Nov. 25, 1969 M. G. CARLSON 3,480,328

OSCILLATING ACTUATING MEANS FOR MINING HEADS OF RIPPER MINER

Filed Nov. 7, 1967

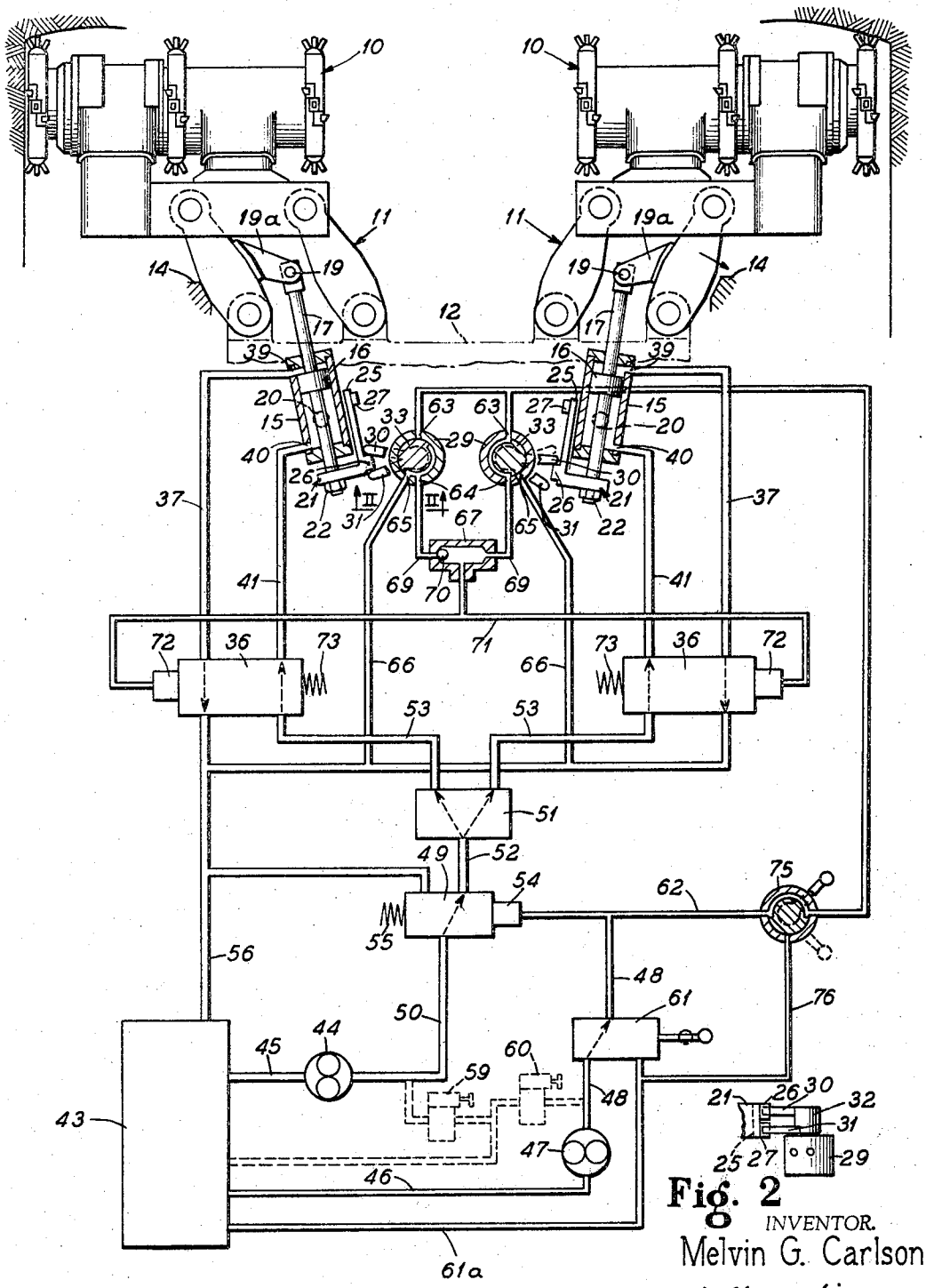


Fig. 1

Fig. 2

INVENTOR.
Melvin G. Carlson

BY Bill Sherman Mercer Gross & Simpson ATTORNEYS

United States Patent Office 3,480,328 Patented Nov. 25, 1969

3,480,328

OSCILLATING ACTUATING MEANS FOR MINING HEADS OF RIPPER MINER

Melvin G. Carlson, Oak Lawn, Ill., assignor to Westinghouse Air Brake Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Nov. 7, 1967, Ser. No. 681,175
Int. Cl. E21c 25/08
U.S. Cl. 299—71 9 Claims

ABSTRACT OF THE DISCLOSURE

Mining machine having a pair of rotary mining heads which are oscillatably movable toward and from each other in horizontal planes. An individual hydraulic cylinder for each mining head, forms the power means for oscillatably moving the mining heads toward and from each other. The circuit to the hydraulic cylinders includes a sensing valve associated with each mining head, which senses the end of oscillatory movements of the mining heads and reverse the oscillatory forces to the mining heads. A response delay valve is provided to hold the mining head which reaches the end of its oscillatory movement in an outward direction first, in a fixed position until the other mining head reaches the end of its oscillatory movement in an outward direction. Both mining heads reverse their directions simultaneously at the outer ends of their paths of travel, and any deviations in synchronization of the mining heads, caused by hard inclusions in the mine face are corrected at the end of each outward oscillatory stroke of each mining head.

BACKGROUND OF THE INVENTION

Ripper types of continuous miners having a pair of sidewise oscillating mining heads, rotating about horizontal axes have heretofore been oscillatably driven by hydraulic cylinders to mine out a complete working place as fed from the roof to the floor of the mine. Where the mining heads are oscillatably driven by individual hydraulic cylinders, the heads frequently come out of phase, as one or the other head encounters a hard spot in the mine face. Efforts have been made to keep the mining heads in phase which operate on the principle of moving the two control valves to neutral positions to stall the two mining heads at the same time or to synchronize the speed of one mining head to the speed of the other mining head to insure that the oscillating mining heads will not be thrown out of phase.

Such systems, however, have been unduly complicated and have resulted in an increase in mining time particularly where there is a tendency for one head to stall, as when encountering a hard inclusion in the mine face.

SUMMARY OF THE INVENTION AND OBJECTS

The operating and control means of the present invention cures the foregoing deficiencies by only bringing the mining heads into phase at the outer ends of their strokes, and by providing a delay in the reversal of the first mining head to reach the outer end of its stroke, until the other mining head reaches the outer end of its stroke.

A principal object of the present invention, therefore, is to provide a novel and improved control system for oscillatably moving the mining heads of a continuous miner, in which a delay in reversal of one mining head is provided, which is effective only when the two mining heads are out of phase, to bring the mining heads into phase at the outer ends of the oscillating strokes thereof.

Another object of the invention is to provide a new and improved oscillating head ripper type of continuous mining machine, in which hydraulic cylinders oscillatably move the mining heads in opposite directions, having a simplified form of control system arranged with a view toward bringing the mining heads into phase in a simple and efficient manner.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawing wherein:

FIGURE 1 is a diagrammatic view, diagrammatically illustrating the oscillating means and hydraulic circuit for the mining heads of a continuous mining machine; and

FIGURE 2 is a fragmentary detail view looking substantially along line II—II of FIGURE 1 and illustrating the operating means for one of the valves, effecting reversal in travel of the mining heads.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGURE 1 of the drawings, I have diagrammatically shown the forward end portion of a continuous mining machine of the ripper type having two rotatably driven oscillatably movable mining heads **10**, mounted on parallelogram linkage supports **11**, for oscillatable movement across the forward end of a boom **12**, extending in advance of a main frame (not shown) of the machine. The boom **12** is elevated by hydraulic jacks (not shown) about an axis extending transversely of the machine, to position the mining heads **10** along the roof in position to be sumped into the working face of the mine by continuous traction devices (not shown) supporting the main frame of the machine and tramming the machine about the mine.

The mining heads, the support and the drive means for rotatably driving the mining heads as well as the parallelogram linkage supports for the mining heads are similar to those shown and described in an application Ser. No. 606,646, filed by Gustaf Albert Marberg on Jan. 3, 1967, and entitled "Oscillating Cutter Ripper Miner," so need not herein be shown or described further.

Outward movement of the mining heads is limited by stops **14**, which may be adjustably mounted on the boom arm **12**, in accordance with the width of the working place to be mined.

Each mining head **10** is oscillatably driven by an individual double acting hydraulic cylinder **15** having a piston **16** therein, having a piston rod **17** extending from each end of said piston and extensible from opposite ends of the cylinder **15**. The forward end of the piston rod **17** is pivotally connected to a connector ear **19a** of a link of the parallelogram linkage support **11**, on a pivot pin **19**. Each cylinder is also trunnioned intermediate its ends to the boom arm on trunnion pins **20** extending generally parallel to the axes of the pivots for the parallel linkage arrangements. The rear or inner end of the piston rod **17** has an actuator bracket **21** mounted thereon and retained thereto as by a nut **22**. The actuator bracket **21** extends

laterally inwardly of the head end of the cylinder **15**, and has a right angled portion **25** extending along the side wall of the cylinder and spaced therefrom. Longitudinally spaced actuator lugs **26** and **27** extend from the right angled portion **25** generally toward a rotatable pilot valve **29**. The lugs **26** and **27**, as shown in FIGURE 2, are in different planes to position the lug **26** to engage an actuator arm **30** during the forward stroke of the piston rod **17** and to position the lug **27** to engage an actuator arm **31** during the return stroke of the piston rod **17**. The actuator arms **30** and **31** extend radially of a cap **32** spaced above the housing for the valve **29** and having operative connection with a rotary valve member **33** rotatably carried within the valve housing.

The valves **29** are pilot valves and serve to supply pilot fluid at a lower pressure than operating pressure to operate pilot operated four-way valves **36**, **36**, one of said valves being provided for each hydraulic cylinder **15**. The valves **36**, **36** are diagrammatically shown as being conventional pilot operated four-way valves, which when in one position, supply fluid under pressure to a pressure line **37** connected with a port **39** in the cylinder **15** and to release fluid from a port **40** and a pressure line **41** leading from said port. When the valve **36** is in its other position, pressure will be supplied to the cylinder **15** through the pressure line **41** and released from a port **39** through the pressure line **37**.

A source of supply of fluid under pressure is shown as comprising a fluid storage tank **43** connected with a high pressure pump **44** through an intake line **45**. A pilot intake line **46** also leads from the fluid storage tank **43** to an auxiliary pump **47**, supplying fluid at a lower pilot pressure to the pilot valves **29**, **29** through a pilot line **48**. The pilot line **48** also supplies pilot pressure to a pilot operator **54** to operate a two-way pilot operated valve **49**.

The valve **49** is connected with the pump **44** through a pressure line **50** and is connected at its output end with a flow divider valve **51** through a pressure line **52**. The flow divider **51** may be a conventional form of pressure compensated valve, and divides the flow from the pump **44** to flow equally to the two pilot operated four-way valves **36**, **36** through pressure lines **53**, **53**. Since this flow divider valve is conventional and forms no part of the invention except to assure than an equal flow of fluid will be supplied to each four-way valve **36**, the valve need not be shown or described further.

As pilot pressure is relieved from the pilot operator **54** for the two-way valve **49**, the valve is shifted by a spring **55** to shut off the flow of fluid to the valves **36** and to return fluid to tank through a return line **56**.

Relief valves **59** and **60** are connected with the respective pressure lines **50** and **48**, on the output sides of the respective pumps **44** and **47**, to return fluid to the storage tank **43** through a return line **61a**.

The pilot pressure line **48** is connected with a manually operated valve **61**, operable to supply fluid under pilot pressure to a pilot line **62**, when the valve is in an on position and to return pilot fluid to tank through a return line **61a** when the valve is in an off position.

Each pilot valve **29** has a pressure input port **63**, a pressure output port **64**, and a return port **65**. The return ports **65** are connected with the return line **56** through lines **66**. The pressure output ports **64** are connected with opposite ends of a shuttle valve **67** through pressure lines **69**. The shuttle valve **67** is diagrammatically shown as a ball type of valve having a ball **70** therein, blocking the flow of fluid from the low pressure end of the valve. A pressure line **71** leads from the shuttle valve **67** and has connection with pilot operators **72** for the four-way valves **36**, to supply pilot pressure to simultaneously operate said valves to supply fluid under pressure to the pressure lines **41** and ports **40** in the cylinders **15** and effect outward movement of the mining heads **10** toward the ribs of the working place of the mine. Upon the release of pressure in the pressure line **71**, as when the pilot valves **29** are in their pilot fluid return positions, the springs **73** will operate the four-way valves **36** to supply fluid under pressure to the forward ends of the cylinders **15** through the pressure lines **37** and ports **39**, and to release fluid from the opposite ends of said cylinders through the ports **40** and lines **41**.

A manually operable rotary valve **75** is provided in the pilot pressure line **62** downstream of the pilot operator **54**, to block the flow of fluid under pressure to the pilot valves **29**, and to return fluid flowing to said pilot valves back to tank through a return line **76**. The valve **75**, however, holds pressure in the pilot operator **54** and holds the valve **49** open, when returning fluid to tank. The valve **75** serves as a manually operable control valve to retract the two mining heads, as when either or both mining heads stall, due to the encountering of sulfur balls or other hard inclusions. As the valve **75** is turned by hand to return fluid to tank, pressure will be relieved from the actuators **72**, and the springs **73** will shift the valves **36**, to supply fluid under pressure to the pressure lines **37** and ports **39**, to effect movement of the mining heads towards each other.

During operation of the mining machine, assuming the mining heads are rotatably driven and positioned along the roof of the mine, the valve **61** is manually operated to supply fluid under pressure to the two pilot valves **29** and to the pilot operator for opening the valve **49**. The two mining heads will then be oscillatably driven. The continuous traction tread devices of the machine may then sump the mining heads into the working face of the mine along the roof in a conventional manner. During oscillation of the mining heads and as the mining heads reach their outermost positions of travel, the actuator lugs **26** engage the arms **30** and turn the valves **29** to release the flow of fluid under pilot pressure to the shuttle valve **67** and to return pilot fluid to tank through the return lines **66**. As pressure is relieved from the shuttle valve **67** and pressure line **71**, the springs **73** will move the four-way valves **36** into position to supply fluid under pressure through the pressure lines **37** and ports **39** and move the mining heads **10** inwardly toward each other. Should inward movement of one mining head be retarded, the other mining head will continue on its inward stroke independently of the delayed mining head.

As the mining heads **10** reach the inner ends of their strokes, the actuator lugs **27** will engage the levers **31** of the pilot valves **29** and move said pilot valves into position to supply fluid under pressure through the shuttle valve **67** and pilot pressure line **71** to the pilot actuators **72** for the valves **36**. This will position said valves to supply fluid under pressure through the pressure lines **41** and ports **40** and effect movement of the mining heads **10** outwardly toward opposite ribs of the working place.

Oscillating movement of the two mining heads is continued as the boom **12** is lowered until the entire working face has been mined. The valve **61** is then turned to its off position to return pilot fluid to tank through the pilot line **61a**. This valve will relieve pressure from the pilot line **62** and the spring **54** will move the valve **49** into its off position to return fluid from the pressure line **50** to tank.

If either mining head should encounter a hard inclusion in the mine face, as the mining heads are moving outwardly, travel of the mining head encountering the hard inclusion will be delayed. The other mining head will then continue to the outer end of its stroke. At this position the actuator lug **26** will turn the valve **29** in position to return fluid to tank **43**. The pilot valve **29** of the stalled mining head, however, will remain in its open position and pressure in the pressure line **69** will move the ball **70** of the shuttle valve **67** in position to block the release of fluid under pressure through the open pilot valve. This will supply pressure to hold the one mining head at the end of its stroke, and to continue operation of the second mining head until it reaches the end of its

stroke. As the lagging mining head reaches the end of its stroke, its associated pilot valve **29** will be turned to its off position, to return pilot fluid to tank through the return line **66**. The spring **73** will then operate the four-way valves **36** to supply fluid under pressure to the pressure lines **37** and ports **39** to move the two mining heads **10** inwardly toward each other in timed relation with respect to each other.

The foregoing circuit, therefore, provides a simple means for maintaining the two mining heads in phase by bringing the mining heads into the proper phase relation with respect to each other at the outer ends of the strokes of the mining heads by holding a leading mining head at the outer end of its stroke until the lagging mining head reaches the extreme end of its stroke. This assures that the mining heads are always in phase as they start their inward travel. It further reduces the power requirements for mining and simplifies the control system for synchronizing the two mining heads.

I claim as my invention:

1. In a mining machine having a frame,
two rotary mining heads spaced in advance of said frame,
mounting means at the forward end of said frame, mounting said mining heads for sidewise oscillatable movement toward and away from each other,
separate fluid pressure operated oscillatory drive means for said mining heads oscillatably moving said mining heads toward and from each other,
a position sensor means for each of said mining heads, arranged to control the supply of fluid under pressure to each of said oscillatory drive means to reverse the direction of sidewise movement of each mining head at preselected points,
fluid pressure operated delay means controlled by operation of said position sensor means to effect a delay in the response to the position sensor means, to hold a first of said mining heads in a preselected position until a second mining head arrives at a corresponding preselected position, to synchronize the mining heads in their oscillatory movements.

2. A mining machine in accordance with claim **1**,
wherein the position sensor means comprises an individual valve for each mining head and operated by said oscillatory drive means, to control operation of said oscillatory drive means, and
wherein the delay means delays the reversal of said oscillatory drive means until both of said valves are operatively moved by the oscillatory drive means to the same positions.

3. A mining machine in accordance with claim **2**, wherein the delay means is a shuttle valve having fluid pressure connection with each of said valves and effecting the supply of fluid under pressure to each of said oscillatory drive means to operate said oscillatory drive means in the same direction as one of said valves is in a closed position and until the other valve is moved into a closed position.

4. A mining machine in accordance with claim **1**,
wherein the oscillatory drive means comprises an individual double acting hydraulic cylinder and piston operatively connected with each of said mounting means, for oscillatably moving said mounting means and the mining heads mounted thereon,
wherein an individual four-way pilot operated valve is provided for each cylinder and piston, to alternately supply fluid to opposite ends of said cylinders to effect oscillatory movement of said mining heads in opposite directions,
wherein the sensing means comprises a pilot valve for controlling operation of each pilot operated valve, movable into open and closed positions by oscillatory movement of said mining heads at opposite ends of the strokes thereof, and supplying and releasing pilot fluid to and from said four-way valves to effect alternate operation thereof, and
wherein the time delay means has connection with each of said pilot valves and is effective to continue the supply of fluid under pressure to each of said four-way valves as one pilot valve is moved to its closed position and until the opposite pilot valve is moved into its closed position.

5. A mining machine in accordance with claim **4**,
wherein the time delay means comprises a shuttle valve connected in the pilot fluid supply lines for each of said four-way pilot operated valves,
wherein the supply of pressure from one of said pilot valves to said shuttle valve maintains the supply of fluid under pressure to maintain said four-way valves in position to supply fluid under pressure to said cylinders to move both of said mining heads to the extreme outer ends of their strokes.

6. A mining machine in accordance with claim **4**,
wherein the double acting hydraulic cylinders are trunnioned on said boom arms and have piston rods extensible from opposite ends thereof,
wherein the forward ends of said piston rods have operative connection with said mounting means, and
wherein the rear ends of said piston rods have actuator means thereon shifting said pilot valves into pilot pressure supplying and pilot pressure release positions at opposite ends of the strokes of said cylinders and pistons.

7. In a mining machine having a frame,
two rotary mining heads spaced in advance of said frame,
mounting means at the forward end of said frame, mounting said mining heads on said frame for sidewise oscillatable movement toward and from each ther,
an individual double acting hydraulic cylinder and pistol for each mounting means, trunnioned on said frame and having operative connection with an associated mounting means,
an individual pilot operated valve for each hydraulic cylinder, alternately supplying fluid under pressure to opposite ends thereof,
a high pressure supply line having a fluid connection with each pilot operated valve,
an individual pilot valve for each pilot operated valve,
operating means operated by operation of said cylinders and pistons for operating said pilot valves at opposite ends of the strokes of said pistons,
a pilot pressure supply line for supplying fluid under pilot pressure to said pilot valves,
pilot pressure lines leading from said pilot valves to said pilot operated valves, to operate said pilot operated valves to move into position to supply fluid under pressure to said mining heads to move said mining heads away from each other, towards the ribs of the working place, and
a shuttle valve connected in said pilot pressure lines and operable by pressure on one end of said shuttle valve to hold pressure on both of said pilot operated valves until both mining heads reach the outer ends of their strokes.

8. A mining machine in accordance with claim **7**, wherein a manually operable valve is provided in said pilot pressure supply line, and is operable to connect said pilot pressure supply line to release pressure from said pilot pressure supply line and from said pilot operated valves, to effect movement of said pilot operated valves to supply fluid under pressure to said cylinders to retractibly move said mining heads inwardly towards each other.

9. A mining machine in accordance with claim **7**, wherein a pilot operated shut off valve is provided in said

high pressure supply line upstream of said pilot operated valves,

wherein the pilot pressure supply line is connected with said pilot operated shut off valve to hold said valve in position to supply fluid under pressure to said pilot operated valves, and

wherein a manually operable valve is provided in said pilot pressure supply line downstream of the point of connection of said pilot supply line to said pilot operated shut off valve, and is operable to release pilot pressure from said pilot valves and to hold pilot pressure on said pilot operated shut off valve,

to effect retractible movement of said mining heads inwardly towards each other.

References Cited

UNITED STATES PATENTS

1,947,253	2/1934	Ellis	91—171 X
3,333,894	8/1967	Frellson	299—71 X
3,333,895	8/1967	Anderson	299—71 X

ERNEST R. PURSER, Primary Examiner

U.S. Cl. X.R.

91—171