. Ball, and Arthur S. Knoizen, Franklin, Pa., assignors to Joy Manufacturing Company, Franklin, Pa., a corporation of Pennsylvania

Application September 6, 1943, Serial No. 501,366

9 Claims. (Cl. 198—10)

This invention relates to coal loading machines, and more particularly to such machines used for loading coal in a mine onto a conveyor belt or into mine cars.

In the type of coal mining called the "long-wall system," a working face is developed which varies from 300 to 600 feet in length. This face is undercut and this is dynamited or shot to loosen the coal to a depth of several feet. Paralleling the working face beside the shot coal but separated therefrom by a line of props generally placed on four-foot centers, is a conveyor belt or mine cars into which the coal is shoveled by miners who work from one end of the face to the other. After the loosened coal has been loaded, the newly cleared area forms the mine passage, and cribbing is erected in the old passage to support its roof. The roof of the new passage is propped, the new working face is undercut, and the conveyor is moved over toward the props to receive the coal that will be shot loose. This procedure is repeated many times, so the passage thus keeps moving laterally as the working face is progressively broken down and carried away and the previously unobstructed area of the passage filled with cribbing. Mobile coal loading machines now in general use were developed for the "room-pillar" system of mining and are not suitable for "long-wall" work because the machines are designed to gather coal at the front and discharge it into suitable haulage devices traveling in the room at right angles to the relatively narrow working face.

It is among the objects of this invention to provide a coal loading machine which is adapted for the long-wall system of mining, which receives coal at the front and discharges it from the side of the loader, which can discharge coal from either side of the loader, which can discharge coal at various levels, which has improved and inexpensive caterpillar frames, and which is small and rugged in construction.

In accordance with this invention a vehicle frame, preferably mounted on caterpillar units, supports an inclined loading conveyor projecting downwardly from its front end. This conveyor may be the usual type consisting of a central endless conveyor onto which the coal is pushed by oscillating gathering arms at its sides. Mounted on the frame below the rear end of the loading conveyor is a discharge conveyor for receiving coal from the loading conveyor. This discharge conveyor extends transversely of the frame so that the coal will be discharged from the side of the machine. The discharge conveyor can be driven in either direction so that the coal can be discharged from either side of the machine. The discharge conveyor also is movable longitudinally in either direction so that it can be projected and can discharge coal from either side of the machine, and can be partially retracted to permit the machine to clear the mine props as it moves along the working face. The discharge conveyor preferably is concave lengthwise so that as it is moved to the side of the machine its outer end rises. This permits the coal to be discharged at various levels without changing the level of the portion of the conveyor below the loading conveyor. The discharge conveyor preferably is driven by an endless chain traveling around sprockets on its end shafts and driven by a central drive sprocket. A pair of idler sprockets are supported in brackets on opposite sides of the drive sprockets where they engage the side of the chain opposite to the drive sprocket. The brackets are pivotally mounted for movement in the plane of the sprockets and are biased toward the drive sprocket to take up the slack in the chain. The frame for each caterpillar unit preferably is formed from a pair of laterally spaced vertical side plates rigidly connected by a pair of vertically spaced horizontal bracing plates extending longitudinally thereof. The lower edges of the side plates are provided with recesses in which narrow wear plates are disposed. Rotatably mounted in the ends of the side plates are sprockets that support the endless caterpillar chain with its attached tread plates. The operator's station is at the rear of the machine behind both conveyors.

The preferred embodiment of the invention is illustrated in the accompanying drawings in which Fig. 1 is a plan view with one of the caterpillar units partly broken away; Fig. 2 is a side view; Fig. 3 is a longitudinal section of the machine; Fig. 4 is an enlarged transverse section taken on the line IV—IV of Fig. 1; Fig. 5 is a similar section taken on the line V—V of Fig. 2; Fig. 6 is a view of the rear end of the machine; and Fig. 7 is an enlarged plan view of half of the center frame of the machine.

Referring to the drawings, especially Fig. 7, a center frame is formed from a pair of vertical front and back plates 1 and 2 at the lower portions of which there are vertical side plates 3 welded to the back plate. Extending across the frame is a pair of stationary square shafts 4 that have cylindrical end portions projecting through the side walls. The rear shaft is adjacent the back plate, but the front shaft is secured to and

supports the front plate which does not reach the side plates. Horizontal beams 6 are connected at their ends to the two shafts and support three laterally spaced bars 7 that extend transversely across the frame. Also extending substantially across the frame is an elongated member 8 having a horizontal top wall attached to the back of the front plate and projecting beyond it, and a downwardly extending rear wall the lower part of which is secured to the back side of the front shaft. There is thus formed between this member and the front shaft an open-front recess at each side of the frame with blocks 9 fastened in both ends of both chambers. These blocks and the side plates are provided with aligned openings. As shown in Fig. 3, extending forward from the bottom of the front plate is a forwardly tapered plate 11 the outer end of which is provided with a pair of laterally spaced bearings 12. Another plate 13 extends forward from the upper portion of the front plate and then downwardly to these bearings to which it is attached.

As shown in Figs. 1, 2, and 5, the center frame is supported between a pair of caterpillar units the frame for each of which consists of a pair of laterally spaced vertical side plates 16 extending a considerable distance ahead of and behind the center frame and rigidly connected by a pair of vertically spaced horizontal bracing plates 17 that are nearly as long as the side plates. The side plates are provided with openings through which the cylindrical ends of shafts 4 extend. Nuts 18 threaded on the ends of these shafts rigidly connect the caterpillar frames to the center frame.

The rear ends of each pair of side plates 16 are provided with aligned openings in which a shaft 19 is journaled, as shown in Fig. 1. The shaft extends through the inner side plate and carries a sprocket 21 by which the shaft is driven, while another sprocket 22 is rigidly mounted on the shaft between the plates that support it. The front ends of side plates 16 are provided with rearwardly extending slots 23 in each of which a block 24 is slidably mounted. Extending through the two blocks is a headed pin 26, and a circular plate 28 is mounted on the outer end of each block where it slidably engages the outer surface of the adjoining side plate to cover the slot 23 therein. These members are all held together by a nut 29 on the end of the pin. Journaled on the pin is a sprocket 31 that is straddled by the forked end of a tubular member 32 also mounted on the pin. To urge this sprocket toward the adjacent end of the caterpillar frame, a coil spring 33 is compressed between a shoulder in the tubular member and a collar on a screw 37 extending through the spring from a nut 38 that bears against a cross plate 39 in the frame. The nut can be adjusted through a slot 40 in the outer side plate of the frame in order to vary the pressure on the spring. Extending around the two sprockets at the opposite ends of the frame is an endless chain 41 that carries tread plates 42. The tread plates at the bottom of the frame slide along wear plates 43 mounted in longitudinal recesses in the lower edges of the side plates. The wear plates extend inwardly toward each other far enough to prevent the tread plates from moving laterally.

The side plates 16 are provided behind back plate 2 with a pair of brackets 44 extending up above the treads, as shown in Figs. 2 and 5. Each pair of brackets is provided with a pair of aligned openings in which the front end of a cradle 45 is pivotally mounted. As shown in Fig. 3, the rear end of the cradle is adjustably supported by a bolt 46 extending through a slotted vertical lug 47 mounted on a side bracket 48 projecting inwardly from the caterpillar frame. Mounted on each cradle is an electric motor 50 that drives a sprocket 51 connected by an endless chain 52 to the sprocket 21 below it.

Fastened to the side brackets 48 is the bifurcated front end of a T-shape control box 53 (Figs. 1, 2, and 6) in and on which various electrical and hydraulic control elements for the loader are mounted. The box also supports a shelf 54 on which the operator kneels. Connected to the central portion of back plate 2 and extending rearwardly therefrom toward the control box is an electric motor 56. As shown in Fig. 3, the reduced front end of the motor extends through an opening in the back plate and drives a sprocket 57 that is connected by a chain 58 (Fig. 5) to a smaller sprocket 59 mounted on a pump shaft. This shaft extends through the back plate to an hydraulic pump 60 (Fig. 1) supported by the back plate and connected by hoses 61 and 62 to a four-way valve 63 mounted beneath a horizontal plate 65 connected to the back plate and control box. The inlet of the valve is connected by a hose 64 to an oil tank 66 suspended from another horizontal plate 67 connected to the back plate and control box on the other side of the motor. The valve outlet is connected by a hose 68 to a pair of manually operable control valves 69 that have an outlet connected by a hose 70 to the oil tank. The control valves also have three ports that are connected by pipes 71, 72, and 73 to hydraulic cylinders that will be described presently.

At the front end of the center frame there is a loading conveyor which comprises a tiltable inclined head 76 carrying an endless conveyor 77 onto which coal is pushed by gathering arms 78. The head has a pair of arms 79 (Fig. 3) that extends rearwardly into the chambers between center frame blocks 9 (Fig. 7) to which they are pivotally connected. The elevation of the front end of the head is controlled by an hydraulic cylinder 81 that is pivotally connected to the bearings 12 of the center frame and that houses a piston 82 pivotally connected to the bottom of the head, as shown in Figs. 1 and 3. This cylinder is connected by pipe 71 to control valves 69. At the rear end of the head there is a cross shaft 83 (Fig. 3) on the ends of which are sprockets 84 that support the upper end of the conveyor, while the lower end of the conveyor extends around sprockets 86 rigidly mounted on a cross shaft 87. Bevel gears 88 (Fig. 2) on the ends of shaft 87 mesh with bevel gears 89 rotatably mounted above them directly below the gathering plates 91 at opposite sides of the conveyor. Gears 89 are connected through openings in the plates to crank discs 92 on which the gathering arms are pivotally mounted. The rear ends of the arms are pivotally connected by links 93 to the gathering plates to give the desired well-known motion to the arms. The gears 89 are driven by bevel pinions 94 that are rotated by electric motors 96 suspended from the gathering plates.

Another feature of this invention is that the upper end of the conveyor dumps coal onto a discharge conveyor 100 that extends across the machine. This conveyor is formed from vertical sides plates 101 connected by a bottom plate 102 and by a longitudinally concave floor plate 103

supporting the upper strand of the conveyor. At the opposite ends of the side plates there are journaled cross shafts 104 and 106 that extend through the rear side plate into a drive housing having a rear wall 107. Rigidly mounted on these shafts between the conveyor side plates are sprockets 108 that carry a pair of endless chains 109 connected at spaced intervals by parallel cross members 111. The upper strand of the conveyor is held down on the concave floor plate by means of concave side bars 112 attached to the side plates directly above the chains.

As shown in Fig. 5, the rearwardly projecting ends of shafts 104 and 106 are provided in the drive housing with sprockets 113 one of which is rigidly mounted on its supporting shaft while the other may be an idler. These two sprockets are connected by a chain 114 that extends over a pair of idler sprockets 116 and 117 and down around a driving sprocket 118 between them. The driving sprocket is connected by a spring loaded clutch to the large sprocket 57 operated by motor 56 so that these last two sprockets are coaxial and are driven in unison. The idler sprockets 116 and 117 are each rotatably mounted in brackets 121 that are pivotally connected at their lower ends to the top of the rear square shaft 4. These brackets have forwardly projecting rotatable pins 122 through which a rod 123 slidably extends. The brackets are urged toward each other by coil springs 124 compressed on the rods between the pins and nuts 126 threaded on the ends of the rods. Mounted on shaft 4 below each bracket is a stop member 127 for limiting downward movement of the adjacent bracket when its sprocket is forced downwardly by the chain being under tension due to the pull of the driving sprocket 118. The stop member prevents the adjacent sprocket from being forced down so far as to permit chain 114 to become disengaged from too many teeth of driving sprocket 118. When one bracket is thus forced down, the other bracket is swung upwardly by the rod and springs to take up the slack in the chain on that side of the driving sprocket. The sprocket brackets are mounted in this way because, as will be shown presently, the discharge conveyor is reversible.

In order to be able to discharge coal from either side of the machine, the cross conveyor can be moved longitudinally to project it from either side. For this purpose rods 130 are secured to the outer surfaces of the front side plate and rear housing wall 107 and extend longitudinally thereof. The rods are slidably supported in recessed guide members 131 (Figs. 2 and 3) attached to the front and back plates of the center frame. The movement of the conveyor across the machine is accomplished by a pair of hydraulic cylinders 132 and 133 mounted on the bars at the bottom of the center frame. The two cylinders face in opposite directions and each is provided with a piston 134 or 136 that carries two pulleys 137 at its outer end. The opposite end of each cylinder carries one pulley 138. As shown in Fig. 4, a cable 139, that is anchored at its lower end in a caterpillar unit, extends across the center frame and up around one of the double pulleys on piston 134, back across the frame and around the pulley 138 on cylinder 132, back to the other double pulley, and then back again to a bracket 141 attached to the bottom plate of the discharge conveyor. Another cable 142 is connected in the same way to the other caterpillar unit and the pulleys of the other piston and cylinder. The upper end of the cable is secured to the bottom of the conveyor near shaft 106.

The two cylinders are connected by pipes 72 and 73 to the hydraulic control valves 69 so that as fluid pressure is admitted to one cylinder the fluid in the other cylinder is released to the oil tank. When motor 56 is reversed in order to drive the conveyor in the opposite direction so that it will always discharge coal from the side of the machine from which it projects, the motor likewise drives the pump in the opposite direction. It is therefore necessary to reverse the flow of oil into and out of the pump, which is done by turning the handle of the four-way valve 63 so that oil under pressure will be delivered to control valves 69 as before.

It is desirable that for any given set of conditions the distance between the rear end of the loading conveyor and the portion of the cross conveyor below it remain uniform, and yet be possible to discharge coal from the cross conveyor at various heights including the level of the upper end of the loading conveyor. In order to accomplish both of these things while allowing the conveyor to discharge from either side of the machine, the supporting rods 130 are bowed downwardly to the same extent as the floor 103 of the discharge conveyor. Therefore, as either end of this conveyor is moved outwardly its outer end rises, but the portion beneath the loading conveyor remains the same distance below the upper end of that conveyor. It will be noted in Fig. 4 that the upper edge of the front side plate 101 of the cross conveyor likewise is concave and is substantially engaged by the curved lower edges of a pair of vertical guard plates 146 extending outwardly from the upper end of the main conveyor.

Fig. 4 also shows the discharge conveyor projecting from the right side of the machine with its outer end level with the top of the main conveyor, but with its inner end portion below the upper end of the main conveyor. By pumping oil into cylinder 132 and releasing it from cylinder 133, piston 134 will be moved to the left and will thereby cause cable 139 to move the discharge conveyor across the center frame so that it will project from the left side of the machine as indicated by broken lines in Figs. 1 and 6.

It will be seen that in the long-wall mining system this loader is adapted to travel parallel to and between the working face and the mine props with the cross conveyor normally extending between the props to discharge onto a belt or into cars likewise traveling parallel to the working face. The cross conveyor also is capable of being readily retracted to permit the machine to pass the mine props. Also, in order to avoid spillage of coal when the cross conveyor is opposite a prop, the machine may be trammed back and forth; that is, the machine is driven forward with the gathering arms in operation to deliver coal to the cross conveyor, but before the coal is discharged from the cross conveyor the machine is backed up so that the discharge end of the cross conveyor is clear of the prop, whereupon the coal is discharged into the haulage unit. After all of the coal has been discharged, the machine is again driven forward and the above-described operation is repeated until the machine has moved forward sufficiently for the cross conveyor to clear the prop. The loader can also be used in the "room" system of mining to pick up slate and gob it between the props along the side of the room at the rear of the working face.

According to the provisions of the patent statutes, we have explained the principle and construction of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, an inclined loading conveyor projecting downwardly from the front end of the frame, a discharge conveyor mounted on said frame transversely thereof and below the rear end of said loading conveyor for receiving coal therefrom, means for moving the discharge conveyor longitudinally in opposite directions to project it from either side of said frame, said discharge conveyor being provided with sprockets at its opposite ends and with an endless conveyor element extending around said sprockets, and means for always driving the sprocket at the projecting end of the discharge conveyor in a direction to pull the upper length of said conveyor element around it, whereby said upper length is kept under tension and coal is always discharged from said projecting end of the conveyor.

2. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, an inclined loading conveyor projecting downwardly from the front end of the frame, a discharge conveyor mounted on said frame transversely thereof and below the rear end of said loading conveyor for receiving coal therefrom, said discharge conveyor being provided with driving sprockets at its opposite ends, an endless chain extending around said sprockets, a drive sprocket engaging the chain between said driving sprockets, means for moving the discharge conveyor longitudinally in opposite directions to project it from either side of said frame, and means for driving said drive sprocket in opposite directions whereby to selectively discharge coal from either side of the machine.

3. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, an inclined loading conveyor projecting downwardly from the front end of the frame, a discharge conveyor disposed transversely of said frame below the rear end of said loading conveyor for receiving coal therefrom, a downwardly bowed supporting member extending lengthwise of each side of the discharge conveyor and secured thereto, guide members mounted on said frame and provided with recesses for slidably receiving said supporting members, means for sliding said supporting members lengthwise in opposite directions in said guide members to selectively project the conveyor from either side of said frame with its outer end higher than the rest of the conveyor, and means for driving the discharge conveyor in opposite directions whereby to discharge coal from either side of the machine.

4. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, an inclined loading conveyor projecting downwardly from the front end of the frame, a discharge conveyor mounted on said frame transversely thereof and below the rear end of said loading conveyor for receiving coal therefrom, a pair of horizontal hydraulic cylinders rigidly mounted on said frame under the discharge conveyor, pistons slidably mounted in the cylinders, cables connecting the pistons with the discharge conveyor for moving it in opposite directions to project it from either side of said frame, means for admitting fluid under pressure selectively into either cylinder and for releasing fluid from the other, and means for driving the discharge conveyor in opposite directions whereby to discharge coal from the side of the machine from which the conveyor projects.

5. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, said frame having spaced vertical front and back walls, a discharge conveyor extending transversely of said frame between said walls, an elongated supporting member extending lengthwise of each side of the conveyor and secured thereto, guide members mounted on said walls and slidably receiving said supporting members, an inclined loading conveyor projecting downwardly from the front end of said frame with its rear end projecting over said front wall to deliver coal to said discharge conveyor, means for sliding said supporting members lengthwise in opposite directions in said guide members to selectively project the conveyor from either side of said frame, and means for driving the discharge conveyor in opposite directions whereby to discharge coal from either side of the machine.

6. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, said frame having spaced vertical front and back walls, a discharge conveyor extending transversely of said frame between said walls, said back wall being provided with an opening, an electric motor mounted behind said back wall and operatively connected through said opening with the conveyor for driving it, and an inclined loading conveyor projecting downwardly from the front end of said frame with its rear end projecting over said front wall to deliver coal to the discharge conveyor.

7. A coal loading machine comprising a vehicle frame, means attached to the frame for propelling it along the ground, an inclined loading conveyor projecting downwardly from the front end of the frame, a discharge conveyor mounted on said frame transversely thereof and below the rear end of said loading conveyor for receiving coal therefrom, hydraulically actuated means for moving the discharge conveyor longitudinally in opposite directions to project it from either side of said frame, an hydraulic pump, an electric motor for driving the pump, means operably connecting the motor to the discharge conveyor, means for reversing the motor to drive the conveyor in the opposite direction, and means for reversing the inlet and outlet connections to the pump when said motor is reversed.

8. A self-propelled coal loading machine comprising a frame, traction members supporting the frame at opposite sides thereof, means for driving each of said members, an inclined loading conveyor pivotally mounted on a horizontal axis on the front end of the frame between said traction members, electrically operated means for driving said conveyor, hydraulic means for tilting said conveyor about its pivot, a discharge conveyor mounted transversely of said frame and below the rear end of the loading conveyor, hydraulic means for moving the discharge conveyor transversely of the frame, electrically operated means for driving the discharge conveyor in opposite directions, and manually operable controls at the rear of the machine for actuating said electrically operated and hydraulic means.

9. A coal loading machine for the long-wall system of mining comprising a frame, means attached to opposite sides of the frame for propelling it along the ground, a loading conveyor at the front end of the frame formed to gather coal in front of the machine and to carry it rearwardly thereof, a reversible discharge conveyor mounted for transverse reciprocation centrally of the frame below the rear end of the loading conveyor and adapted to receive coal therefrom and to discharge it at either side of the machine, and manually operable control means mounted at the rear of the frame behind the discharge conveyor for controlling the operations of said propelling means and the two conveyors and of the reciprocation of the discharge conveyor, said control means being located in a position for actuation by an operator stationed behind the machine.

JOHN D. RUSSELL.
CHARLES F. BALL.
ARTHUR S. KNOIZEN.