May 19, 1953 R. H. GOODRICH 2,639,023

LOADING MACHINE

Filed March 26, 1946 3 Sheets-Sheet 1

Fig. 1.

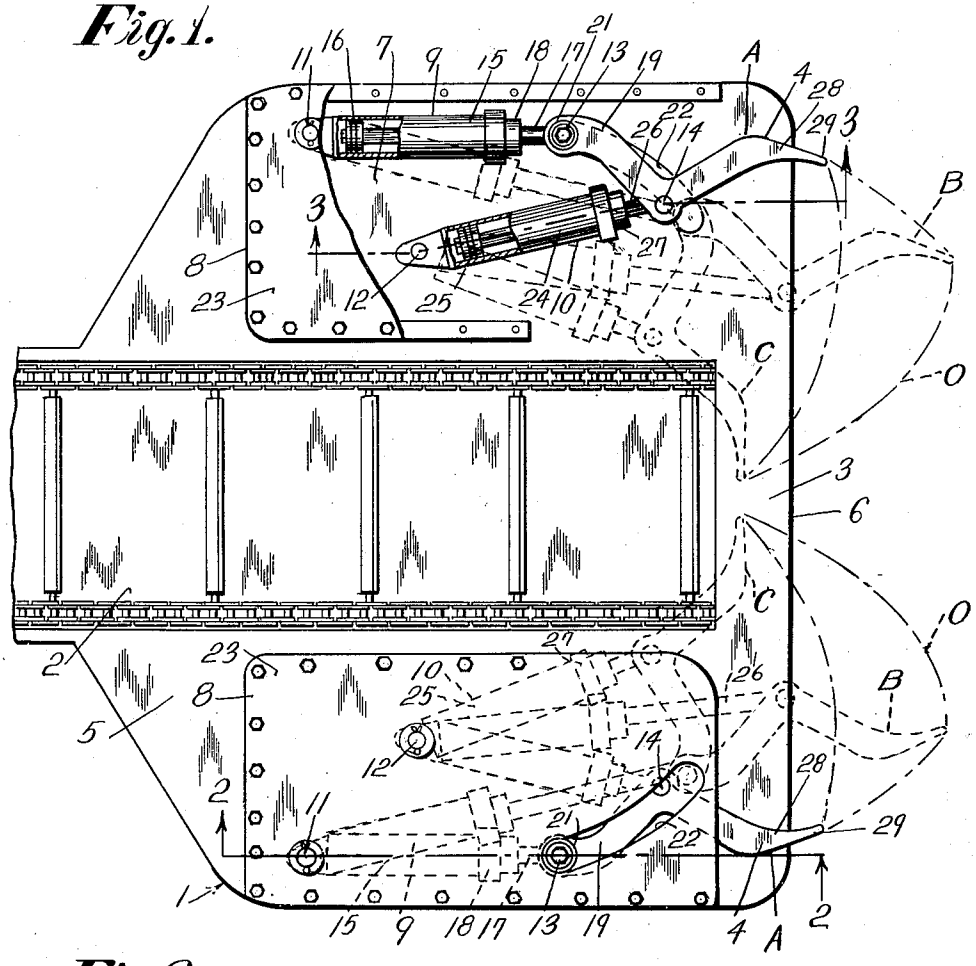


Fig. 2.

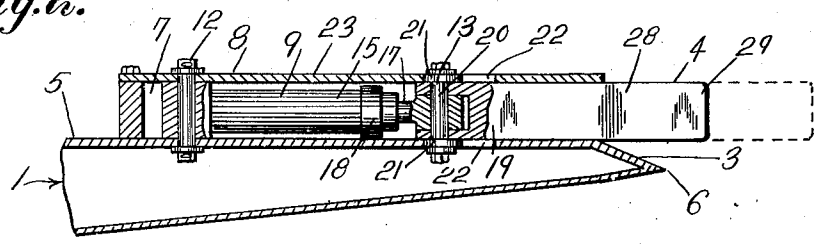
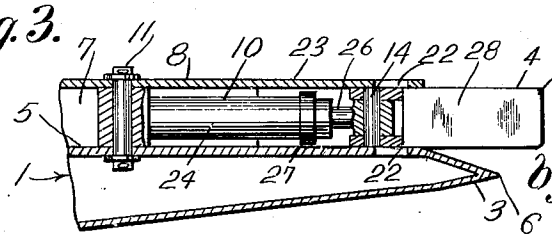


Fig. 3.



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May 19, 1953 R. H. GOODRICH 2,639,023

LOADING MACHINE

Filed March 26, 1946 3 Sheets-Sheet 2

Fig.4.

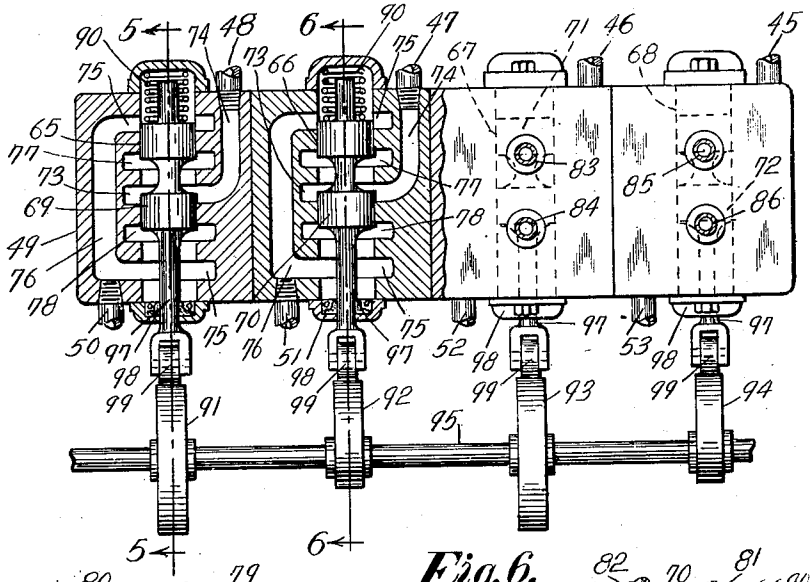


Fig.5.

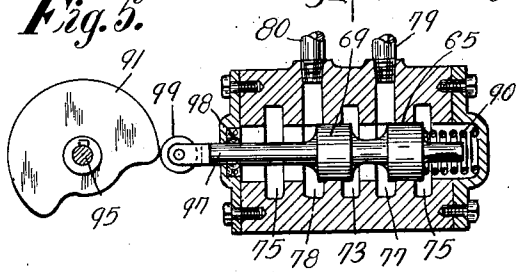


Fig.6.

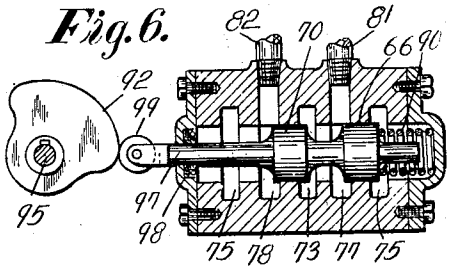


Fig.7.

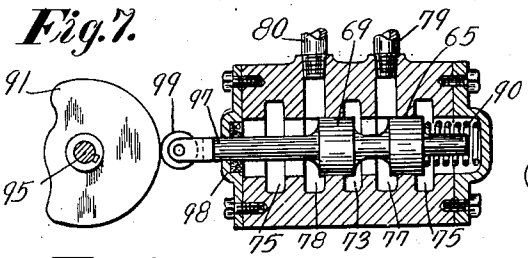


Fig.8.

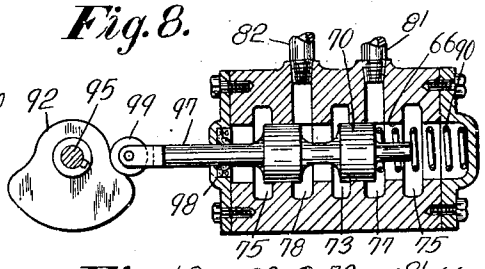


Fig.9.

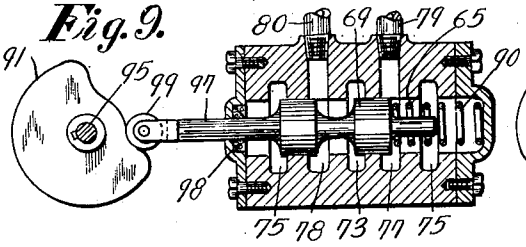
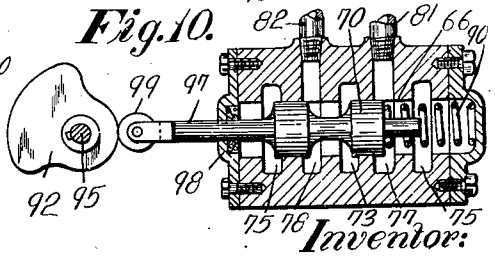


Fig.10.



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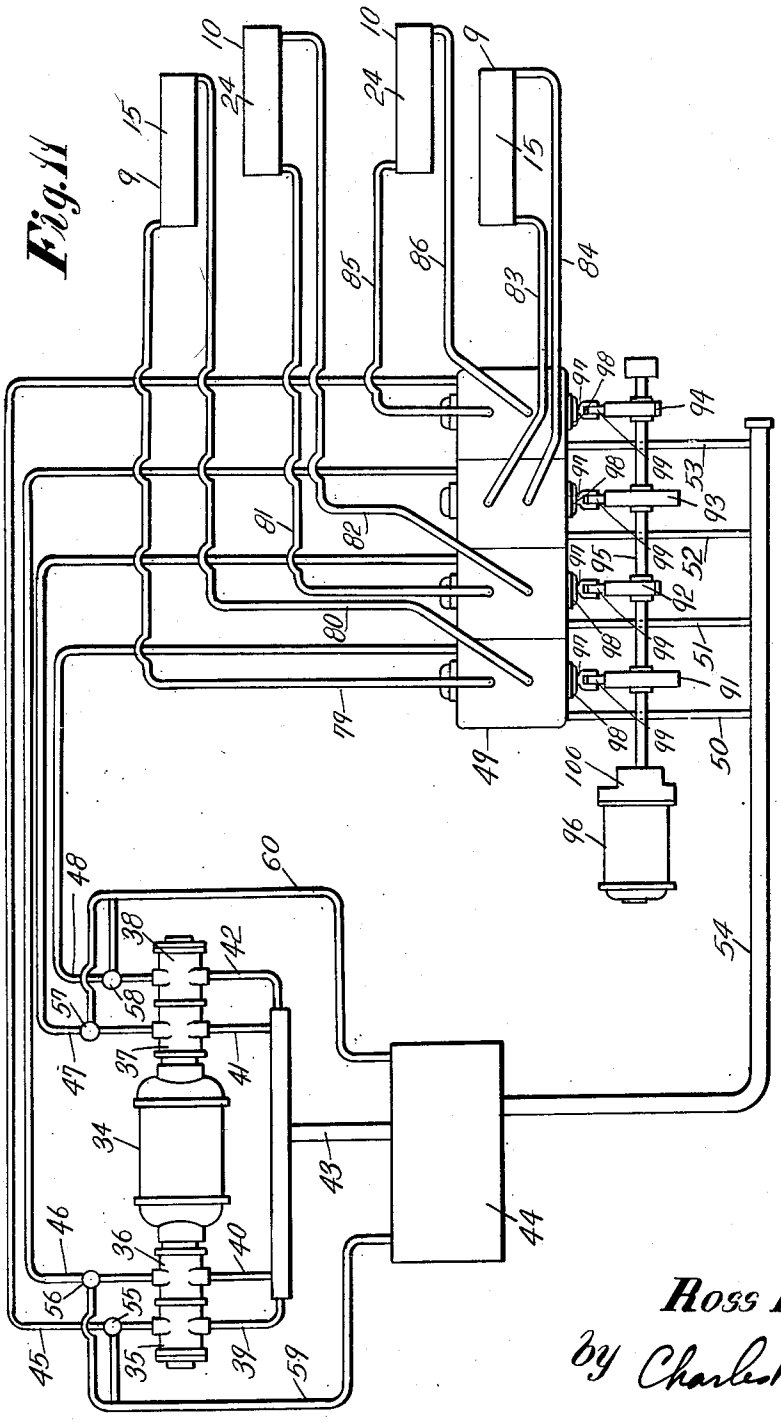
LOADING MACHINE

Filed March 26, 1946 3 Sheets-Sheet 3

Fig. 11



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UNITED STATES PATENT OFFICE

2,639,023

LOADING MACHINE

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Application March 26, 1946, Serial No. 657,107

1 Claim. (Cl. 198—10)

1

This invention relates to loading machines and more particularly to an improved material gathering mechanism embodying cooperating relatively movable gathering elements and improved fluid operated means for moving the gathering elements during the gathering operation.

In a gathering mechanism for a loading machine, there are usually employed cooperating, relatively movable gathering elements for moving the material to be loaded onto an elevating conveyor, and such gathering elements are usually mechanically interconnected and mechanically driven in unison so that in the event that one gathering element becomes stalled due to overloading, the other gathering element concurrently ceases to function. Also in such mechanically driven gathering elements, the drive thereof is usually of the substantially constant speed type so that varying gathering speeds under varying loads to suit different loading conditions are impossible. And such mechanically interconnected and mechanically driven gathering elements oftimes lack inherent flexibility of operation such as is desirable in gathering mechanism of loading machines for loading material, such as coal, in underground coal mines. The gathering elements are usually driven by one or more electric motors through reduction gearing and friction clutches, and overloading of the mechanism often results in excessive wear of the clutches and damage to the windings of the motor or motors; and often when the mechanism is operating under extremely heavy load, the demands on the electric system in a mine become excessive, resulting in undesirable peak loads.

In accordance with the present invention, in a preferred embodiment, the cooperating gathering elements of the gathering mechanism may be driven by fluid operated motors so arranged and so associated with the gathering elements that in the event one gathering element slows down or becomes stalled due to overloading, the other gathering element may continue to function in a normal manner. By the provision of variable control for the fluid operated motors for moving the gathering elements, great flexibility is attained, thereby making it possible for an electric driving motor to continue to run at normal speeds by the provision of suitable safety means in the fluid system. Also in accordance with the present invention, in a preferred embodiment, fluid operated cylinder and piston devices are employed to move the cooperating gathering elements and novel means is provided for controlling the distribution of fluid with respect to these cylinder and piston devices so that the same may be operated in a definite sequence determined by the paths of movement of the gathering elements. By the provision of suitable automatic bypass valve means in the fluid system, overloading of the electric driving motor is impossible and overheating, due to overload, is precluded. More specifically, the cylinder and piston devices may be pivotally mounted and may be pivotally connected to the gathering elements and the latter may be confined to a predetermined path during portions of their movements by the provision of suitable guiding means. Automatic fluid distributing valve mechanism operating at a constant speed under any given condition may be employed for controlling the fluid distribution with respect to the cylinder and piston devices to effect operation of the latter in a predetermined manner so that a predetermined sequence of operation of the gathering elements may be maintained. The speed of operation of the distributing valve mechanism may be varied under manual control to obtain the variable speed operation of the gathering elements.

2

An object of the present invention is to provide an improved gathering mechanism for a loading machine. Another object is to provide an improved gathering mechanism wherein the gathering elements thereof are fluid operated, resulting in extreme flexibility of operation. Yet another object is to provide an improved gathering mechanism wherein the gathering elements may be moved during the gathering operation by fluid cylinder and piston devices arranged and mounted in a novel manner. Another object is to provide improved fluid operated moving means for the gathering elements of a gathering mechanism together with improved control means for the moving means whereby variable speed operation may be obtained. A further object is to provide an improved fluid operated gathering mechanism embodying automatic fluid distributing valve means for distributing the operating fluid with respect to the cylinder and piston devices to operate the latter in a predetermined sequence. Still another object is to provide an improved fluid distributing valve mechanism which may have variable operating conditions wherein the speed of operation of the fluid motors for moving the gathering elements may be varied to suit different loading conditions. A still further object is to provide improved gathering elements mounted and guided during their operation in an improved manner. Still another object is to pro-

vide an improved material gathering mechanism having a novel combination and arrangement of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a plan view of the gathering head of a loading machine in which an illustrative form of the improved gathering mechanism is embodied.

Fig. 2 is a view in longitudinal vertical section taken substantially on line 2—2 of Fig. 1.

Fig. 3 is a longitudinally extending vertical sectional view taken substantially on lines 3—3 of Fig. 1.

Fig. 4 is a horizontal sectional view, with a portion in plan, illustrating the fluid distributing valve mechanism.

Fig. 5 is a cross-sectional view taken on line 5—5 of Fig. 4.

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 4.

Figs. 7 and 8 are sectional views similar to Figs. 5 and 6 respectively, showing the cams and valves in different positions.

Figs. 9 and 10 are sectional views similar to Figs. 7 and 8 respectively, showing the cams and valves in still other positions.

Fig. 11 is a diagrammatic view illustrating the fluid system.

In this illustrative embodiment of the invention, the improved gathering mechanism is embodied in the loading head of a loading machine especially designed for use in the loading of coal or similar material in underground mines. Evidently, the gathering mechanism may be associated with loading machines of various kinds for loading various sorts of material.

As shown in the drawings, the gathering head, generally designated 1, of the loading machine has associated therewith an endless elevating conveyor 2. As is usual in coal loading machines, the gathering head and the forward portion of the elevating conveyor may be pivotally mounted on a portable base for vertical tilting adjustment, and during the loading operation, the nose 3 of the gathering head is located near or rests on the mine floor so that the pile of material to be loaded may be readily penetrated.

The improved gathering mechanism of the gathering head comprises a pair of cooperating relatively movable gathering elements or arms 4, 4 so arranged and mounted on the head at the opposite sides of the receiving end of the conveyor as to penetrate the pile of material to be loaded and to move the material onto the elevating conveyor whereby the material may be moved rearwardly of the machine to a suitable point of discharge. In Figs. 1, 2 and 3, the nose of the gathering head is shown in its elevated transport position with the gathering elements substantially horizontally disposed. However, during the loading operation, the gathering head is inclined downwardly with its nose in proximity to the mine floor. The gathering head has a platform or deck 5 and the forward portion of the elevating conveyor is substantially flush with the top surface of the platform. The forward penetrating edge 6 of the head-nose is provided by the relatively inclined converging surfaces of the nose. Arranged in chambers 7, 7 provided by casings 8 carried on the head platform at the opposite sides of the elevating conveyor are fluid motors 9 and 10, herein pivotally mounted at their rear ends at 11 and 12 respectively on the head platform, and pivotally connected at 13 and 14 respectively at their front ends to the gathering arms 4. Since the specific structure of the gathering arms and the actuating motors therefor at the opposite sides of the elevating conveyor are the same, the description of the structure associated with one gathering arm will suffice for both. The motors 9 and 10 are of the fluid operated cylinder and piston type and each motor 9 comprises a cylinder 15 containing a reciprocable piston 16 having its piston rod 17 projecting forwardly through the front packed head 18 of the cylinder. The piston rod is pivotally connected by the pivotal connection 13 to the rear end of the inclined rear portion 19 of the associated gathering arm. The pivotal connections 13 each includes a pivot pin 20 carrying rollers 21 guided in arcuate slots or guideways 22 formed respectively in the platform 5 and a top plate 23 of the casing 8. Each motor 10 comprises a cylinder 24 containing a reciprocable piston 25 having its piston rod 26 projecting forwardly through the front packed head 27 of the cylinder. The forward end of the piston rod is pivotally connected by the pivotal connection 14 to the associated gathering arm intermediate the ends of the latter. Each gathering arm has its forward gathering portion 28 arranged angularly with respect to the rearward portion 19, and the gathering portion terminates in a forward penetrating end 29 which overlies the nose of the gathering head. The points of pivotal connection at 14 are herein located at the juncture of the arm portions 19 and 28 of the gathering arms. The gathering portion 28 is confined to movement in a predetermined path so that its tip end traces an irregular orbit as indicated in broken lines at 6 in Fig. 1. As the gathering portions 28 of the gathering arms move inwardly and rearwardly during the gathering operation, they approach the receiving end of the elevating conveyor near the longitudinal median line of the head in the manner shown. It is accordingly evident that when operating fluid is supplied to the rear ends of the cylinders 15 and 24, the pistons 16 and 25 are moved forwardly in unison, moving the gathering arms from the full line positions indicated at A in Fig. 1 in a forward direction into the pile of material to be loaded; and as the arms move forwardly, the arcuate guide slots or guideways 22 cause the arms to move inwardly toward the longitudinal vertical center of the loading head to the position indicated at B in dotted lines in Fig. 1. The pistons 16 of the cylinders 15 are then held in their foremost positions against the front cylinder heads by the pressure of the fluid, while the rear ends of the cylinders 24 are connected to exhaust, and operating fluid is supplied to the front ends of the cylinders 24 to effect retraction of the pistons 25, and as these pistons move rearwardly, the gathering arms are swung inwardly about the axes of their pivotal connections 13 with the piston rods 17 toward the receiving-end of the elevating conveyor to the position indicated in dotted lines at C in Fig. 1, thereby moving the material onto the conveyor. The pistons 25 are then held in their rearmost positions against the rear cylinder heads by the pressure of the fluid, and operating fluid may then be supplied to the front ends of the cylinders 15 while the rear ends of the cylinders are con-

nected to exhaust to retract the pistons 16, thereby swinging the arms outwardly and rearwardly to their original positions indicated at A in Fig. 1. The cycle of events above described is then successively repeated during normal operation of the gathering mechanism.

Now referring to the improved fluid system shown in Fig. 11 and more particularly to the improved automatic fluid distributing valve mechanism for distributing operating fluid with respect to the motor cylinders, it will be noted that a motor 34, preferably an electric motor, drives pairs of conventional fluid pumps 35, 36, 37 and 38, one pump individual to each of the arm-moving motors, and having their intake sides connected by branch conduits 39, 40, 41 and 42 to a conduit 43 connected to a fluid tank 44. The discharge sides of the pumps are connected by conduits 45, 46, 47 and 48 to the supply passages of a valve box 49. The exhaust passages of the valve box are connected by branch conduits 50, 51, 52 and 53 to a conduit 54 leading back to the tank. The pump discharge conduits 45, 46, 47 and 48 are respectively connectible by automatic relief valves 55, 56, 57 and 58 and conduits 59 and 60 back to the tank so that when the pressure in the fluid system becomes excessive due to overload, the fluid will be automatically bypassed back to the tank.

The valve box 49 is of a conventional design having parallel bores 65, 66, 67 and 68 respectively containing reciprocable slide valves 69, 70, 71 and 72 of the well known balanced spool type herein having cam actuation and spring return. Communicating with the valve-receiving bores midway between their ends are recesses 73 with which the supply passages 74, 74 of the valve box respectively communicate, while communicating with the valve-receiving bores near their ends are recesses 75, 75 with which the exhaust passages 76 of the valve box respectively communicate. Also communicating with the valve-receiving bores intermediate the recesses 75, 75 and the central recesses 73 are recesses 77 and 78. The recesses 77 and 78 which communicate with the valve-receiving bore 65 are connected by conduits 79 and 80 respectively to the rear and front ends of the upper motor cylinder 15 as viewed in Figs. 1 and 11, while the recesses 77 and 78 communicating with the valve-receiving bore 66 are connected by conduits 81 and 82 respectively to the rear and front ends of the upper motor cylinder 24. The recesses 77 and 78 communicating with the valve-receiving bore 67 are connected by conduits 83 and 84 respectively to the rear and front ends of the lower motor cylinder 15 as shown in Figs. 1 and 11, while the recesses 77 and 78 communicating with the valve-receiving bore 68 are connected by conduits 85 and 86 respectively to the rear and front ends of the lower motor cylinder 24. The slide valves 69, 70, 71 and 72 may be shifted to connect the recesses 77 and 78 either with the supply recesses 73 or the exhaust recesses 75, 75 to connect the opposite ends of the motor cylinders either to supply or exhaust in an obvious manner. Coil springs 90 constantly urge the valves in one direction and cams 91, 92, 93 and 94, fixed to a shaft 95 driven by a motor 96, move the valves in the opposite direction against the action of the springs. The valves have valve-stems 97 which project outwardly from the valve box through packed heads 98, and these stems carry rollers 99 engaging the cams, and the springs 90 yieldingly hold the rollers in contact with the cams. The cam driving motor 96 is preferably a constant speed electric motor and suitable conventional variable speed, manually controllable reduction gearing 100 may be arranged between the motor power shaft and the cam shaft 95 to obtain variable speed drive of the latter. If desired, a variable speed electric motor under manual control may be employed to drive the cam shaft 95 at variable speeds. The cams 91, 92, 93 and 94 are so shaped and so arranged as to move the slide valves in a predetermined manner to effect operation of the arm-moving motors 9 and 10 in their proper sequence as determined by the paths of movement of the gathering arms. By varying the speed of the cam shaft 95, the gathering speed of the gathering arms may be varied as desired. The pairs of cams 91 and 93 for the valves 69 and 71 respectively and 92 and 94 for the valves 70 and 72 respectively are identical in design and have the same angular relation with respect to the cam shaft so that the motors 9, 10 for one arm and the motors 9, 10 for the other arm may be operated in unison. When the cams 91 and 92 are in the positions shown in Figs. 5 and 6, the valves 69 and 70 are positioned to connect the supply recesses 73, 73 with the recesses 77, 77 and fluid may then flow through conduits 79 and 81 to the rear ends of the upper motor cylinders 15 and 24 (Figs. 1 and 11), while the conduits 80 and 82 leading from the front ends of these cylinders are connected to exhaust through recesses 78 and 75 and exhaust conduits 50 and 51. The pistons 16 and 25 are then moved by the pressure of the fluid forwardly to move the associated gathering arm from the position A in Fig. 1 to the position B in that figure. When the cams 91, 92 assume the positions shown in Figs. 7 and 8, the valve 69, due to the shape of the cam-lobe, remains in the position of Fig. 5 with fluid held in the rear end of the cylinder 15 while the valve 70 is moved to connect the supply recess 73 with the recess 78 and fluid may then flow through conduit 82 to the front end of the cylinder 24 and to connect the rear end of the cylinder 24 to exhaust through conduit 81, recesses 77 and 75 and exhaust conduit 51. The piston 25 in the cylinder 24 is then moved rearwardly by the pressure of the fluid to swing the gathering arm inwardly and rearwardly to the position shown at C in Fig. 1. When the cams 91 and 92 assume the positions shown in Figs. 9 and 10, valve 70, due to the cam-lobe shape, remains in the position of Fig. 8 while the valve 69 has moved into its opposite position to connect the supply recess 73 with the recess 78 to supply fluid through conduit 80 to the front end of the cylinder 15 and to connect the rear end of the cylinder to exhaust through conduit 79, recesses 77 and 75 and exhaust conduit 50. The piston 16 is then moved rearwardly by the pressure of the fluid to move the gathering arm back to the position at A in Fig. 1 to complete the gathering cycle. The cams 93 and 94 for the valves 71 and 72 operate in the same manner as and concurrently with those described above so that the other gathering arm is concurrently moved through a similar gathering cycle. Since there are provided four pumps, one individual to each motor cylinder, the gathering arms may be moved at a constant speed determined by the speed of the cam drive shaft 95, and in the event one gathering arm slows down or stalls due to overload, the other arm may continue to function at a normal gathering speed. Upon overloading of the gathering arms, an excessive pressure is prevented from building up in

the fluid system by the automatic relief valves 57, 58, 59 and 60. By varying the speed of the cam drive shaft 95, the gathering speed may be varied to suit varying loading conditions.

In a loading machine of the type disclosed, the pumps, the driving motors 34 and 96 and the distributing valve mechanism may be mounted on the gathering head beneath the elevating conveyor or may be mounted at the base of the machine independently of the head, and in the latter case, the conduits leading from the valve box to the motor cylinders will be flexible to permit tilting adjustment of the head relative to the base. While there is shown herein a separate pump for each piston motor, it will be evident that other suitable forms of pumping means may be employed.

The general mode of operation of the improved gathering mechanism will be clearly apparent from the description given. The loading machine may be moved in a wellknown manner into adjacency to a pile of material to be loaded and the gathering head 1 may be tilted downwardly to bring the head-nose 3 into proximity to the mine floor. The elevating conveyor 2 may then be suitably rapidly circulated and the motors 34 and 96 may be started with the cam drive shaft 95 driven at the desired predetermined speed. As the cam drive shaft revolves, the slide valves 69, 70, 71 and 72 are actuated by the cams 91, 92, 93 and 94 to effect fluid supply concurrently to the rear ends of the four motor cylinders 15, 15 and 24, 24 to effect movement of the gathering arms 4, 4 forwardly in unison from the positions indicated at A in Fig. 1 to penetrate the material to be loaded, and as the arms move forwardly, the arcuate guideways 22 cause the arms to swing inwardly about their pivotal connections 13 toward the longitudinal median line of the gathering head to the positions indicated at B in Fig. 1. When the pistons 15 and 24 are at the forward ends of their forward strokes, the valves 70 and 72 are automatically shifted to effect fluid supply to the front ends of the cylinders 24 while the rear cylinder-ends are connected to exhaust to swing the gathering arms about the pivotal connections 13 inwardly and rearwardly to the positions indicated at C in Fig. 1, thereby moving the material onto the elevating conveyor. When the pistons 25 are at the ends of their rearward strokes, the slide valves 69 and 71 are automatically shifted to effect fluid supply to the front ends of the cylinders 15 while the rear cylinder-ends are connected to exhaust to move the gathering arms outwardly and rearwardly along the curved guideways 22 to the initial positions indicated at A in Fig. 1. These events are rapidly successively repeated in a definite sequence during normal operation of the mechanism. In the event one gathering arm slows down or stalls due to overload, the other arm may continue to function in a normal manner. By changing the speed of the cam drive shaft 95, the speed of movement of the gathering arms may be varied to suitably variable loading conditions. Upon overload of the gathering arms, the relief valves will open automatically to prevent the building up of excessive pressures in the fluid system. By the provision of a separate pump for each motor cylinder, a constant rate of fluid flow may be maintained regardless of the relative loads on the gathering arms, thereby eliminating the tendency of a greater rate of flow to those motor cylinders which are under the smaller load. Other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claim.

What I claim as new and desire to secure by Letters Patent is:

In a loading machine having a gathering and loading head provided with an inclined deck, a gathering arm movable bodily forwardly relative to said deck in planes parallel with the latter to effect penetration of the material to be loaded and swingable laterally and rearwardly in said planes to load the material rearwardly onto said deck, a guideway for said arm on said deck, a guide for said arm movable along said guideway and to which said arm is pivotally connected, fluid cylinders on said deck and pivotally connected to said arm and simultaneously operable to effect bodily movement of said arm along said guideway thereby to effect penetration of the material, said arm when it reaches the forward end of said guideway being prevented from farther forward bodily movement, one of said fluid cylinders then being operable while the other cylinder remains stationary thereby to effect swinging of said arm about its pivotal connection with said guide while the latter is held in engagement with the forward end of said guideway, said other fluid cylinder thereafter being operable to effect movement of said arm rearwardly along said guideway into its initial retracted position with respect to said deck, and control valve means for controlling fluid flow to and from said fluid cylinders for effecting operation of said fluid cylinders in the definite sequence aforementioned, said control valve means having power actuating means and means for coordinating the motion of said valve means with the arm-movement so that said arm is moved to effect penetration and loading of the material as aforementioned.

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