United States Patent

[11] 3,618,794

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[73] Assignee Koppers Company, Inc.

[54] METHOD AND APPARATUS TO INTERLOCK A LARRY CAR AND A PUSHER MACHINE
17 Claims, 10 Drawing Figs.

[52] U.S. Cl. 214/23, 202/262, 214/35, 214/152, 340/282
[51] Int. Cl. C10b 31/04
[50] Field of Search ..... 214/18 PH, 23, 35, 152; 202/262, 263; 340/268, 282

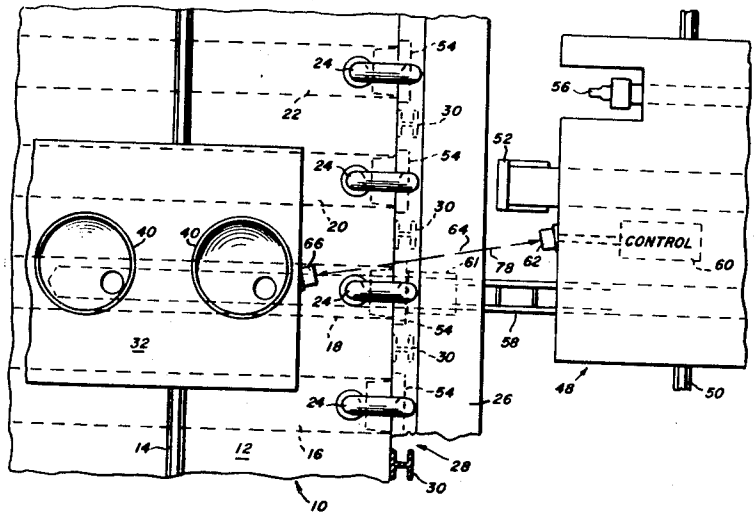
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Primary Examiner—Robert G. Sheridan
Attorneys—Oscar B. Brumback, Olin E. Williams and Stanley J. Price

ABSTRACT: A signal-transmitting device such as a source of columnated gamma ray radiation is positioned on the upper structure of a pusher machine and a receiver responsive to gamma ray radiation is positioned on the larry car. An actuator device such as an electrical relay is arranged to control the power-operated apparatus for discharging the coal from the hoppers on the larry car and is arranged to be actuated by the signal-transmitting device through the receiver. The signal transmitted by the signal device on the pusher machine is directional and is only received by the receiver on the larry car when the leveler bar on the pusher machine is in position to level the coal in the same oven which the larry car is in position to charge. The power-operated apparatus for discharging the coal from the hoppers on a larry car into the oven remains deenergized until the relay is actuated by the signal transmitted from the pusher machine. With this arrangement, the oven can not be charged with coal from the larry car until the leveling bar is in position to level the charge in the same oven. A second signal-transmitting device is positioned on the larry car and a second receiver is positioned on the pusher machine. The second signal-transmitting device is arranged to transmit a signal when a preselected quantity of coal has been charged into the oven and the second receiver, upon receiving the signal, actuates a relay to energize the power-operated apparatus for moving the leveler bar into the coke oven being charged to level the coal in the coke oven chamber and maintain a passageway between the coal charge and the top of the coke oven chamber.



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FIG. 1

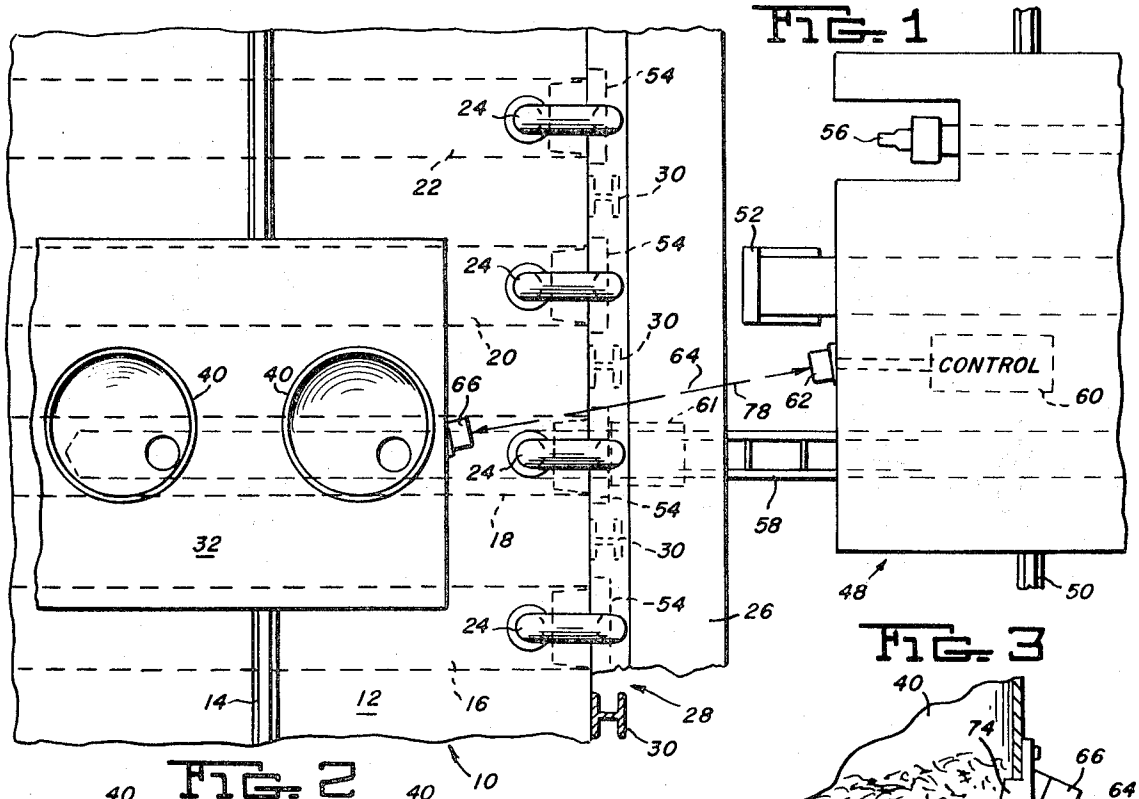


FIG. 2

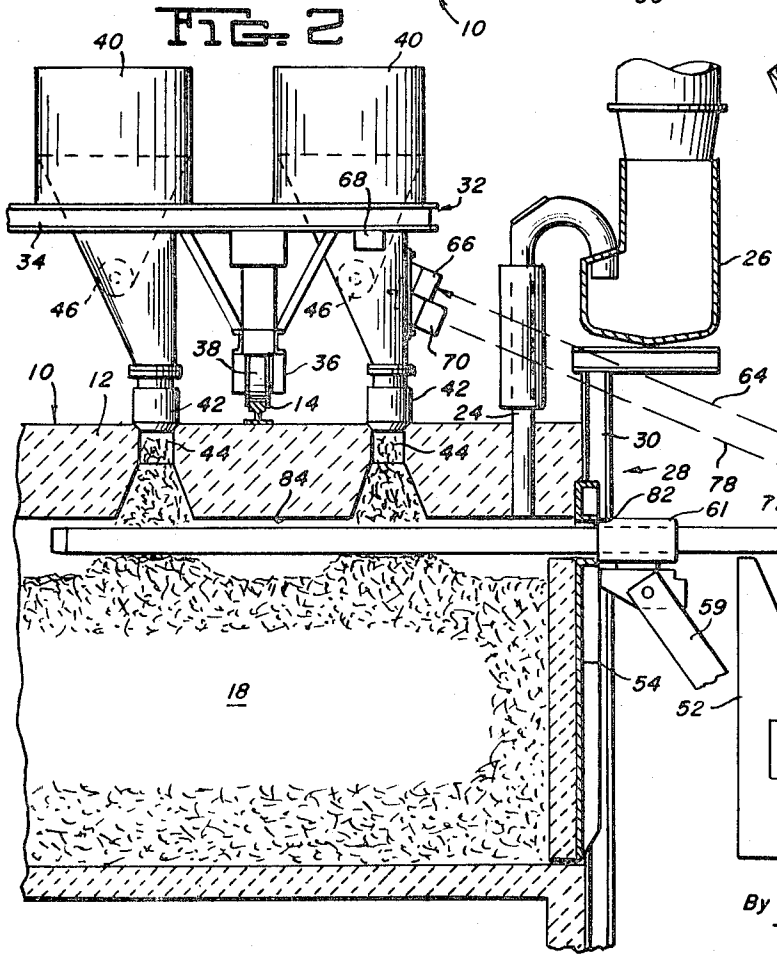
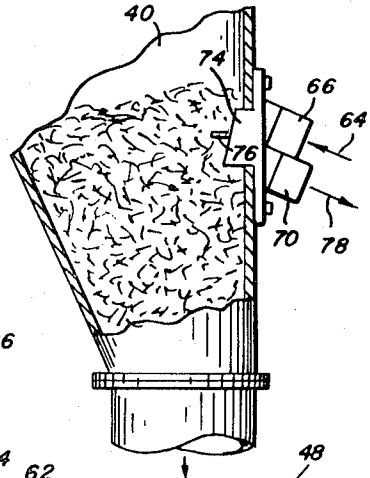


FIG. 3



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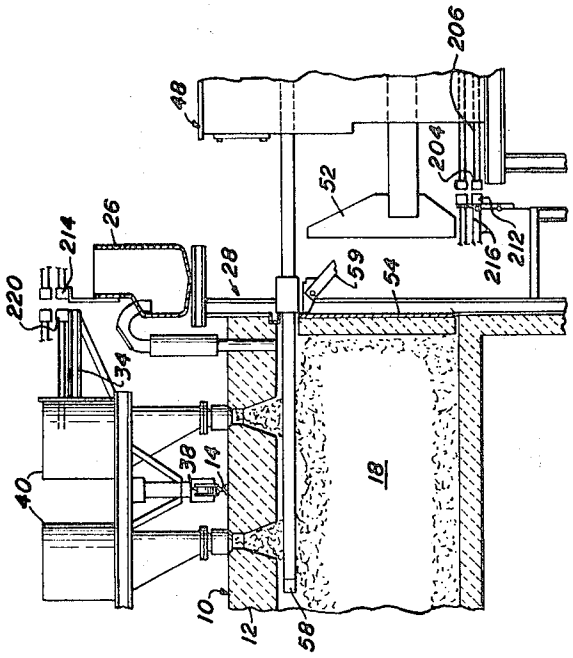


FIG. 6

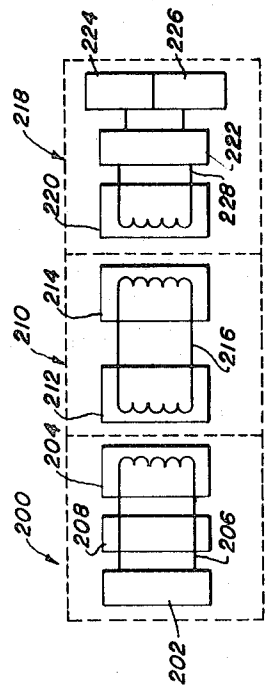


FIG. 7

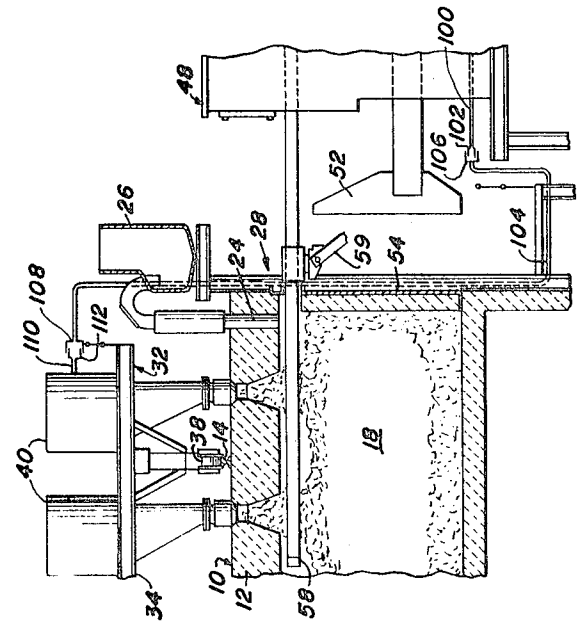


FIG. 4

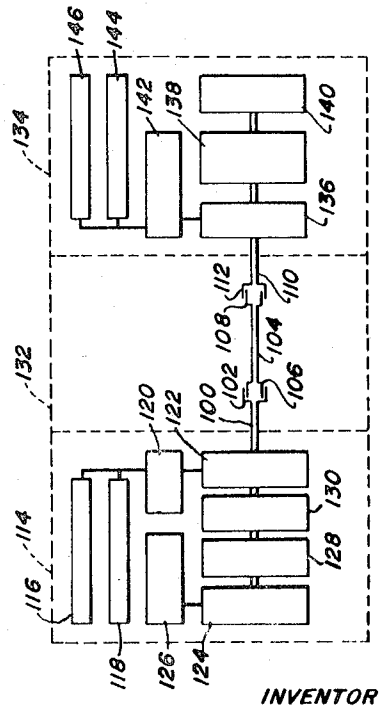


FIG. 5

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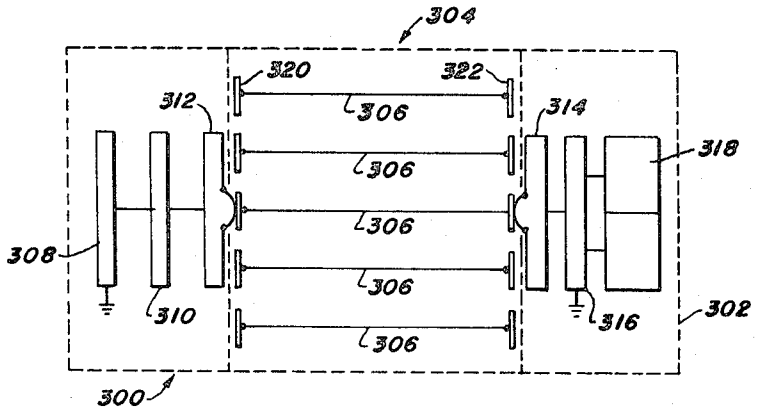


FIG. 8

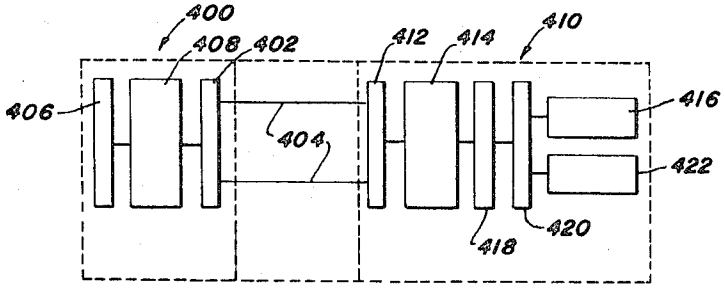


FIG. 9

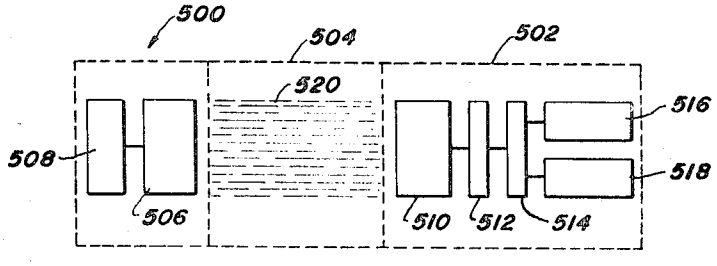


FIG. 10

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METHOD AND APPARATUS TO INTERLOCK A LARRY CAR AND A PUSHER MACHINE

BACKGROUND OF THE INVENTION

1 Field of the Invention

This invention relates to a method and apparatus to interlock the larry car and pusher machine and more particularly to a method and apparatus for initiating the charging of a coke oven chamber only when the pusher machine is in position to level the coal charge in the same coke oven.

2 Description of the Prior Art

In charging coal into an oven of a battery of horizontal slot type byproduct ovens it is conventional practice to level the coal charge by means of a horizontally reciprocating leveler bar carried on the pusher machine. The leveler bar is inserted into the top of the coke oven through a leveler door which usually forms a part of the pusher side oven door. In conventional charging practice it is not usually possible to charge the last portion of coal into the oven without using the leveler bar because the flow of coal into the oven is stopped by the angle of repose of the coal in the oven intersecting the bottom of the charging hole openings. This results in valleys between the charging holes and in one or more peaks of coal extending up into the charging hole and on into the coal hopper of the larry car. These peaks of coal are leveled into the valleys by reciprocation of the leveler bar adjacent the upper portion of the coke oven.

Frequently, in normal operation, the pusher machine and its operator are not in position to level the coal in the oven being charged when the coal-charging operation requires such leveling. When this occurs the peaks of coal extending up into the charging holes frequently block the flow of gas across the top of the oven to the off-take connections causing the gas and smoke to escape to the atmosphere through the charging holes. The escaping gas is often ignited, causing a safety hazard to operating personnel and damage to the larry car. The The gas may also cause a health hazard to operating personnel because of the toxic materials it contains. The smoke and gas liberated may also cause air pollution.

The present practice is to aspirate as much of the gas evolved from the coal on charging as possible into the gas-collecting main by using one or more stream jet aspirators in the ascension pipes or elbow connections between the ascension pipes and the collecting mains. Many coke oven batteries have a single-collecting main along one side of the battery with one ascension pipe and one stream jet aspirator for each oven. This requires pulling the gas from the entire length of the oven into the single ascension pipe. Other coke oven batteries have two collecting mains, one on each side of the battery, with an ascension pipe and steam jet at each side of each coke oven. This arrangement is superior to the single collecting main but increases substantially the cost of construction and requires more labor for operation and maintenance. A third arrangement consists of a collecting main, ascension pipes and steam jets on one side of the battery with hooded connections on the larry car at each charging hole to collect any gas not pulled into the ascension pipe. The gas flowing through the hooded connections at the larry cars is mixed with air and ignited and the products of combustion are circulated through a wet gas scrubber system by means of a fan or similar suction producing device. In any of the above-described systems gas may escape at the charging holes and through the hoppers of the larry car if the coal peaks are permitted to build up into the charging holes during the charging operation and block the passageway above the coal charge that communicates with the gas-collecting main. There is a need, therefore, to provide a method and apparatus to interlock the charging operation with the leveling operation so that the leveler bar is in position to proceed with the leveling operation at the time required to prevent blockage of the passageway at the top of the oven by the buildup of peaks of coal that extend up into one or more of charging holes.

SUMMARY OF THE INVENTION

In accordance with the hereinafter described inventions an interlock is provided between the larry car and the pusher machine to require the pusher machine to be positioned to level the same coke oven chamber that is to be charged by the larry car before the coal is charged into the coke oven chamber. A signal-transmitting device is positioned on the pusher machine and a signal-receiving device is positioned on the larry car. The signal-receiving device receives a signal only when the leveling bar on the pusher machine is positioned to level the charge in the coke oven chamber to be charged from the larry car. The signal-receiving device is connected to a control device that is responsive to the signal to actuate the power-operated means of the larry car for discharging the coal from the hoppers on the larry car into the coke oven chamber. A second signal-transmitting device is positioned on the larry car and a second signal-receiving device is positioned on the pusher machine. The second signal-transmitting device transmits a signal when the coal in the larry car coal hoppers has attained a preselected level. A second control device responsive to the signal transmitted by the second signal device actuates the power-operated means to start the leveling operation. With this arrangement the coal in the coke oven chamber is leveled before the peaks of coal can be formed to block or obstruct the gas flow passage in the coke oven chamber.

Accordingly, the principal object of this invention is to provide a method and apparatus for preventing the flow of gasses formed during the charging of a coke oven from escaping through the charging holes in the coke oven chamber roof.

Another object of this invention is to provide a method and apparatus for coordinating the charging and leveling operations so that the leveling operation is initiated before the coke oven chamber is completely charged.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary top plan view of a portion of the coke oven battery with the larry car positioned for charging a given coke oven chamber and the pusher machine in position for the leveler bar to level the coal charge in the oven being charged.

FIG. 2 is a fragmentary view in elevations illustrating the transmitters and receivers positioned on the larry car and on the pusher machine.

FIG. 3 is a fragmentary view in section of a coal hopper illustrating the level probe and signal-initiating device for initiating a signal by the transmitter on the larry car when a preselected amount of coal has been discharged from the hopper.

FIG. 4 is a fragmentary sectional view in elevation similar to FIG. 2 illustrating the pneumatic pressure system type of signal transmitter and receiver.

FIG. 5 is a diagrammatic illustration of the components in the pneumatic system.

FIG. 6 is a fragmentary view in elevation similar to FIGS. 2 and 4 illustrating the half transformer type of transmitter and receiver.

FIG. 7 is a diagrammatic illustration of the components in the half transformer system.

FIG. 8 is a diagrammatic illustration of the segmented collector rails.

FIGS. 9 and 10 are diagrammatic illustrations of the radio and audio type of transmitters and receivers.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A coke oven battery generally designated by the numeral 10 has a roof 12 with a plurality of rails 14 extending longitudinally thereon. Coke oven chamber 16, 18, 20 and 22 are arranged in parallel spaced relation transversely across the coke

oven battery 10. Each coke oven chamber has an ascension pipe 24 connected to a gas-collecting main 26 that extends longitudinally parallel to the pusher side of the oven 28. Vertical buckstays 30 extend upwardly along the pusher side of the oven and provide a support for the gas-collecting main 26. A larry car generally designated by the numeral 32 has a frame member 34 with depending supports 36 for trolley wheels 38 that are mounted on the rails 14. A plurality of hoppers 40 are supported on the larry car 32, each of which has a telescopic pipe 42 positionable in a charging hole 44.

Turntables or screw feeders are provided adjacent the lower portion of the hoppers 40 and are arranged to convey the coal from the hoppers 40 through the telescopic pipes 42 into the charging holes 44. The hoppers may be discharged by gravity also, with power-operated gates or valves to block and/or control the flow of coal from the hoppers. A power-operated means diagrammatically illustrated in FIG. 2 and generally designated by the numeral 46 provides the power for driving the mechanical turntable devices or screw feeders. It should be understood the power-operated means 46 may be positioned adjacent the lower portions of the hoppers 40 or may be positioned at other locations on the larry car 32.

A pusher machine generally designated by the numeral 48 is mounted on rails 50 along the pusher side 28 of coke oven battery 10 and is arranged to move longitudinally along the pusher side of the coke oven battery 10 to push the coked charge by means of pusher ram 52; to extract the coke oven doors 54 on the pusher side of the coke oven battery by a door extractor 56 and to level the coal charge within the coke oven chamber by a leveler bar 58. A smoke sleeve seal 61 surrounds the leveler bar 58 and is moved into position adjacent the leveling opening by means of an arm 59 pivotally secured to the pusher machine. Power-operated controls 60 are provided on the pusher machine to perform the above-discussed functions. It should be understood that the pusher machine 48 may have the components arranged otherwise than as illustrated, as for example, the leveler bar 58 may be positioned above the pusher ram 52 or above extractor 56 or two ovens away from the pusher ram. The particular arrangement of the components does not form a part of the invention and the invention may be practiced with pusher machines having component arrangements other than that illustrated in the drawings.

A signal-transmitting device designated by the numeral 62 is positioned on the upper portion of the pusher machine 48 and is arranged to transmit a signal in the direction indicated by the line 64. The interlock requires that, in addition to the pusher machine being aligned with the leveler bar on the same centerline as the oven to be charged, that the leveler door is open and the leveler bar is brought forward until the smoke sleeve seal 61 has engaged the leveler door-sealing face. When the smoke sleeve is in the forward position, it trips a limit switch which closes a power circuit to provide power for the signal transmitter 62. A receiver device 66 is positioned on the larry car and is arranged to receive a directional signal from the transmitting device 62 when both the larry car 32 and the pusher machine 48 are in the positions illustrated in FIGS. 1 and 2 relative to coke oven chamber 18. A control device diagrammatically illustrated at 68 is connected to the receiver 66 and the power-operated means 46 on the larry car 32. The control device 68 is arranged to control the power-operated means 46 so that coal can not be discharged from the hoppers 40 until a signal is received by the receiver 66 on larry car 32 from the transmitter 62 on the pusher machine 48. With this arrangement coal can not be discharged from the hoppers 40 on larry car 32 until the pusher machine 48 is in position for the leveler bar 58 to level the coal charge in the same coke oven chamber. The signal-transmitting device 62 and signal-receiving device 66 are so arranged that the signal-transmitting device 62 is aimed to clear obstacles such as the ascension pipes 24 and the associated supporting connections between the coke oven buckstays 30 and other structural steel supports and the collecting main 26 when the larry car 32 and pusher machine are properly positioned to charge and level the same coke oven chamber.

A second signal-transmitting device 70 is mounted on the larry car 32 preferably below the receiver 66 and is aimed or focused downwardly toward the pusher side of the coke oven battery. A second signal-receiving device is positioned on the upper portion of the pusher machine 48 and is arranged to receive the signal transmitted by the transmitter 70 when the signal-transmitting device is actuated and the larry car 32 and pusher machine 48 are positioned to charge and level the same oven. As illustrated in FIG. 3, a signal-initiating device 74 is secured to the hopper 40 and includes a level-indicating device 76. The signal-initiating device is arranged to prevent the transmission of a signal by the signal-transmitting device 70 until the level of the coal within the hopper 40 is below the level-indicating device 76. After the level of the coal has descended below the probe 76, the signal-initiating device 74 actuates the signal-transmitting device 70 to transmit a signal along the line 78 illustrated in FIG. 2 As an alternative to the level-indicating device 76 and the signal-initiating device 74, an adjustable timer could be used to actuate the signal-transmitting device 70 at a preset time after the start of the charging operation. When the larry car 32 and pusher machine 48 are positioned to charge and level the same coke oven chamber, the signal-transmitting device 70 and signal-receiving device 72 are aligned for the receiver 72 to receive a signal from the signal-transmitting device 70 when the level of coal within the hopper 40 is below the probe 76. A second control device 80 is connected to the signal-receiving device 72 and the power-operated means 60 in the pusher machine 48. The control device 80 is arranged upon the signal-receiving device 72 receiving a signal from the signal-transmitting device 70 to actuate or to permit manual actuation of the power-operated means 60. The power-operated means 60 then moves the leveling bar 58 through the leveling opening 82 in the pusher side oven door 54 to level the coal within the coke oven chamber 18 adjacent the top wall 84 and maintain the passageway adjacent the chamber roof open throughout the length of the oven 18 so that the charging gases flow through the passageway and upwardly through the vertical ascension pipe 24. With this arrangement, the leveling bar displaces the peaks of coal before the peaks increase to an extent that they extend upwardly into the charging holes 44. The peaks of coal are displaced into the adjacent valleys while the coal is being charged into the coke oven chamber 18 so the the passageway adjacent the top of the coke oven chamber remains open and the peaks do not block the flow of gas across the coke oven chamber adjacent the oven roof 84 to the ascension pipe 24.

The signal-transmitting devices 62 and 70 and signal-receiving devices 66 and 72 may be of any type suitable for use under conditions of exposure to weather, heat, vibrations, dirt and corrosive gasses. The elements should be arranged to ensure proper location and alignment of the pusher machine and larry car before any signal can be received. The previously discussed arrangement of the signal-transmitting devices and signal-receiving devices is such that the signal is only received when the pusher machine 48 is positioned with the leveler bar 58 aligned with the openings 82 of the leveler door in the same coke oven chamber which the larry car 32 is in position to charge.

The signal-transmitting devices 62 and 70 are preferable sources of gamma ray radiation as, for example, cesium 137 or cobalt 60. The receiver may include one or more Geiger-Muller tubes that detect gamma radiation. With the use of gamma ray radiation it is preferred to provide a shutter or similar closure to shut off the source of gamma radiation until it is desired to transmit a signal. This shutter may be opened mechanically by any suitable means such as levers, cables and pulleys, or the like when the leveler bar and smoke seal are moved forward into the leveling position. On retraction of the leveler bar and apparatus associated therewith, the shutter may be closed, cutting off the signal transmitter by the signal-transmitting device 62. With this arrangement the proper

alignment of the pusher machine is assured and also the leveler bar 58 and apparatus associated therewith is in the leveling position before the signal can be received.

It should be understood that although the use of gamma ray radiation is preferred, other systems may be used for the signal transmitting devices and signal-receiving devices, for example, a light beam source may be positioned on the pusher machine and a photoelectric-cell-type receiver may be positioned on the larry car. In FIGS. 1 and 2 the signal-transmitting device 62 may be the light beam source and the signal-receiving device 66 may be a photoelectric-cell-type receiver. A pneumatic pressure system can be used with an individual pipe for each oven extending from a point where a connection can be made from a source of compressed air or other gas on the pusher machine to a point where a connection can be made to a pressure switch or similar device on the larry car. Referring to FIGS. 4 and 5 where similar numerals are intended to designate similar parts, a suitable pneumatic system is illustrated. The pusher machine 48 has a source of air under pressure connected to a conduit 100 that has a fast coupling end portion 102 extending toward the pusher side of the coke oven 28. At each oven there is a conduit 104 that has a corresponding coupling 106 arranged to be connected to coupling 102 on conduit 100 and a second coupling 108 at the other end thereof. A pressure-sensitive device on the larry car 32 has a conduit 110 extending therefrom with a coupling member 112 arranged to be connected to the coupling 108 of conduit 104 at each respective oven.

As illustrated in FIG. 5 the transmitter section generally designated by the numeral 114 includes a control switch 116 and a signal indicator 118. Both the switch and indicator are connected through a relay 120 to a pressure switch 122. A source of air under pressure is schematically designated by the numeral 124 and has a pressure regulator 126 associated therewith. A signal valve 128 is connected in series with the air compressor 124 and the pressure switch 122. A restricting orifice 130 may be provided for the conduit between the air compressor 124 and pressure switch 122.

The transmission channel is schematically designated in FIG. 5 by the numeral 132 and includes the couplings and conduit 104 previously described in reference to FIG. 4. The receiver is diagrammatically illustrated and designated by the numeral 134 and includes a pressure switch 136 operable to be actuated by pressure through the conduit 110. There is also included a pressure relief valve 138 and a relief valve actuator 140. A latching relay 142, signal indicator 144 and control switch 146 are connected to the pressure switch 136.

With the above arrangement when the pusher machine 48 and the larry car 32 are in position the respective couplings 102 and 106 are connected and couplings 108 and 112 are connected to transmit air under pressure from the pusher machine to the larry car. The air under pressure opens the signal valve 128 to activate the pressure switches 122 and 136. The pressure switch 136 at the receiver operates a latching relay 142 which, in turn, provides a signal at signal indicator 144 to close a switch and permit charging of the oven.

Half transformers may also be used for the signal transmitting device and the signal receiving device.

Referring to FIGS. 6 and 7 the signal transmitting and receiving arrangement using half transformers is illustrated and similar numerals are intended to designate similar parts. The transmitter generally designated by the numeral 200 in FIG. 7 includes a power supply 202 connected to a plate antenna or half transformer 204 by means of conduits 206. A signal switch 208 is connected in the transmitter circuit. The transmission channel schematically designated by the numeral 210 in FIG. 7 includes a pair of half transformers 212 and 214 connected to each other by conduits 216. The receiver is schematically designated by the numeral 218 and includes a half transformer 220 connected through a relay 222 to a signal indicator 224 and control switch 226 by means of conduits 228. Referring to FIG. 6 the transmitter half transformer 204 is illustrated connected to the pusher machine 48 by means of the conduits 206. The transmission channel includes at each coke oven a half transformer 212 positioned opposite the pusher machine 48 and another half transformer 214 positioned at an elevation opposite the frame member 34 of the larry car 28. The receiver half transformer 220 is mounted on the larry car frame 34. There is also illustrated unnumbered other half transformers for providing a signal in the opposite direction between the larry car 28 and the pusher machine 48 to perform the same function as the previously described signal devices 70 and 72. With this arrangement the half transformer 204 connected on the pusher machine 48 is aligned with another half transformer 212 in the transmission channel. The half transformer 212 is connected by means of conduits 216 to the other half transformer 214 positioned at an elevation opposite the larry car frame member 34. When the pusher machine 48 is aligned with the oven to be charged, the two half transformers 212 and 204 form a complete transformers with an airgap therebetween to thereby transmit current through the conduits 216 in the transmission channel 210. When the other half transformer 220 on larry car 32 is aligned with transformer 214, current flows between the pusher machine and the larry car through the two aligned pairs of half transformers to actuate the control devices on the larry car. Similarly, when in this aligned position when the level of the coal within the hoppers 40 reaches a predetermined level, a switch is actuated to provide a signal through the other sets of half transformers to the pusher machine to actuate the leveling bar as previously described.

Another system for transmitting a signal between the pusher machine and the larry car is illustrated schematically in FIG. 8 where the transmitter portion is generally designated by the numeral 300 and is arranged to form a part of the controls on the pusher machine. The receiver section is designated by the numeral 302 and forms a part of the larry car controls. The transmission channel generally designated by the numeral 304 includes a plurality of conductors 306 with a conductor located at each coke oven. The transmitter includes a source of power 308 connected through a signal switch 310 to a collector shoe 312. Similarily, the receiver 302 has a collector shoe 314 connected through a relay 316 to a signal indicator 318. The conduits 306 have actuators 320 and 322 connected at opposite ends thereof and arranged to abut the collector shoes 312 and 314 as they are moved into abutting relation therewith. With this arrangement the pusher machine with the transmitter 300 thereon, when properly aligned with an oven, transmits a current through line 306. When the receiver on the larry car 32 is in proper position the collector shoe 314 conducts the current to the signal indicator to thereby provide a remote control device for the relative position of the pusher machine 48 and larry car 32.

Referring to FIG. 9 there is schematically illustrated a radio or audio tone frequency signal or control system that employs existing power lines as the transmission channel. The transmitter generally designated by the numeral 400 is mounted on the larry car and is arranged to transmit a signal to the pusher machine indicating the level of the coal in the hoppers 40. The transmitter includes a coupling unit 402 connected to the power lines 404. A signal switch 406 is connected to an audio or radiofrequency transmitter 408. When a preselected level of coal is reached in the hopper 40, the signal switch 406 actuates the transmitter 408 to transmit a signal through the coupling unit 402 a power lines 404. The receiver schematically indicated by the numeral 410 includes a coupling unit 412 connected to the power lines 404 and an audio or radiofrequency receiver 414. The receiver 414 is connected to a signal indicator 416 through an amplifier 418 and relay 420. A control switch 422 may also be provided. With this arrangement a nondirectional signal is provided in which a signal is transmitted from the larry car 32 to the pusher machine 48 when a preselected level of coal is reached in the hoppers 40.

FIG. 10 illustrates a similar type of radiofrequency signal and control system where radio waves are employed as the transmission channel. Again, this system is nondirectional and

is preferably employed to transmit a signal indicating a given level of the coal The radiofrequency control system is diagrammatically illustrated and includes a transmitter **500**, a receiver **502** and a transmission channel **504**. The transmitter includes a radiofrequency transmitter **506** actuated by a signal switch **508**. The receiver includes a radio receiver **510** connected through an amplifier **512** and relay **514** to a signal indicator **516**. A control switch **518** is also provided in the receiver **502**. The radio transmitter **506** transmits RF waves **520** that are received by receiver **510**. With this arrangement a signal is transmitted from the larry car **40** to the pusher machine **48** when the coal reaches a preselected level in the hopper **40**.

The signal-transmitting device **70** on the larry car **32** and the signal-receiving device **72** on the pusher machine **48** provides for automatic initiation of the leveling sequence by means of the signal received by the signal-receiving device **72**. The signal from signal-transmitting device **70** is initiated when the level of coal in the hopper **40** descends below the probe **76**. The signal-initiating device **74** may be a shutter device or the like that is opened mechanically or electrically by the probe **76**. Other types of signal-initiating devices may be used, as, for example, a timer set for a selected time after initiating the charging operation or by the ammeter connected to the power circuit for one or more of the turntable or screw feeders to sense the change in power as the flow of coal through the feeders changes or stops.

When the signal receiver device **72** receives a signal from the signal-transmitting device **70** the control device **80** which may be a relay or the like, is actuated to close a switch in the control circuit and actuate the power-operated device to initiate the automatic leveling sequence by the leveling bar **58**. The control device **68** on the larry car **32** may also be a relay actuated by the signal-receiving device **66** to actuate the power-operated device **46** to discharge coal from the hopper **40** into the charging hole **44**.

With the above-described arrangement, the larry car **32** and the pusher machine **48** must be positioned to charge and level the same coke oven chamber before the coal is discharged into the coke oven chamber. Also, the leveling operation is automatically initiated when a preselected amount of coal has been charged into the coke oven chamber.

The return signal from larry car to pusher could be by means of an intercom system of the walkie-talkie type or of the carrier frequency type using the power-collecting rails for the larry car and the pusher machine. It could be of garage door opening and closing type. In all of these types, it would not be necessary for an alignment arrangement for the return signal, depending upon the pusher machine to remain in the same spot from which it had sent the signal to the larry car to permit the start of charging (which did require proper alignment). This return signal without positive assurance of continued proper alignment would be satisfactory only if the return signal actuated a permissive relay on the pusher to permit manual initiation of leveling. If the return signal is used to actually trigger the start of leveling, then a positive alignment-type signalling method is required for the return signal as well as for the original signal.

According to the provisions of the patent statues, I have explained the principle, preferred construction and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment.

I claim:

1. Apparatus to interlock a pusher machine an larry car comprising,

a signal-transmitting device positioned on a pusher machine, said pusher machine arranged to move longitudinally along the pusher side of a coke oven battery,

a signal-receiving device positioned on a coal charging larry car, said larry car arranged to move longitudinally on the roof of a coke oven battery, said larry car having a plurality of coal-charging hoppers and power operated means to discharge coal from said hoppers into the coking chamber charging holes in said coke oven battery roof and

a control device connected to said receiver and said power-operated means on said larry car, said control device operable upon actuation by signal-receiving device to receive a signal from said transmitting device to actuate said power-operated means and discharge coal from said coal hoppers on said larry car into a preselected coke oven chamber,

said signal-receiving device on said larry car and said signal-transmitting device on said pusher machine arranged relative to each other so that said signal-receiving device receives a signal from said signal-transmitting device when said pusher machine is positioned with the leveling bar in position to level the coal charge in said preselected coke oven chamber to be charged with coal from the coal hopper on said larry car.

2. Apparatus to interlock a pusher machine and larry car as set forth in claim 1 in which,

said signal-transmitting device includes a source of columnated gamma ray radiation and said signal-receiving device includes apparatus to detect gamma ray radiation.

3. Apparatus to interlock a pusher machine and larry car as set forth in claim 2 in which,

said control device includes an electrical relay actuated by said receiver device when said receiver device device detects the gamma ray radiation from said transmitter device.

4. Apparatus to interlock a pusher machine and larry car as set forth in claim 1 in which,

said signal-transmitting device is positioned on the upper portion of said pusher machine and focused to directionally transmit a signal upwardly in a direction adjacent the roof of said coke oven battery,

said signal-receiving device is positioned on said larry car adjacent the pusher side of said coke oven battery and focused to receive a signal transmitted from the pusher said of said coke oven,

said signal-receiving device arranged to receive a signal from said signal-transmitting device on said pusher machine when said larry car is in position to charge a preselected coke oven chamber and said pusher machine is in position to level the coal charge in the same coke oven chamber.

5. Apparatus to interlock a pusher machine and a larry car as set forth in claim 1 which includes,

a second signal-transmitting device on said larry car and a second signal-receiving device on said pusher machine,

a signal-initiating device on said larry car arranged to initiate the transmission of a signal from said second signal-transmitting device when a preselected amount of coal has been charged into said coke oven chamber,

a second control device connected to said second receiver and a second power-operated means to advance said leveling bar into said coke oven chamber being charged and to reciprocate said leveling bar in said coke oven chamber to maintain an open passageway between the coal charge and the top of said coke oven chamber.

6. Apparatus to interlock a pusher machine and a larry car as set forth in claim 5, in which,

said signal-initiating device includes a level indicator in one of said coal hoppers on said larry car, said level indicator arranged to initiate the transmission of a signal by said second signal-transmitting device when the level of coal in said hopper is below a preselected level.

7. Apparatus to interlock a pusher machine and a larry car as set forth in claim 5 in which,

said second signal-transmitting device on said larry car includes a source of columnated gamma ray radiation and said second signal-receiving device includes apparatus to detect the gamma ray radiation from said second signal-transmitting device.

8. Apparatus to interlock a pusher machine and a larry car as set forth in claim 5 in which,

said second signal-transmitting device is positioned on on said larry car adjacent the pusher side of said coke oven battery and focused to directionally transmit a signal downwardly toward the pusher side of said coke oven,

said second signal-receiving device is positioned on the upper portion of said pusher machine machine and focused to receive a signal transmitted downwardly from a location adjacent the roof of said coke oven battery,

said second signal-receiving device arranged to receive a signal from the second signal-transmitting device on said larry car when the larry car is in position to charge a preselected coke oven chamber and said pusher machine is in position to level the coal charge in the same coke oven chamber and the level of coal in one of said coal hoppers on said larry car is below a preselected level.

9. A method to interlock a pusher machine and larry car comprising,

moving a coal charging larry car into overlying relation with a coke oven chamber for charging said coke oven chamber with coal,

moving a pusher machine on the pusher side of the coke oven battery into position for leveling the same coke oven chamber to be charged with coal by said coal charging larry car,

transmitting a signal from said pusher machine, and

actuating a power-operated means on said coal charging larry car to discharge coal into said coke oven chamber by said signal so that said coal is discharged into said chamber only when said pusher machine is positioned to level the coal charge in the same coke oven chamber.

10. A method to interlock a pusher machine and a larry car as set forth in claim 9 which includes,

transmitting a signal from said coal-charging larry car,

actuating a power-operated means on said pusher machine to initiate the leveling operator when the coke oven chamber has been charged with a preselected amount of coal to prevent peaks of coal from entering the charging holes in the coke oven battery roof and obstructing the gas passageway adjacent the top portion of the coking chamber.

11. Apparatus to interlock a pusher machine and a larry car as set forth in claim 1 in which,

said signal-transmitting device includes a light beam positioned on said pusher machine, and

said signal-receiving device includes a photo electric cell positioned on said coal-charging larry car.

12. Apparatus to interlock pusher machine and a larry car as set forth in claim 5 in which,

said second-signal transmitting device includes a light beam positioned on said larry car, and

said second signal-receiving device includes a photoelectric cell positioned on said pusher machine.

13. Apparatus to interlock a pusher machine a larry car as set forth in claim 1 in which,

said signal-transmitting device and signal-receiving device includes a pneumatic pressure system having a source of pneumatic pressure on said pusher machine,

a conduit at each coke oven chamber, said conduit arranged to be connected to said source of pneumatic pressure when said pusher machine is aligned with said preselected coke oven chamber,

said control device on said larry car having a pressure-actuated switch operable to actuate said power operated means, said larry car being operable to receive pneumatic pressure from said pusher machine through one of said conduits at said preselected coke oven chamber to actuate said pressure actuated switch.

14. Apparatus to interlock a pusher machine and larry car as set forth in claim 1 in which,

said signal-transmitting device and said signal receiving device includes,

a half transformer on said pusher machine connected to a source of electricity,

a group of other half transformers positioned at each coke oven chamber so that when said pusher machine is aligned with a coke oven chamber said half transformer on said pusher machine is aligned with one of said other half transformers to form a complete transformer with a gap therebetween,

said other half transformers connected to a second group of half transformers arranged on the roof of said coke oven chamber,

a second half transformer on said larry car connected to said control device, said second half transformer operable to be aligned with one of said second group of half transformers to thereby transmit electricity from said pusher machine to said control device.

15. Apparatus to interlock a pusher machine and larry car as set forth in claim 1 in which,

said signal-transmitting device includes a transmitter for transmitting directional radio signals, and

said signal-receiving device includes a receiver for receiving said directional radio signals.

16. Apparatus to interlock a pusher machine and a larry car as set forth in claim 5 in which,

said second signal-transmitting device is a nondirectional-signal-transmitting device positioned on said larry car, and

said second signal-receiving device positioned on said pusher machine is arranged to receive said nondirectional signal transmitter by said second signal-transmitting device.

17. Apparatus to interlock a pusher machine and a larry car as set forth in claim 16, in which,

said nondirectional-signal-transmitting device is a radio transmitter operable to transmit a radio signal at a preselected frequency,

said second signal-receiving device is a radio receiver operable to receive said radio signal at said preselected frequency.

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