April 5, 1927. F. C. MARSHALL 1,623,194

EXCAVATING MACHINE

Filed Aug. 30. 1921 3 Sheets-Sheet 1

Fig. 1.

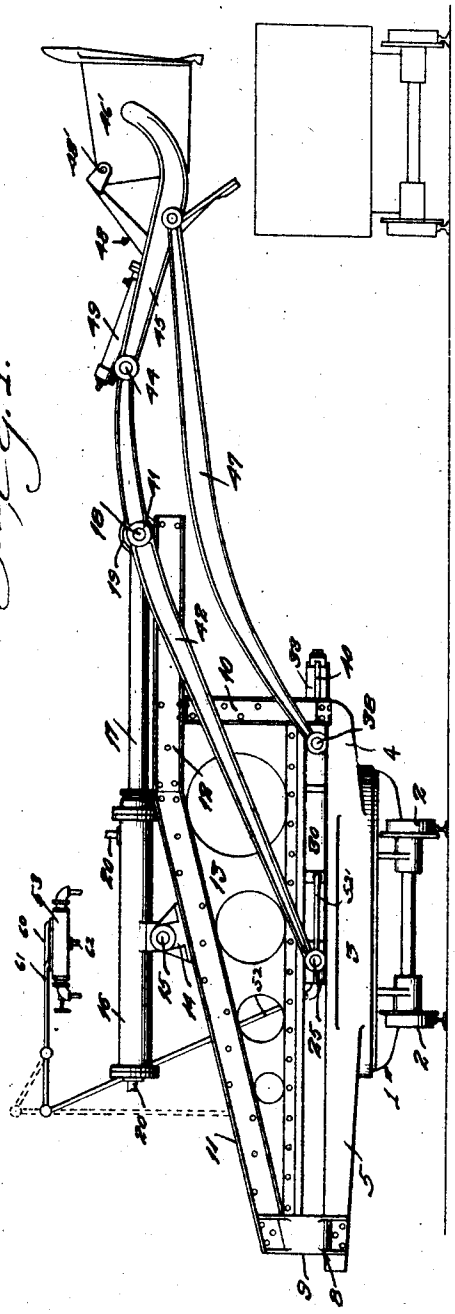
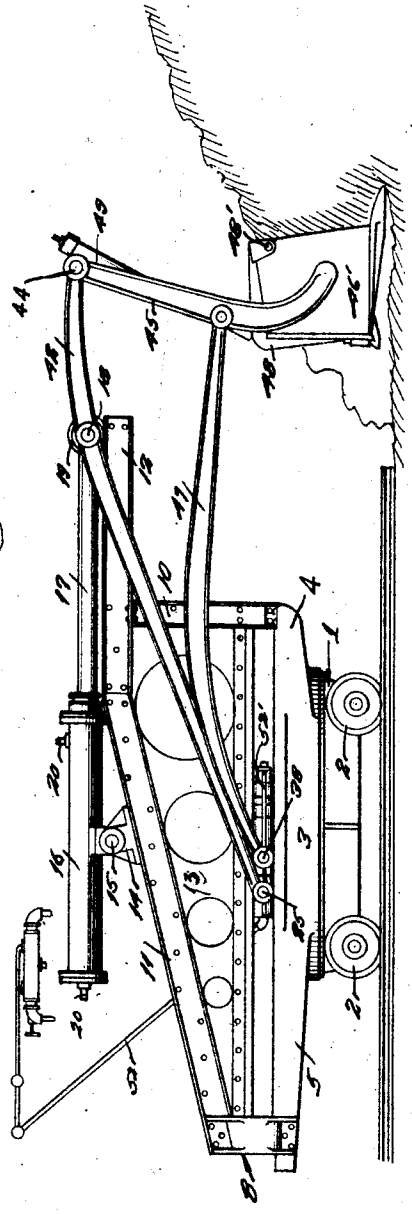


Fig. 2.



Inventor
FRANCIS C. MARSHALL.

By Young & Young
Attorneys

April 5, 1927. 1,623,194

F. C. MARSHALL

EXCAVATING MACHINE

Filed Aug. 30, 1921 3 Sheets-Sheet 2

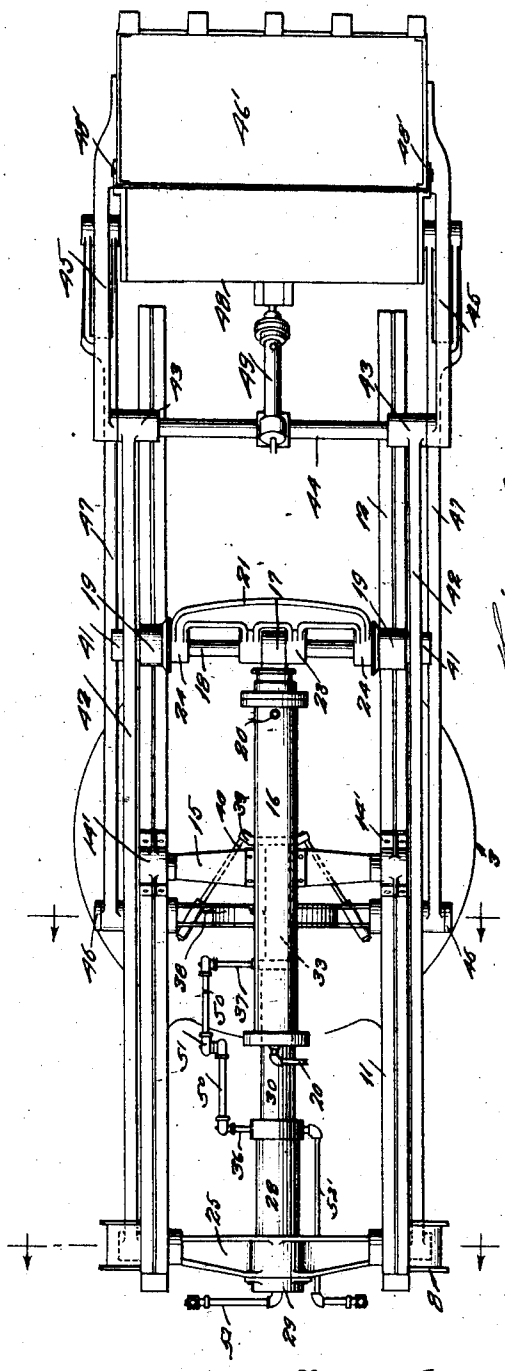


Fig. 3.

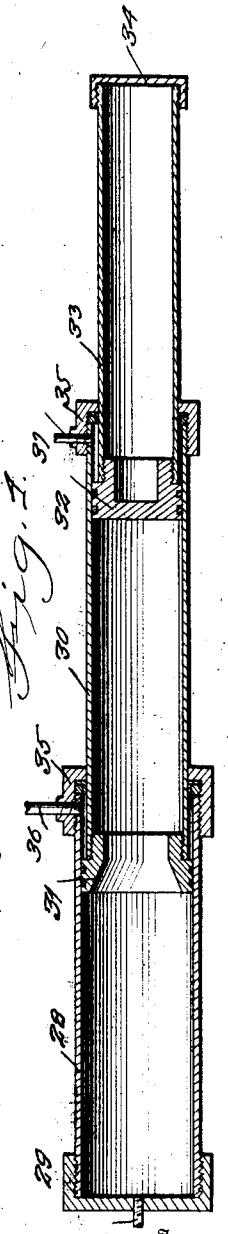


Fig. 4.

Inventor

FRANCIS C. MARSHALL.

By Young & Young

Attorneys

April 5, 1927

F. C. MARSHALL

1,623,194

EXCAVATING MACHINE

Filed Aug. 30. 1921

3 Sheets-Sheet 3

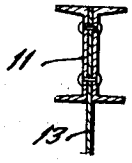


Fig. 5

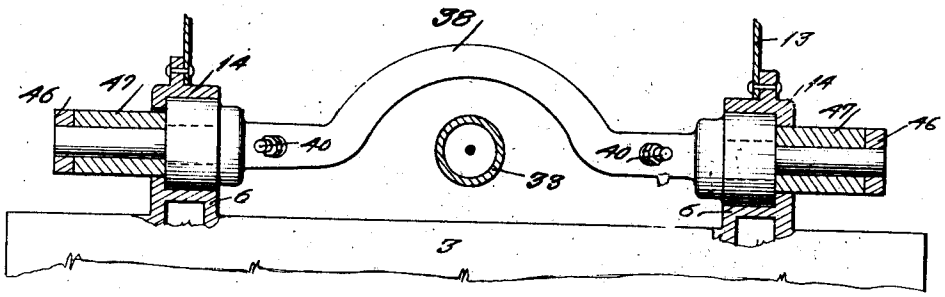
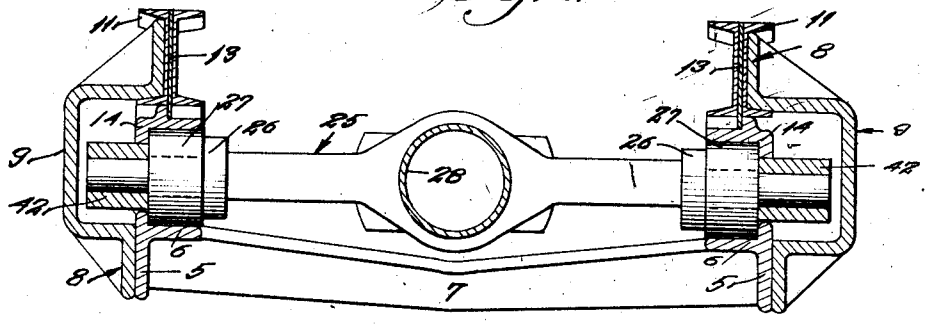


Fig. 6.



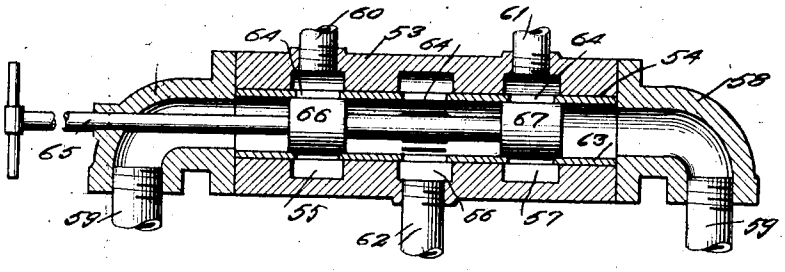


Fig. 7.

Inventor

FRANCIS C. MARSHALL

By Young and Young

Attorneys

Patented Apr. 5, 1927. 1,623,194

UNITED STATES PATENT OFFICE.

FRANCIS C. MARSHALL, OF GREEN BAY, WISCONSIN.

EXCAVATING MACHINE.

Application filed August 30, 1921. Serial No. 496,880.

My invention relates to improvements in excavating machines and is particularly directed to that class of machines which are designed primarily for use in tunneling and mining work having restricted head room, although its application is not limited to these fields.

Heretofore, the loading of coal and the like in mines has generally been done by manual labor, as the conditions of the mines were thought to be such as to prevent the practical use of loading machines therein, owing to the low ceilings, narrow passages and small rooms in which the work is done.

Therefore, it is the object of my invention to provide a machine of the character described which will readily transfer material such as coal, ore or other like substances from one point within the mine to another point, and it is especially designed for loading coal from the floor of a mine onto a mine car.

A further object of my invention is to provide a machine of the class described having a dipper that is moved in its several operating positions by motive elements which are operated by fluid, preferably air, under pressure.

Another object of my invention is the combination of a digging motive element and a positioning motive element, the digging element being so arranged that it is freely movable upon the shovel carriage and adapted to effect a digging stroke to the dipper and at the same time lift it clear of the mass of material. The positioning element functioning to place the dipper in its correct position for digging and dumping the contents of the dipper and for advancing the digging element into the mass of material as the same diminishes.

Another object of my invention is to provide a novel arrangement of valves for controlling the admission of fluid under pressure to the several motive elements, said valves being primarily designed for manual operation but their structure being such that they may be automatically operated if so desired.

While I have illustrated in the accompanying drawings a specific form of construction it will be readily understood that other elements of design may be included in the construction without departing from the essentials of the invention.

In the accompanying drawings which illustrate a simple embodiment of my invention,

Figure 1 is a side elevation of the machine showing the position of the several elements at the completion of the digging and dumping operations.

Figure 2 shows the machine as positioned ready for the digging stroke.

Figure 3 is a top plan view of the machine showing the digging motive element, in its extended position.

Figure 4 is a longitudinal vertical sectional view taken through the digging element as shown in Figure 3.

Figure 5 is a section on the line 5—5 of Figure 3.

Figure 6 is a section on the line 6—6 of Figure 3.

Figure 7 is a sectional view of the control valve for the several motive elements.

Referring to the drawings in detail, the numeral 1 designates a truck having the wheels 2 which are spaced apart equivalent to that of the usual narrow standard gauge track which is used in mines or the like, the truck 1 having mounted thereupon the loading mechanism which it conveys from place to place as occasion may demand, and to which my invention relates.

The loading mechanism proper comprises a base 3 upon which the various operating elements of the dipper are mounted, said base being arranged upon the truck in such a manner that the same may be readily swung from one side to another of the same, similar to that of a turntable.

The base 3 is formed preferably from a casting and has made integral therewith and extending therefrom the forwardly and rearwardly projecting arms 4 and 5, the same having formed integral therewith and on their top faces the flanged tracks 6 which extend across the base 3, the purpose of which will be fully apparent as the description proceeds.

Referring to Figure 6 it will be noted that

the end portions of the arms 5 are braced by the transversely extending web 7 made integral with the arms and slightly curved downwardly, the purpose of which will be apparent.

The adjacent end portions of the arms 5 have secured thereto, by suitable bolts or rivets, on their outer sides the vertically disposed members 8, the intermediate portion of each being bowed outwardly, as indicated at 9, while the arms 4 have secured to their outer sides and adjacent their ends, in a similar manner, the vertically arranged members 10. It will be noted that these latter members are not bowed outwardly in their intermediate portions, as the members 8, but remain entirely in a vertical plane, the purpose of which will be more fully disclosed later on.

The upper ends of the members 8 have secured thereto the upwardly inclined side bars 11 made of suitable channel iron and secured to the members 8 in a manner as that disclosed in Figure 6. Abutting the upper ends of the side bars 11 are similar bars 12 arranged in a horizontal plane and projecting somewhat in advance of the arms 4, while their adjacent intermediate portions rest upon the upper ends of the vertically disposed members 10 and are secured thereto by bolts or the like.

The members 10, 11 and 12 have bolted on their common sides the side walls 13 which are cut from sheet material and having portions cut therefrom to reduce the weight of the same.

The lower edges of the side walls 13 have secured thereto in a horizontal plane the flanged tracks 14, one end portion of each being secured to the vertical members 10, and the entire track being so positioned as to be over the correspondingly formed tracks 6 arranged upon the arms 4 and 5, and the base 3, thus forming therebetween a space, the purpose of which is to receive rollers which will be fully described later on.

In order that sufficient rigidity may be added to the structure just described, the members 11 and 12 have secured thereto on the sides having thereon the side walls 13, channel bars similar to the main bars themselves, thus presenting in cross-section I beams having in their intermediate portions the downwardly projecting walls 13.

The foregoing is merely a brief description of the structure of the carriage upon which the various operating elements and parts of the shoveling machine are mounted, the latter I will now proceed to describe.

The inclined side bars 11 have secured to their top faces, and adjacent their intermediate portions, transversely aligned bearing blocks 14 which are adapted to have journalled therein the ends of a cross beam 15, the intermediate portion of which has mounted thereon an air cylinder 16, which I shall hereinafter refer to as the main or positioning cylinder or motive element. The cylinder 16 has slidably arranged therein a reciprocating piston and its rod 17, the latter passing through a suitable stuffing box carried by the removable head of the cylinder, while its end is provided with a bearing through which passes the transverse shaft 18, the adjacent end portions of which have loosely mounted thereon the rollers 19 which are adapted to travel back and forth upon the top face of the bars 12 as fluid under pressure is admitted into the cylinder 16 at either end, through the pipes 20, one exhausting air to the control valve and the other permitting live air to enter from the supply through the control valve. In order that the shaft 18 may be held in its true relation with respect to the piston rod 17, and to give sufficient rigidity to the connection, I have provided a brace 21, the same having intermediate spaced bearings 23 and end bearings 24 through which the shaft 18 passes. The intermediate bearings 23 being adapted to receive therebetween the head of the piston rod 17, while the end bearings 24 tend to hold the rollers 19 in their proper spaced relation in order to ride upon the top face of the bars 12.

Extending transversely of the arms 5, and freely movable thereon, is an axle 25 the adjacent end portions of which have loosely mounted thereon and held in spaced relation to each other by the collars 26, rollers 27 which lie between the tracks 6 and 14. The central portion of the axle 25 is somewhat enlarged and provided with an opening adapted to receive therein the end of a cylinder 28, the adjacent end of which is closed by the removable head 29 the same being threaded thereon and locked or bolted to the axle 25.

The structure thus described is a portion of the digging element and the same further comprises a second cylinder 30 which is adapted to reciprocate within the cylinder 28 and serve as a piston therein, it will be noted that the cylinder 30 is provided with a head 31 through which the fluid passes and bears upon the head 32 of the piston 33, the same being formed of a tube and having its end closed by a removable head 34. By referring to Figure 4, it will be noted that both the cylinders 28 and 30 have their ends, adjacent the sliding elements, closed by a flanged ring 35 the same being threaded thereon and compressing between its flange and the cylinder edge suitable packing rings or the like, each ring 35 having passing therethrough and into the interior of each cylinder the pipes 36 and 37 which are adapted to discharge fluid behind the movable cylinder and piston and force the same forwardly.

Extending transversely of the base 3, and also freely movable on the tracks, is a second axle 38 the intermediate portion of which is bowed upwardly sufficient to receive thereunder the end of the piston 33, the removable head of which is provided with oppositely disposed and outwardly extending lugs 39 by which the piston is securely braced and held to the axle 38 by means of the brace rods 40.

From the foregoing, it will be noted that the digging cylinder or motive element is composed of several cylinders and a piston, the entire structure being freely movable upon the base 3 as a unit, and when fluid is admitted to the cylinders on the working stroke the piston is caused to move outwardly from the cylinder or cylinders, thus separating the two axles 25 and 38 and causing a novel movement of the dipper which will be hereinafter more fully described.

Journalled on the ends of the shaft 18 and held thereon by the collars 41 are curved arms 42, the lower ends of which are loosely mounted upon the ends of the axle 25, as disclosed in Figure 6, the other ends of which are provided with bearings 43 in which a horizontally disposed shaft 44 is journalled, the end portions of which protrude through the bearings 43 and have mounted thereon the ends of the dipper carrying arms 45, the latter being made integral with the dipper 46′.

The end portions of the axle 38 have mounted thereon in a similar manner to that of the axle 25 and held by the collars 46, the curved arms 47, the other ends of which are bifurcated and pivotally secured to the arms 45, adjacent their connection with the dipper 46′.

The dipper 46′, as disclosed in the drawings, comprises side walls having made integral therewith the arms 45, and the usual dipper teeth arranged on one wall, the remaining opened bottom and side of the dipper is closed by a member 48 hingedly connected to the side walls as at 48′. In order that the closure 48 may be properly operated, I have provided a small cylinder 49 mounted upon the shaft 44 and having therein a piston and its rod, the latter being connected to the closure. The cylinder 49 is provided with the usual inlet pipes and it will be noted that when fluid is admitted therein at either end the movement of the piston will cause a corresponding movement of the closure, resulting in the opening and closing of the dipper.

From the foregoing description, it will be apparent, briefly, that when fluid is admitted in the rear end of the cylinder 16, its piston 17 advances and carries with it the arms 42, the lower ends of which move the digging cylinder the same distance travelled by the piston upon the base 3. When the forward movement of the piston 17 is stopped, fluid is admitted into the rear end of the cylinder 28 through the pipe 52 and as the axle 25 remains stationary, the axle 38 moves away from the same, thus separating the two axles and imparting a digging stroke to the dipper and at the same time giving the dipper an upper swinging movement.

In order that air may be admitted behind the cylinder and piston arranged within the cylinder 28, I have provided a rigid but yet flexible connection between the cylinders 28 and 30, whereby the two axles may be drawn together. This connection comprises the pipes 36 and 37, previously referred to, the same being provided with oscillating joints or elbows at their outer ends to which the pipes 50 are connected, the ends of which are connected to a common oscillating joint or elbow 51. As shown in the drawings, this arrangement of pipes and joints is positioned in a vertical plane, but in the actual structure it is desired to position the same beneath the cylinders in a horizontal plane, in order that they might not interfere with the working of the cylinders.

In order that the axles 25 and 38 may be separated by motive power, I have provided the pipe 52 through which fluid is admitted into the end of the cylinder 28, where it passes through the head 31 and bears upon the piston head 32, thus moving the axles away from each other. When desired to draw the axles together, fluid is admitted into the cylinder 28 through the pipe 52′ leading into the cylinder behind the head 31 and through the ring 35. The pipe 52′ is connected to the cylinder 28 in a manner similar to that of the pipe 36 disclosed in Fig. 4. The fluid bears upon said head and moves the cylinder 30 inward of the main cylinder, after which the fluid passes through the flexible connections 50 and 51 to the pipe 37 which directs it behind the head 32, whereby the piston 33 is drawn inward and the two axles caused to approach each other, or more specifically, causes the cylinder 30 and the piston 33 to move inwardly of the main cylinder 28, thereby moving axle 38 toward axle 25, thus causing the dipper to assume a position such as that shown in Figure 2.

Each of the various cylinders or motive elements used in the complete operation of the dipper are controlled by an independent control valve, preferably manually operated, the same being arranged upon the base 3 of the machine, or at any convenient place desired, and connected to certain cylinders by rigid piping and others by flexible. In practice, I have found that flexible piping may be employed for the main cylinder 16 and the dipper closing cylinder 49, but due to the fact that the digging cylinder is

required to make so many movements during the operation of the machine it is though advisable to provide rigid piping leading to the same, this I have previously described, and as shown in Figures 1 and 2 it will be noted that at various points throughout the run of the pipe I have provided swinging or oscillating joints whereby the piping may be swung back and forth upon itself as the movement of the digging cylinder takes place.

As disclosed in Figure 7, I have illustrated a simple form of valve by which I may direct the flow of fluid to either end of the cylinder, one valve being adapted for each cylinder.

The valve proper comprises a casing 53 having therein a central longitudinal bore 54 and the annular channels 55, 56 and 57 while each end of the casing is closed by an elbow 58 from which leads a pipe 59 to a surge tank. The channels 55 and 57 have each in communication therewith the pipes 60 and 61, respectively, which lead to the ends of the cylinder which the valve is adapted to control. The intermediate channel 56 has in communication therewith the pipe 62 which leads from the source of supply for the fluid.

The bore 54 has fitted therein a bearing sleeve 63 which is provided with a series of elongated slots 64 lying within the confines of each channel. Slidable through one of the elbows 58 is a piston rod 65 the same having made integral therewith the spaced heads 66 and 67, the distance between each being equivalent to that between the adjacent edges of the channels 55 and 57. Thus it will be seen that when the piston rod is moved in either direction, particularly in such a direction that the heads will uncover the slots lying within the confines of the channels 55 and 57 and the head 66 will cut off communication between the channel 55 and the supply pipe 62 and permit the fluid from the cylinder to pass to the surge tank through the channel 55, slots 64, elbow 58 and into the pipe 59, while the head 67 cuts off communication between the pipes 61 and 59, but opens communication between the pipes 61 and 62, the latter leading from the supply.

The operation: In the use of the machine the truck mechanism is first brought into operation to cause the machine to be brought in contact with the material to be handled. Assuming that the dipper is in a position similar to that illustrated in Figure 2, the operator then moves the control valve to such a position as will admit the fluid into cylinder 16 and cause the piston 17 to move forward, as it does, it moves with it the dipper 46 and the movable digging cylinder, and as the dipper moves forward it will be moved parallel with the floor, thus effecting a scraping and gathering action. If, in this movement forward the dipper strikes an obstruction on the floor, by reason of the pivotal mounting of the cylinder 16, the same will be caused to move upward and the dipper will ride over the obstruction. When the limit of the desired forward movement has been reached, the operator cuts off the supply of fluid from the cylinder 16 and operates the valve controlling the fluid supply to the digging cylinder and when fluid is admitted into the same the axles are caused to separate, in a manner previously described, thus giving an upward swinging motion to the dipper through the mass of material. When the dipper is elevated a sufficient height for dumping, the base is swung upon the truck 1 so as to position the dipper above the mine car, after which the valve controlling the flow of fluid to cylinder 49 is operated to cause the opening of the closure.

After the machine and the dipper are once positioned in their correct starting point it is not necessary to change the position of the piston 17, or the pivot of swing for the dipper, until all of the material has been gathered up from that point, after which the digging cylinder is moved by the main cylinder 16 to a new position. If occasion may demand, the dipper may be moved forward in its elevated position by the cylinder 16, in order to bring the same above the mine car or any other purpose that may present itself.

In order that the dipper may be returned to its starting position, the operator merely moves the valve to such a position that the fluid will be caused to enter the cylinder in a reverse direction, thus forcing the piston backward or forward as the case may be.

As disclosed in Figures 1 and 2, it will be noted that the dipper 46′ is provided with a member which projects slightly beyond the edge of the dipper wall and adapted to receive thereunder the free end of the closure 48 when the same is in a closed position.

Furthermore, it is apparent that by reason of the particular structure of the digging cylinder a greater force is exerted at the first half of the digging stroke than at the last half, thereby giving greater force when the dipper is in the mass of material and less as it clears the same and moves upwardly, thus saving power.

From the foregoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. A shoveling machine of the class described having a dipper, pairs of arms pivotally connected to said dipper, a movable motive element to which said arms are pivoted and by which the arms are separated to cause an upward swinging movement of the dipper, and a main element for moving said dipper and motive element in a horizontal plane.

2. In a shoveling machine, a dipper, actuating elements connected thereto, the other ends of which are connected to members movable on said machine, a motive element for moving said members to and away from each other whereby a swinging movement is imparted to said dipper, and a second motive element pivotally mounted on said carriage for imparting a horizontal movement to said dipper and said motive element.

3. In a shoveling machine, a carriage, a motive element pivoted thereon and having associated therewith a reciprocating actuating element, members movable on said carriage, a second motive element positioned between said members for moving one away from the other, a dipper, arms connecting said dipper and movable members whereby said dipper is moved in various positions, and one of said arms being connected to the actuating element of the first said motive element whereby said movable members and dipper are moved in a horizontal plane.

4. A shoveling machine of the class described having a dipper, arms pivotally connected to said dipper the ends of which are journalled on axles movable on the machine, a motive element having a reciprocating actuating element connected to certain of said arms for moving the said dipper and axles, and a second motive element adapted to move said axles to and away from each other whereby said dipper is caused to oscillate upon said arms.

5. A shoveling machine of the class described having a platform and a track portion, a dipper, an extensible motive element movable upon said platform and having pivotally connected thereto dipper-carrying arms, a second motive element positioned near said track and having its movable member connected to certain of the dipper-carrying arms for positioning the dipper with respect to the work, and a third motive element having a movable actuating element connected to said dipper for imparting a certain operative movement thereto.

6. A shoveling machine of the class described having a platform, a track portion and a dipper, an extensible motive element movable upon said platform and having pivotally connected thereto dipper-carrying arms, a second motive element positioned near said track and having its movable member connected to the first said motive element through certain of the dipper-carrying arms for positioning the dipper with respect to the work, and a third motive element having a movable element connected to said dipper for imparting a certain operative movement thereto.

7. A shoveling machine of the class described having a platform, a track portion and a dipper, members movable upon said platform and having therebetween a motive element for moving one of said members with respect to the other, a pair of dipper arms pivotally connected to one of said members, a second motive element positioned adjacent said track and having a movable element resting thereon, arms connecting said dipper and the last said movable element with the other of the first said movable members for positioning the dipper with respect to the work, and a third motive element having a movable element connected to said dipper for imparting certain operative movement thereto.

In testimony that I claim the foregoing I have hereunto set my hand at Green Bay, in the county of Brown and State of Wisconsin.

FRANCIS C. MARSHALL.