United States Patent [19]

Tucker

[11] **3,833,478**

[45] **Sept. 3, 1974**

[54] **REVERSING MECHANISM FOR COKE OVEN BATTERY**

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[73] Assignee: **Koppers Company, Inc.,** Pittsburgh, Pa.

[22] Filed: **Jan. 29, 1973**

[21] Appl. No.: **327,595**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 103,306, Dec. 31, 1970, abandoned, which is a continuation-in-part of Ser. No. 885,678, Dec. 17, 1969, abandoned.

[52] **U.S. Cl.** **202/151,** 202/141, 202/143, 202/144

[51] **Int. Cl.** **C10b 1/06,** C10b 21/10

[58] **Field of Search** 202/151, 139, 141, 143, 202/144

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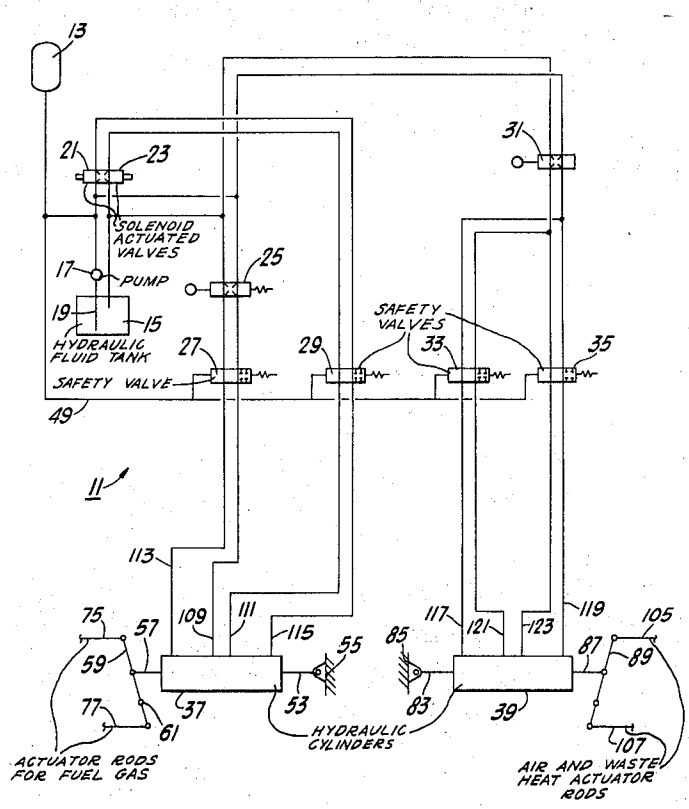
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Assistant Examiner—D. Sanders
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[57] **ABSTRACT**

A coke oven battery reversing mechanism comprises a repeat-cycle timing device that signals the commencement of the sequence of movement of cylinder-piston assemblies to initiate the 1–4,5 reverse, and also the 2,3 reverse of the coke oven battery. Two tandem cylinder-piston assemblies are connected to the actuating rods for the air, waste heat valves and the fuel gas valves, hydraulic power being obtained from an accumulator.

7 Claims, 15 Drawing Figures



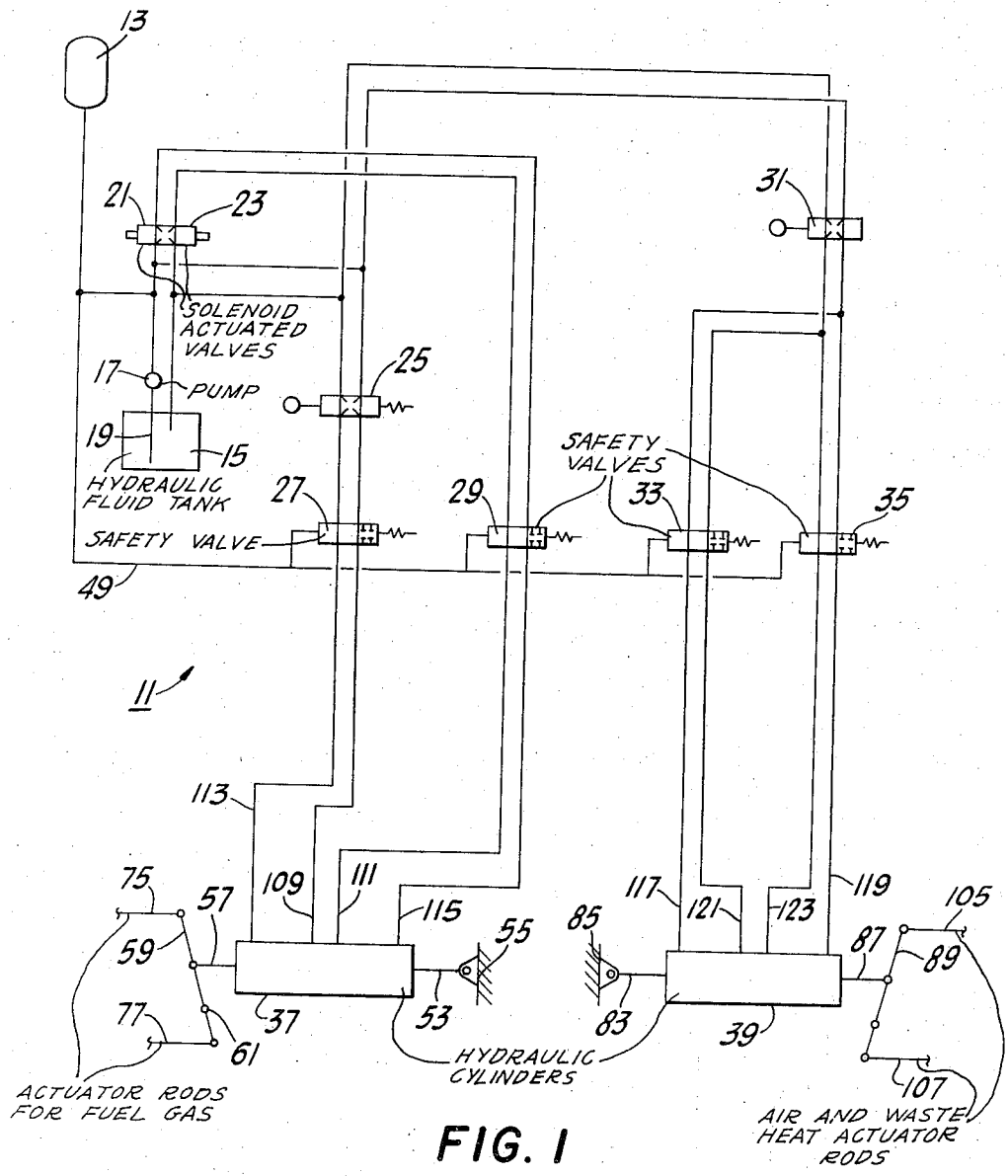


FIG. 1

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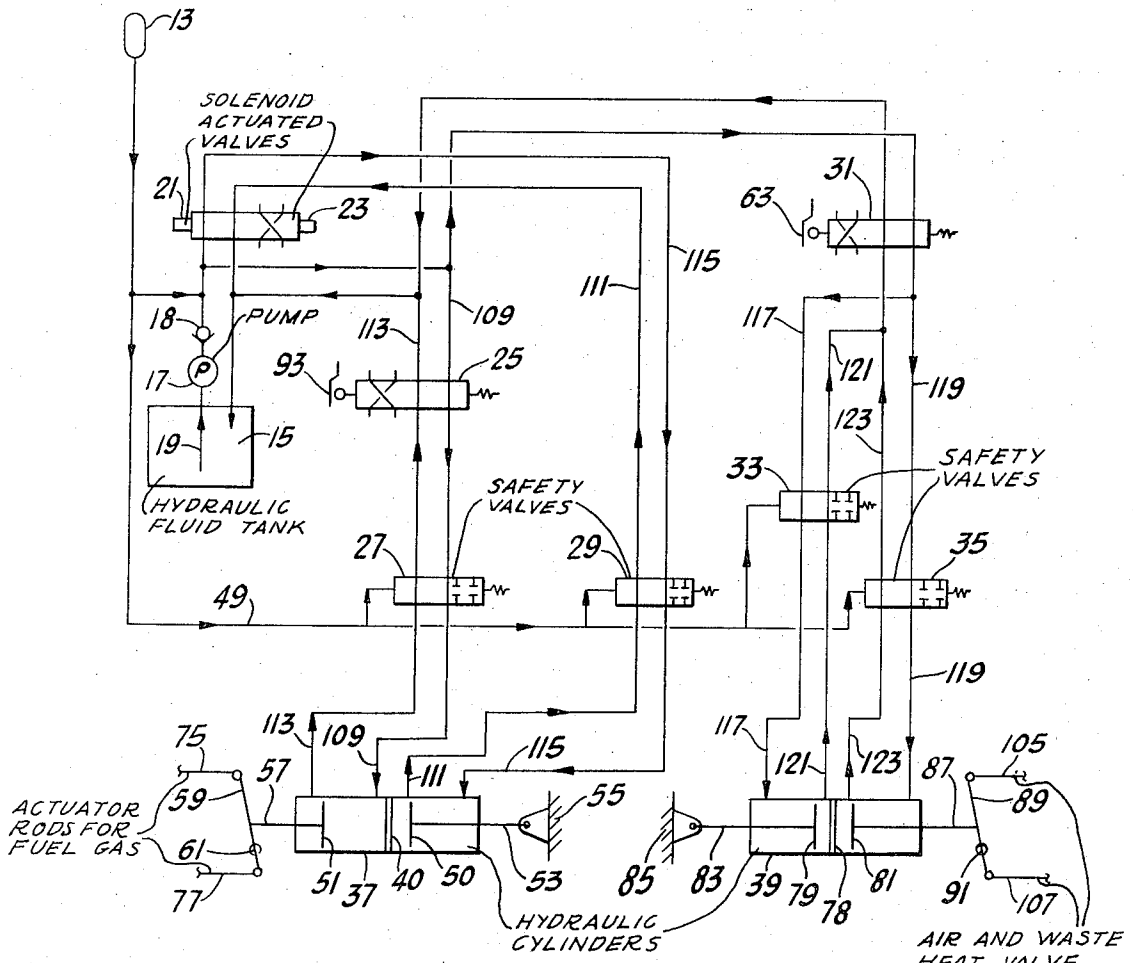

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ACTUATOR RODS FOR FUEL GAS
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HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. 1a

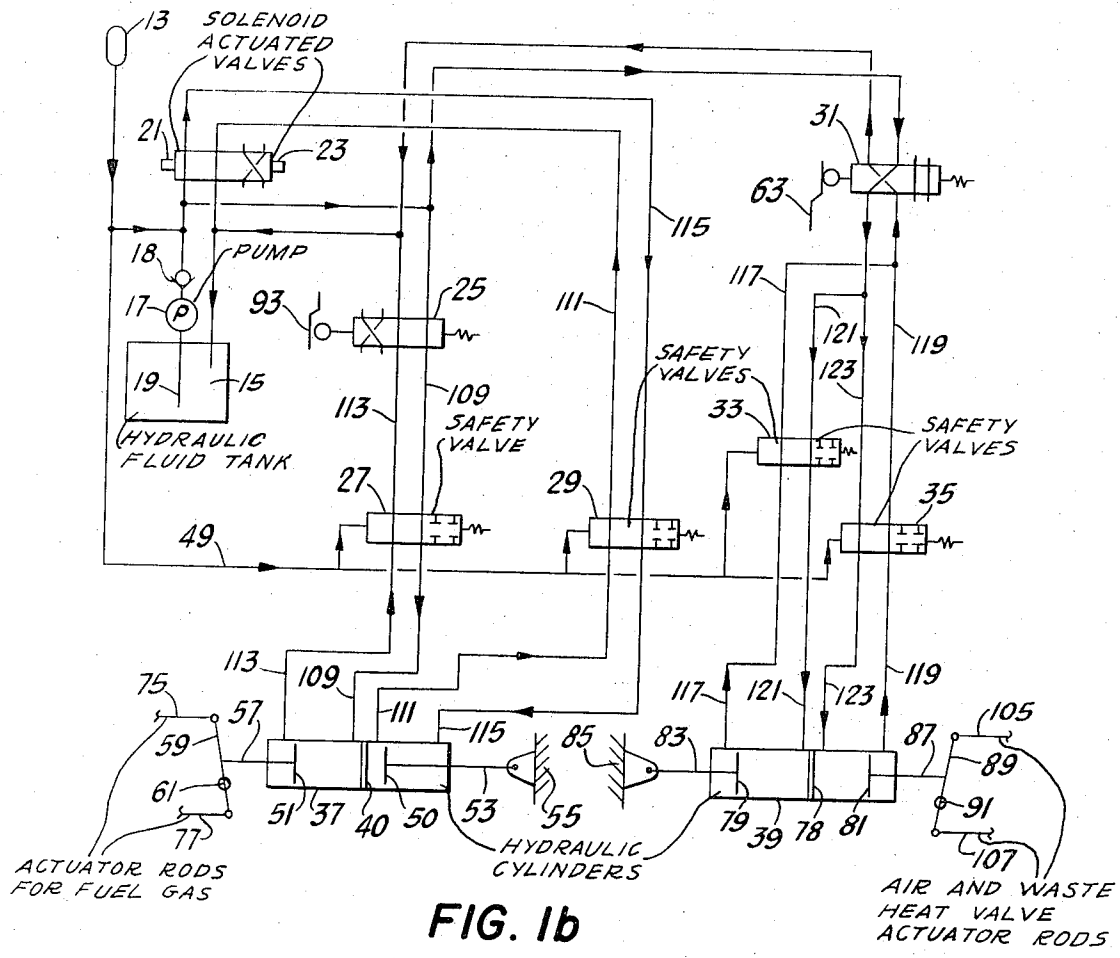

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ACTUATOR RODS FOR FUEL GAS
HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. 1b

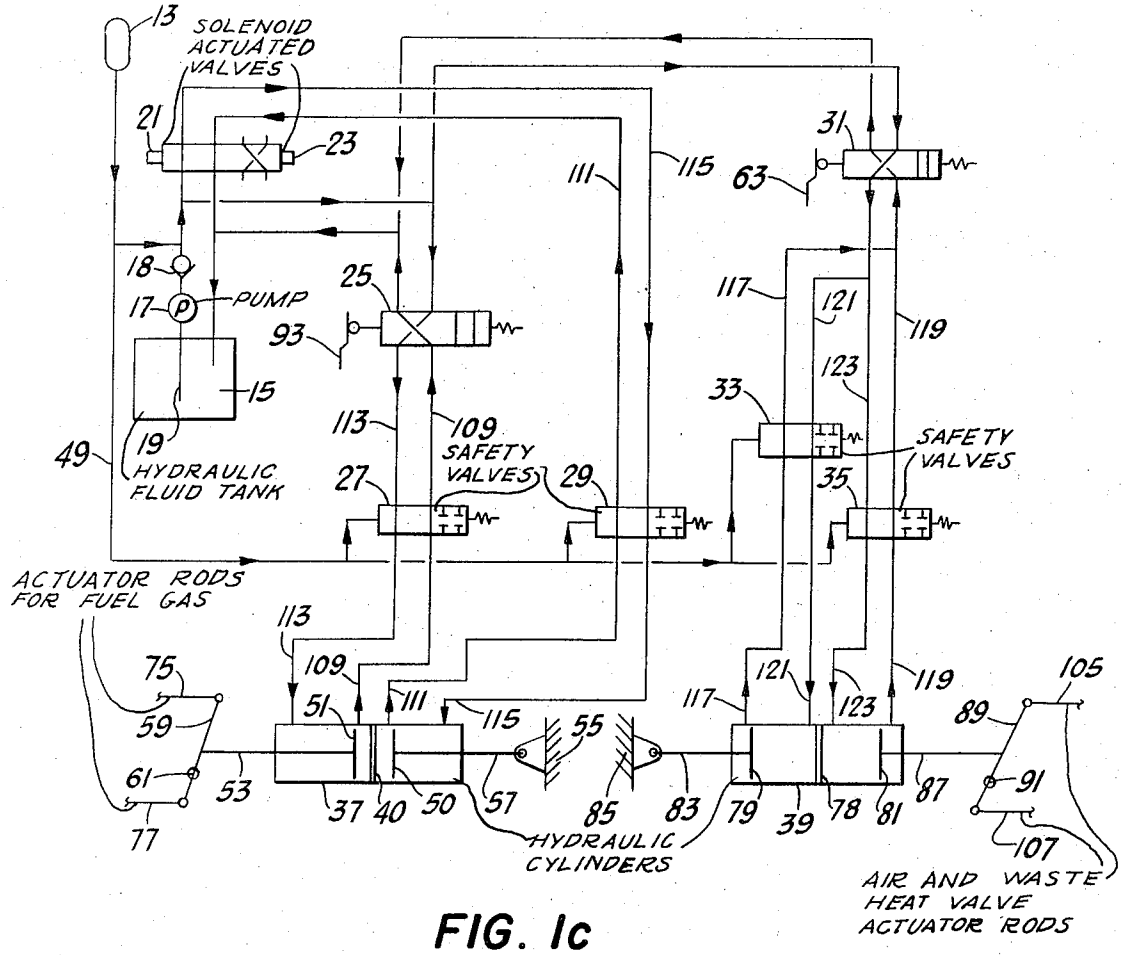

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HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. Ic

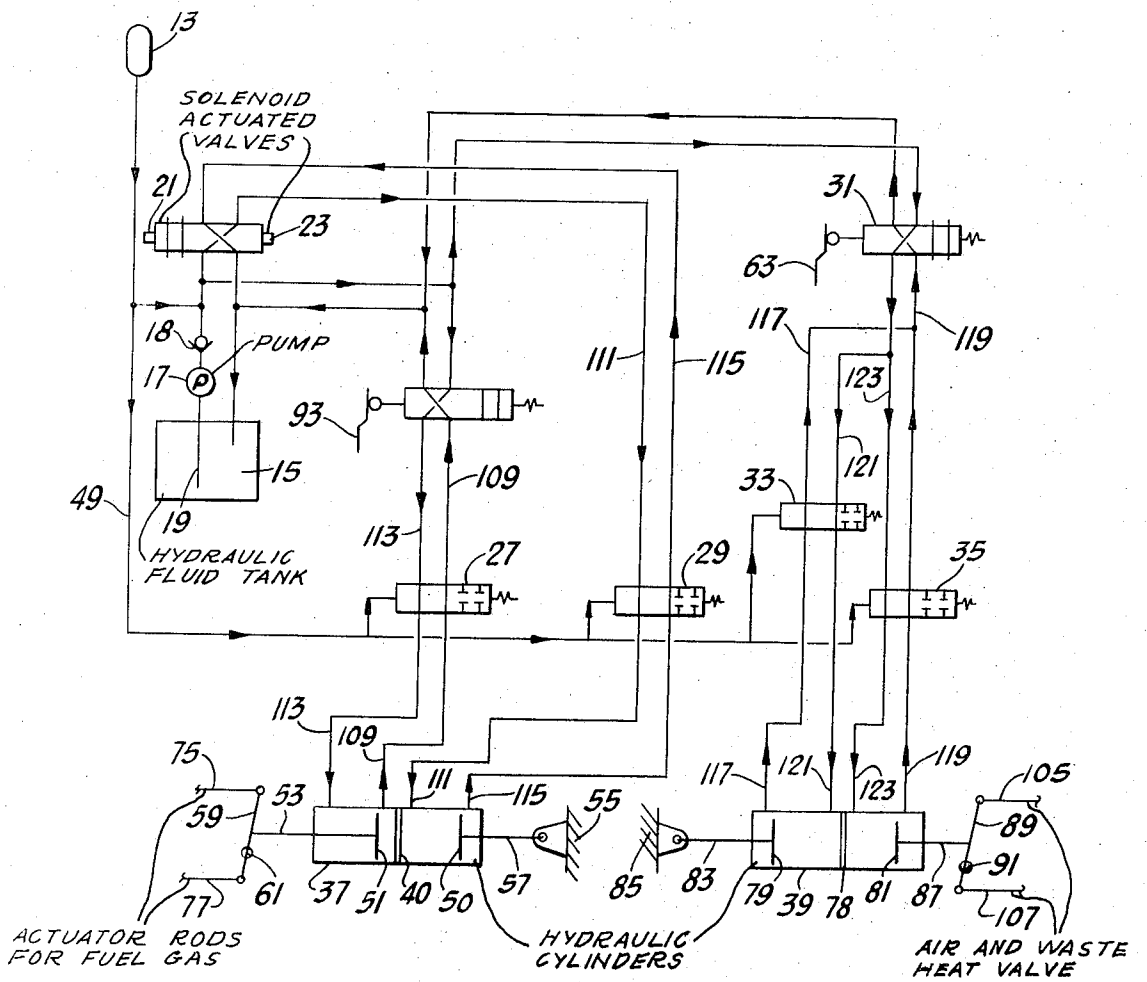

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ACTUATOR RODS FOR FUEL GAS
HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. 1d

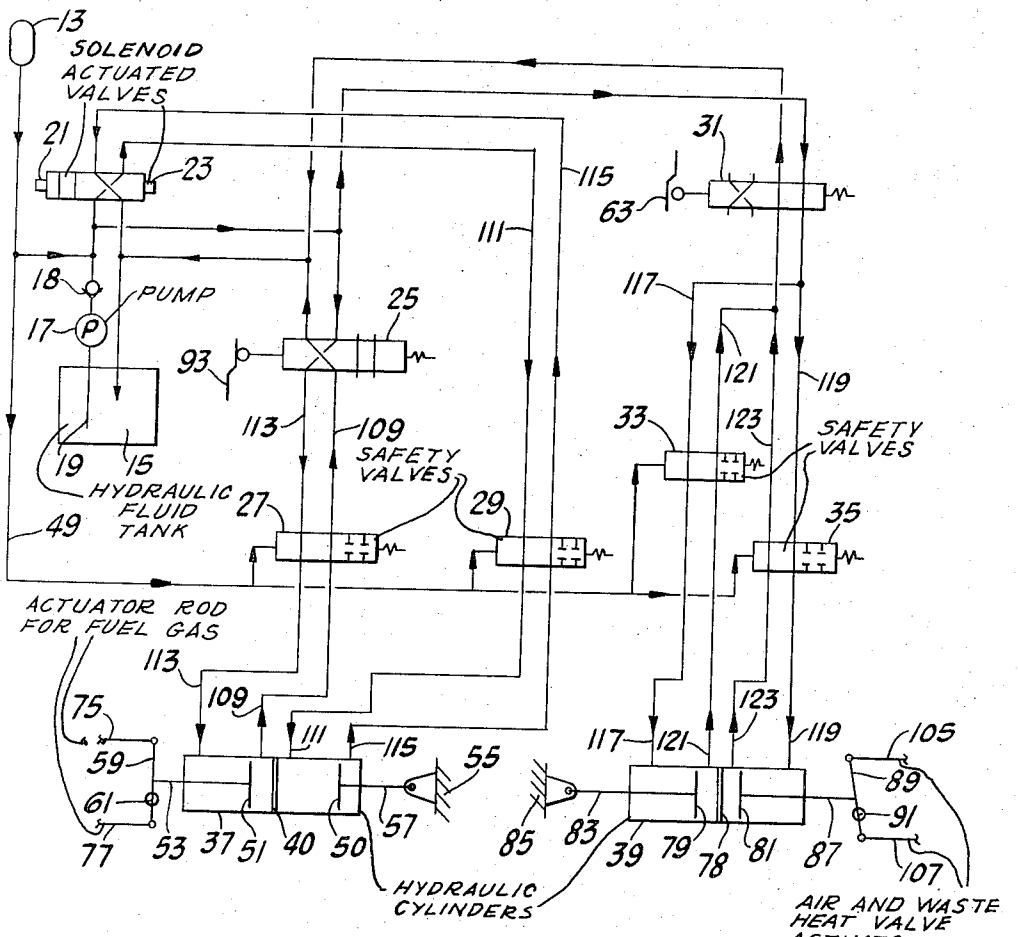

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HYDRAULIC FLUID TANK
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ACTUATOR ROD FOR FUEL GAS
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HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. 1e

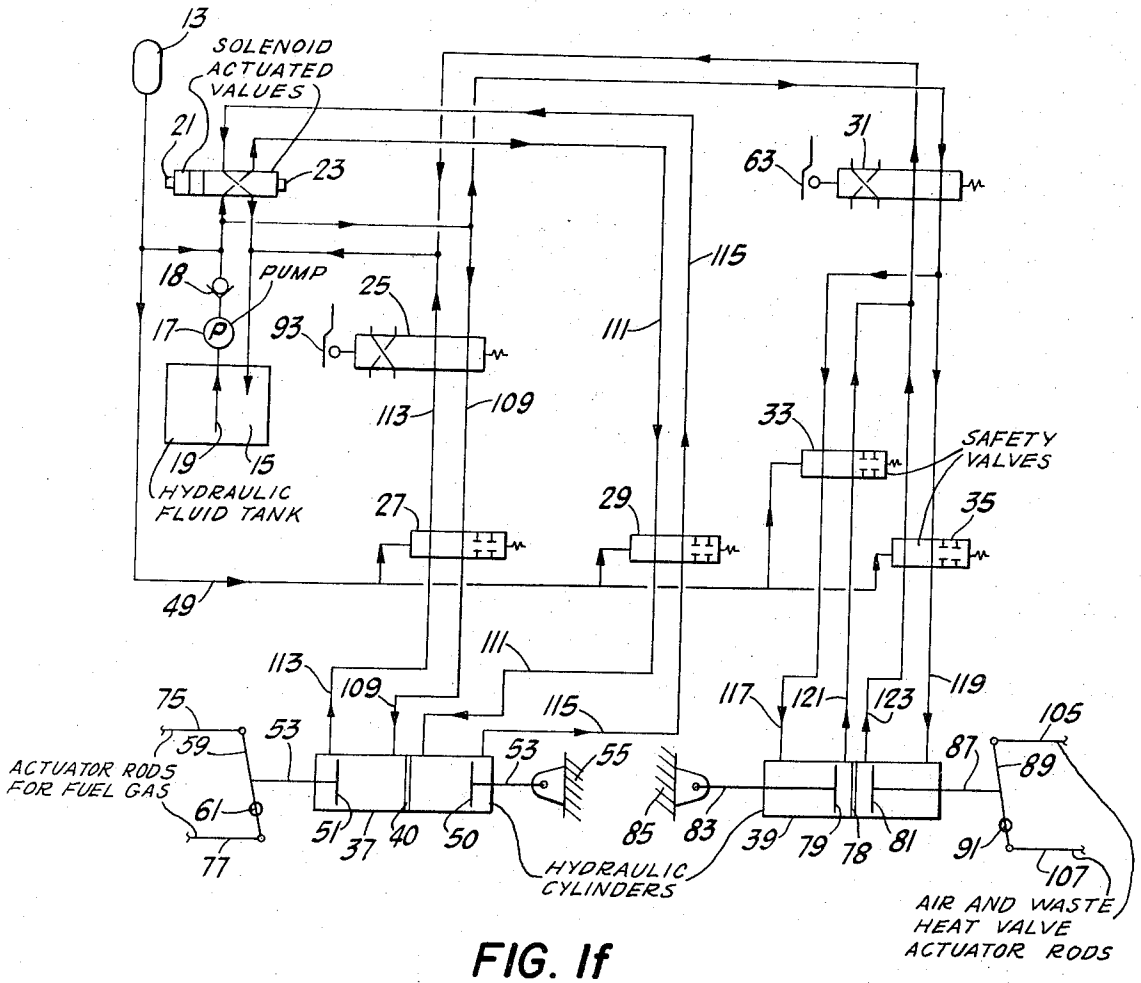

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ACTUATOR RODS FOR FUEL GAS
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HYDRAULIC CYLINDERS
AIR AND WASTE HEAT VALVE ACTUATOR RODS

FIG. If

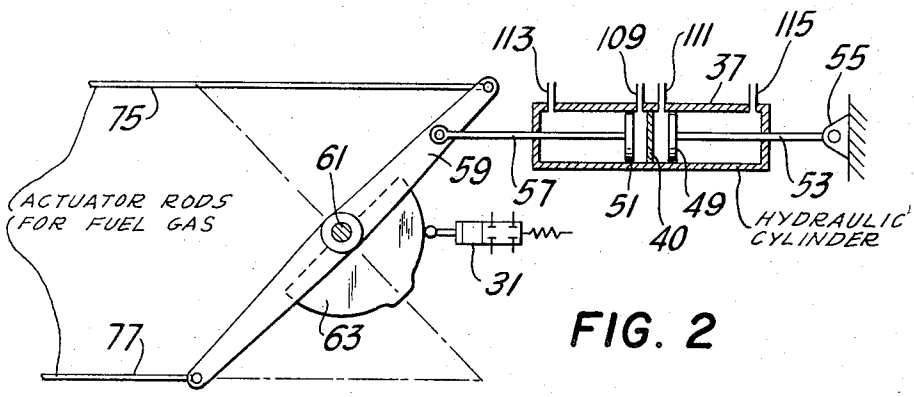


FIG. 2

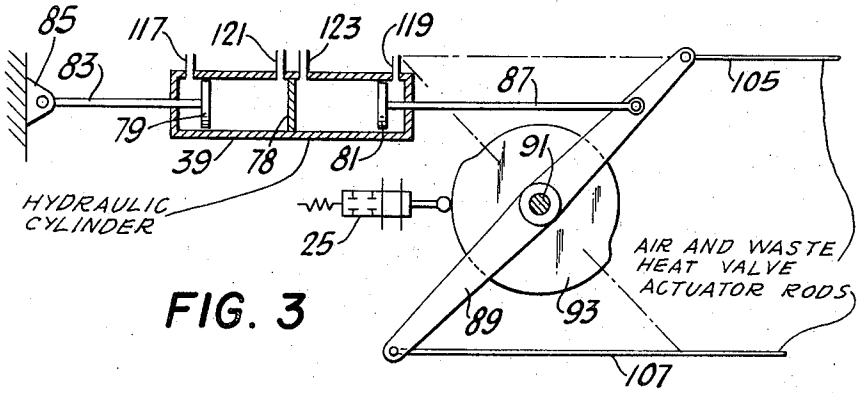


FIG. 3

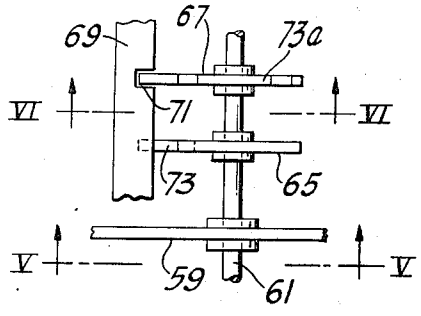


FIG. 4

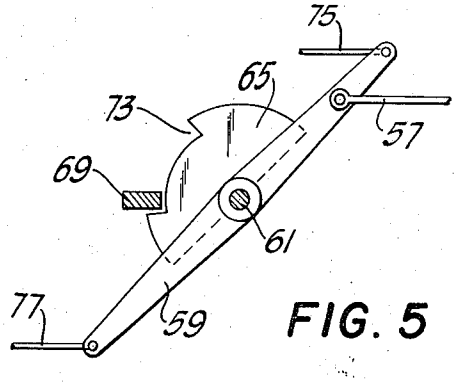


FIG. 5

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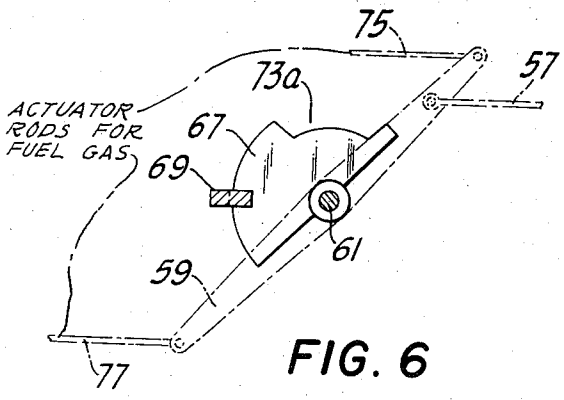


FIG. 6

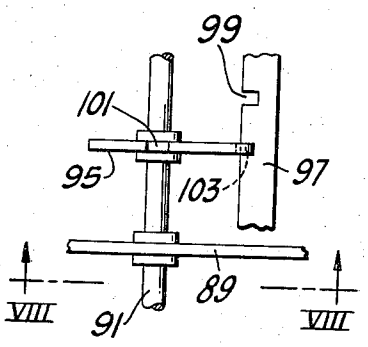


FIG. 7

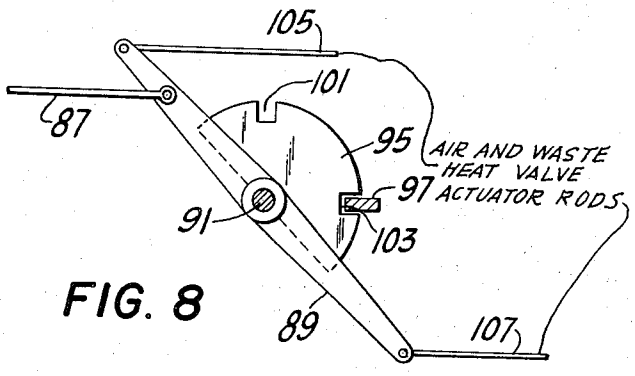


FIG. 8

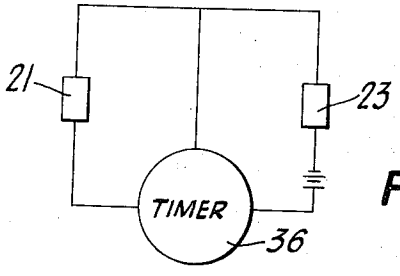


FIG. 9

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REVERSING MECHANISM FOR COKE OVEN BATTERY

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 103,306, filed Dec. 31, 1970, and now abandoned which application is a continuation-in-part of application Ser. No. 885,678, filed Dec. 17, 1969, now abandoned.

BACKGROUND OF THE INVENTION

The invention relates to coke ovens and, more particularly, to a mechanical mechanism for reversing the flow of air and gas through the flues of the cooling chamber heating walls.

In the operation of a conventional horizontal coke oven battery, it is customary to burn gaseous fuel in one heating flue of a pair of flues during the "on-cycle," and to direct the hot gases of combustion of such gaseous fuel into the other flue during the "off-cycle." Periodically, say every half-hour, the burning of fuel in the "on-flues" ceases and these flues become the "off-flues," while the original "off-flues" become "on-flues," as gaseous fuel is burned in them.

The change over from "on-flues" to "off-flues" is carried out by reversing certain valves in the basement of the coke oven battery. Reversing may be done manually, by an electro-mechanical mechanism, by an hydro-mechanical means, or by mechanical means associated with a timer mechanism set to induce reversal at prescribed time intervals.

This sequential burning of gaseous fuel in high and low burners in the heating wall flues presents problems in the proper control of the flow of air, waste heat, fuel gas, and decarbonizing air to the coke oven battery flues. In a horizontal coke oven battery, wherein the direction of the flow of air and waste gas is periodically reversed, additional control problems are encountered in the proper sequential operation of the valves controlling the flow of gas and decarbonizing air to the burners.

The control of the flow of fuel gas and the flow of decarbonizing air to the high and the low burners in two groups of flame flues, and the flow of combustion air and waste heat to the same two groups of flame flues increases the number of sequential steps in the operation of a coke oven battery. The steps must be timed to occur in a predetermined sequence, and all of the control components associated with the operation are actuated in response to signals from a central reverse timing mechanism.

As mentioned previously, some reversing mechanisms consist of a large piece of equipment located in the battery control room and associated with such equipment are heavy structural flooring, mechanical connectors such as control rods, chains, sprockets and the like extending between the basement and the control room.

An advantage of an hydraulic reversing machine is that the control room can be located in the most desirable place without regard to a reversing machine.

Because reliability plays such an important part in the consideration of a reversing system for a coke oven battery, it has been customary to select a mechanical system instead of an hydraulic system. But, hydraulic

equipment is now available that can be used in a reliable and positive reversing system, and such a system is considerably less costly than a mechanical system in the long run.

The present invention is directed to one such hydraulic reversing system.

For a further understanding of the invention and for other features and advantages thereof, reference may be made to the following description of one embodiment of the invention taken in conjunction with the drawings which illustrate for the purpose of exemplification such embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** illustrates schematically and generally an hydraulic reversing system for a coke oven battery in accordance with the invention;

FIGS. **1***a*–**1***f* illustrate the system of FIG. **1** as the system appears in various operative positions;

FIG. **2** illustrates a mechanical detail of the system of FIG. **1**;

FIG. **3** illustrates another mechanical detail of the system of FIG. **1**;

FIGS. **4**–**8** illustrate details of a mechanical locking mechanism within the system of FIG. **1**; and

FIG. **9** illustrates a simplified wiring diagram of a portion of the system of FIG. **1**.

DETAILED DESCRIPTION

FIG. **1** illustrates schematically an hydraulic reversing system **11** for the valves of a horizontal coke oven battery. Such a system **11** includes the following principal items of equipment: an accumulator **13**; an hydraulic oil supply or sump tank **15**; a pump **17** having a suction tube **19** within the tank **15**; solenoid actuated valves **21** and **23**; a plurality of mechanically actuateable valves **25, 27, 29, 31, 33,** and **35**; a rich or fuel gas reversing piston-cylinder assembly **37**; and an air and waste heat reversing piston-cylinder assembly **39.**

The accumulator **13** is of conventional design and is pressurized at all times by the pump **17** which is controlled to cut-in and to cut-out so as to maintain the pressure within the accumulator within a desired range. This is readily accomplished by means of a conventional check valve **18** that is installed in the discharge line from the pump **17,** as shown in FIG **1.**

The accumulator **13** is fluidly connected by piping **49** to valves **27, 29, 33,** and **35** so that one side of a piston in such valves would be kept pressurized at all times, thereby making sure that all of such valves **27, 29, 33,** and **35** remain in their desired positions.

In cases of emergency, such as a power failure or the like, it may be necessary to pressurize the accumulator **13** by operating a hand pump (not shown) so that the system can operate for at least one reverse or possibly two reverses. In some applications, a storage battery may provide emergency power to operate a motorized pump (not shown) for pressurizing the accumulator **13.**

The reversing system **11** is equally suitable for use in either gun flue type ovens with air decarbonizing, or under jet types of ovens with waste gas recirculation. The following describes typically the reversing system **11** for a coke oven battery heating on a 1–4, 5 cycle, and reversing on a 2,3 cycle. Thus, in a group of 5 ovens, the flues of ovens 1, 4, and 5 will be "on flues,"

and the flues of ovens 2, 3 will be "off flues." During the reverse heating, the flues of ovens 2, 3 will be "on flues," and the flues of ovens 1, 4, and 5 will be "off flues."

The reverse is initiated by a timing device **36** (FIG. 9) located preferably in a battery control room. A preferred form of timing device is manufactured and sold by the Eagle Signal Company, Davenport, Iowa. Such a timer **36** is a repeat-cycle timer driven by a synchronous motor and has two timing cams; one cam initiating the 1–4, 5 reverse, and the other cam initiating the 2, 3 reverse.

As is known, in a reversing operation, the air and waste heat valves are actuated in sequence with the fuel gas valves. Now, in order to place the air and heat waste valves, as well as the fuel gas valves, in the mid-position or neutral position, and in the two extreme open and closed positions, two tandem cylinders, **37, 39,** with duel pistons in each cylinder, are employed. FIGS. **1***a*–**1***f* illustrate various positions of the system, shown generally in FIG. **1,** during the heating and reversing cycle.

FIG. **2** illustrates the cylinder **37** in which there is a central wall **40** that divides the cylinder interior into two chambers in which pistons **50** and **51** are disposed. Piston **50** is connected to a rod **53** anchored as at **55,** and piston **51** is connected to a rod **57** pivotally connected to an arm **59.**

The arm **59** is fixed to a shaft **61** carrying a cam **63.** The cam **63** is disposed to engage and actuate valve **31.**

The shaft **61** also carries a pair of spaced apart interlocking plates **65, 67** (FIG. **4**) that cooperate with a locking gate **69.** The locking gate **69** is a rectangular shaped bar that is slidable lengthwise and is provided with a notch **71** located so as to allow the interlocking plate **67** to rotate as the shaft **61** rotates when the locking gate **69** is in the operative position shown in FIG. **4.**

The interlocking plate **65** is provided with a notch **73** in which the locking gate **69** is disposed, as shown in FIG. **5.**

While not shown, the locking gate **69** moves lengthwise when the air and waste heat valves move, as described hereinafter. A description of the use of the locking gate **69** is provided herein later on.

Referring again to FIG. **2,** the arm **59** is connected to fuel gas valve actuating rods **75, 77** as shown, and the arm **59** is pivotable about the axis of the shaft **61** through an angle of about 90°, to the position shown by the dotted outline.

FIG. **3** illustrates the cylinder **39** in which there is a central wall **78** that divides the cylinder interior into two chambers in which pistons **79, 81** are disposed. Piston **79** is connected to a rod **83** anchored as at **85,** and piston **81** is connected to a rod **87** pivotally connected to another arm **89.**

The arm **89** is fixed to a shaft **91** carrying a cam **93;** the cam **93** being disposed to engage and actuate valve **25.**

The shaft **91** (FIGS. **7, 8**) also carries a semicircular shaped interlocking plate **95** which cooperates with a rectangular shaped locking gate **97** that is slidable lengthwise and that is provided with a notch **99** located about where shown in FIG. **7.**

The interlocking plate **95** is provided with two notches **101, 103** which are disposed about **90°** apart along the perimeter of the semicircular shaped interlocking plate **95.** The locking gate **97** is shown in one operating position in notch **103.** The locking gate **97** also is movable lengthwise when the fuel gas valve rods move and its use is described hereinafter.

Referring again to FIG. **3,** the arm **89** is connected to air and waste heat valve actuating rods **105, 107** as shown, and the arm **89** is pivotable about the axis of the shaft **91** through an angle of about 90°, to the position shown by the dotted outline.

Referring now to FIG. **1** and to FIGS. **1***a*–**1***f*, a reversing cycle will be described.

It is assumed first that, at the conclusion of a preceding reversing cycle, the fuel gas cylinder **37,** and the air and the waste gas cylinder **39** are in their respective positions, as shown in FIG. **1f.** In the position of FIG. **1f,** the pistons **50** and **51** are at the extreme outer ends of the cylinder **37,** which has also moved laterally towards the left by virtue of the fixed anchor **55** which prevents lateral movement of the piston **50** and rod **57.** Thus, both the cylinders **37, 39** can and do move laterally, as well as only one piston within each cylinder, since the other piston and piston rod are anchored and cannot move.

When the cylinders **37, 39** move laterally, it will be evident that the respective lever arms **59, 89** pivot about the respective shafts **61, 91,** whereby the valve rods **75, 77** and valve rods **105, 107** move to actuate the valves of the battery linked to these rods.

What makes cylinder **37** and piston **50** move is pressurized fluid entering the cylinder **37** through conduits **109** and **111.** The other two conduits **113, 115** of cylinder **37** vent fluid from the cylinder back to the tank **15.**

When cylinder **37** is in the position of FIG. **1***f*, cylinder **39** is also in the position shown in FIG. **1f.** In such position, both of the pistons **79, 81,** as well as the cylinder **39,** are fully retracted, which is evident when the pistons **79, 81** are closest to the central wall **78.**

Cylinder **39** has arrived at this position by introducing fluid under pressure into both chambers of the cylinder **39** through conduits **117, 119.** Fluid is also vented from the chambers through conduits **121, 123** back to the tank **15.**

Now, when the reversing timer **36** (FIG. **9**) calls for a 1–4, 5 reverse in the heating cycle, solenoid actuated valve **21** is opened, as shown in FIG. **1***a*, so that fluid flows from the accumulator **13** through conduits and ports **115,** while fluid vents through conduit **111,** flowing back to the sump tank **15.**

Thus, at the commencement of a reversing cycle, the pistons **50, 51** and cylinder **37,** as well as the pistons **79, 81** and cylinder **39,** are positioned as shown in FIG. **1***a*.

The valves **27, 29, 33,** and **35** are normally open and they remain open until pressure in the hydraulic power supply fails. When the hydraulic power fails, valves **27, 29, 33,** and **35** close automatically, thus locking all the mechanism in a fixed position. The valves remain in this fixed closed position until power is resumed, whereupon valves **27, 29, 33,** and **35** open, and the reversing sequence is restored.

In FIG. **1***a*, the fuel gas cylinder **37** is in its neutral position and, while moving to the neutral position, the cam **63** actuates valve **31** thereby causing pressurized fluid to flow into cylinder **39** through conduits **121** and **123,** as shown in FIG. **1***b*.

Pressurizing of conduits **121, 123** and venting conduits **117, 119** results in the movement of the cylinder **39** from the position of FIG. **1***a* to the position shown in FIG. **1***b*. Piston **37,** however, remains in the neutral position, which is the position shown in FIG. **1***a*.

As the air and waste heat cylinder **39** moves toward its fully extended position shown in FIG. **1***b*, valve **25** is actuated by cam **93** (FIG. **3**).

When valve **25** is actuated, as shown in FIG. **1***c*, pressurized fluid flows from the accumulator **13** through valve **25** in conduit **113** into cylinder **37,** and fluid in cylinder **37** vents through conduits **109, 111** back to the sump tank **15.**

Wherefore, the piston **51** moves from left to right, as viewed in FIG. **1***c*, thereby pivoting the arm **59** about shaft **61,** and the cylinder **37** and pistons **50, 51** assume the fully retracted position shown in FIG. **1***c*.

The 1–4, 5 reverse is now completed, and the valves remain in the position of FIG. **1***c* while the coke oven is heated by flues 1–4, 5. After a selected heating period, about 30 minutes, the timer **36** indicates a reverse to a 2, 3 heating cycle.

From the position of FIG. **1***c*, with the fuel gas cylinder **37** in the retracted position, the solenoid actuated valve **23** is opened by the timer **36.** Pressurized fluid from the accumulator **13** flows into the conduit **111,** while fluid within the cylinder **37** is vented through conduit **115** back to the sump tank **15.** The piston **50,** being anchored as at **55,** cannot move; wherefore, the cylinder **37** moves laterally, but the piston **51** does not move relative to the cylinder. Then, the cylinder **37** and pistons **50, 51** assume the position shown in FIG. **1***d*. As the fuel gas cylinder **37** moves to the position of FIG. **1***d*, cam **63** on shaft **61** is released; wherefore, the valve **31** assumes the position shown in FIG. **1***e*.

When the cylinder **39** moves from the position shown in FIG. **1***d* to that shown in FIG. **1***e*, fluid under pressure flows in conduits **119, 117** into cylinder **39,** and fluid vents therefrom through conduits **121, 123** back to the tank **15.** The cylinder **39** then assumes the position shown in FIG. **1e**.

As the cylinder **39** moves to the position shown in FIG. **1***e*, cam **93** releases valve **25** which returns to the position shwn in FIG. **1***f*.

Fluid under pressure then flows through valve **25** in conduit **109,** and fluid vents through conduit **113** back to the sump tank. When pressurized fluid flows through conduit **109** into cylinder **37,** piston **51** moves from right to left, as viewed in FIG. **1***e*, and assumes the position shown in FIG. **1***f*. When the piston **51** so moves, the piston rod **53** urges the lever **59** to pivot about shaft **61** to actuate the valve rods **75, 77** and, of course, the valves of the battery connected to such rods.

The 2, 3 reverse is now completed, and heating on the 2, 3 cycle continues for a selected period, about 30 minutes.

The position of the valves and cylinders shown in FIG. **1***f* is the initial position assumed at the commencement of the description of operation herein. The 1–4, 5 and the 2, 3 reverse cycles are repeated thereafter, as described herein, in accordance with a timed schedule.

While the foregoing describes the basic operation of mechanism in the reversing system **11** of the invention, it is recognized that other operations are carried out simultaneously with some of the sequences described hereinbefore. For example, as soon as the fuel gas cylinder **37** moves to the neutral position, as shown in FIG. **1***a*, valve **31** is actuated by cam **63**; and, at the same time, a four-way solenoid valve (not illustrated) is actuated by the fuel gas valve rod **75** to reverse the flow of fluid to conduits **123, 119.** Whereupon, the air and waste gas cylinder **39** moves to a neutral position and stops there. The four-way solenoid valve would be electrically connected to another timer (not shown) so that after a predetermined time interval, this other timer would release the four-way solenoid valve to allow the normal flow of fluid to conduits **123, 119** to be resumed. The air and waste heat cylinder would then complete its travel and valve **25** would be actuated by cam **93** as arm **89** rotates, thereby completing the reverse.

In any application, solenoid actuated valves **21** and **23** would be provided with re-set buttons that would allow either solenoid to be energized as desired. This would allow an operator of the coke oven battery to actuate the reversing system from either the 1–4, 5 or the 2, 3 reverse position.

The reversing system **11** would also be provided with a selector switch, located in the central control room, that would energize either solenoid actuated valve **21** or **23** in the case of an emergency, which would effect moving the fuel gas cylinder **37** to a neutral position. But, in order to prevent the reverse, actuated by pressing the selector switch, from going forward to its full completion, the special four-way valve that reverses the flow of fluid to conduits **121, 123** would be actuated. In such event the timer would be by-passed and the reversing system would remain in neutral until the reset button was pushed a second time. This would then actuate the reverse procedure in the normal manner.

With any reversing mechanism the danger of an explosion or fire is always imminent. Therefore, it is imperative that the actuation of the fuel valves and the air and waste heat valves be carried out sequentially, lest a dangerous condition exist in any flue.

In the sequence described hereinbefore, the fuel gas cylinder **37** can move only in the proper direction when the air and waste heat cylinder **39** is in a proper position. Likewise, the air and waste heat cylinder **39** can move in the proper direction only when the fuel gas cylinder **37** is in a proper position.

FIGS. **4–6** illustrate an interlock system for the fuel gas cylinder. When the arm **59** pivots counterclockwise from the positon shown in FIG. **5** through an angle of about 60°, the upper side of the notch **73** engages the locking gate **69,** and such locking gate prevents further rotation of the arm **59** until the locking gate **69** moves under the influence of the air and waste heat valve rods. When the notch **71** in the locking gate **69** (FIG. **4**) is opposite the interlocking plate **67,** the arm **59** is then able to continue its counterclockwise rotation.

Likewise, when the reverse cycle calls for the arm **59** to pivot clockwise from the position described previously, a similar notch **73***a* (FIG. **6**) in the interlockng plate **67** engages the locking gate **69** and prevents the uninterrupted rotation of the arm **59** until the locking gate notch **71** is opposite the interlocking plate **67.** Whereupon, complete rotation counterclockwise of the arm **59** is then possible. The locking gate **69** is movable by the air and waste heat valve rods **105, 107.**

FIGS. **7** and **8** illustrate a similar interlocking mechanism for controlling the actuation of the air and waste heat valves. Only one locking plate **95** is attached to the

shaft **91**, but the plate **95** has two notches **101, 103** disposed **90°** apart around the perimeter of the locking plate.

The arm **89** can rotate only when the notch **99** (FIG. 7) in the locking gate **97** is opposite the locking plate **95**. Otherwise, the locking gate **97**, being disposable in the notches **101, 103**, prevents rotation of the plate **95** and the arm **89**. The locking gate **97** is movable when the rod **75**, connected to the fuel gas valves, moves.

It will be noted from FIGS. **7** and **8** that the air and waste heat actuating rods **105, 107** are mechanically interlocked so that the air and waste heat rods can move only if the fuel gas cylinder **37** is in a neutral position with all fuel gas valves closed.

It will be noted from FIGS. **4–6** that the fuel gas cylinder **37** can, at any time, move the fuel gas rods **75, 77** to neutral so as to shut the fuel gas valve, but that the fuel gas rods are mechanically interlocked from completing the stroke and opening the fuel gas valves unless the air and waste gas cylinder **39** is in its proper position.

While the invention has been described herein with a certain degree of particularlity, it is understood that the foregoing description has been made as an example only and that the scope of the invention is defined by what is hereinafter claimed.

What is claimed:

1. In a system whereby reversing the fuel gas valves and the air and waste heat valves of a coke oven battery effects the reversal of the heating of the battery, the improvement comprising:

a. an actuator rod connected to said fuel gas valves;

b. an actuator rod connected to said air and waste heat valves;

c. a source of fluid under pressure;

d. a timer actuating in sequence both a first fluid flow control device and a second fluid flow control device;

e. conduit means connecting said source of fluid under pressure with both said first and said second fluid control devices;

f. first fluid operated means connected to said fuel gas valve actuator rod for opening and closing said fuel gas valves;

g. second fluid operated means connected to said air and waste heat valve actuator rod for opening and closing said air and waste heat valves;

h. a first fluid flow control valve;

i. a second fluid flow control valve;

j. conduit means carrying fluid under pressure to said first fluid flow control valve;

k. conduit means carrying fluid under pressure to said second fluid flow control valve;

l. conduit means carrying fluid from said first flow control valve to said first fluid operated means;

m. conduit means carrying fluid from said second fluid flow control valve to said second fluid operated means with said timer actuating in sequence, said first and second fluid flow control devices so that fluid flows from said source through said first and second fluid control devices, through said fluid flow control valves and into said first and second fluid operated devices, and said actuator rods open said fuel gas valves and said air and waste heat valves in accordance with a preselected schedule that accomplishes reversal of the heating of flues in said coke oven battery;

n. means interlocking the movement of the fuel gas actuator rods and the air and waste heat actuator rod so that each moves only in accordance with a predetermined sequence; and

o. normally open valve means in each one of said conduit means that closes upon receipt of a signal indicating an emergency condition warranting such closing.

2. The invention of claim **1** including:

a. cam means movable with said actuator rods actuates the first and second fluid control valves in accordance with a predetermined sequence.

3. In a system whereby the fuel gas valves and the air and waste heat valves of a coke oven battery effects the reversal of the heating of the battery, the improvement comprising:

a. a pair of actuator rods connected to the fuel gas valves;

b. a first arm pivotally mounted and connected to said rods;

c. a second pair of actuator rods connected to the air and waste heat valves;

d. a second arm pivotally mounted and connected to said second rods;

e. a source of fluid under pressure;

f. a timing device actuating in sequence both a first and a second fluid flow control device;

g. conduit means connecting said source of fluid and said first and second fluid flow control devices;

h. a first fluid actuated means connected to said first arm for pivoting said first arm thereby actuating said fuel gas valves;

i. a second fluid actuated means connected to said second arm for pivoting said second arm and actuating said air and waste heat valves;

j. a first flow control valve;

k. a second flow control valve;

l. conduit means connecting said first fluid flow control device to said first fluid actuated means;

m. conduit means connecting said second fluid flow ontrol device to said second fluid actuated means;

n. conduit means connecting said first control valve and said second control valve;

o. first can means actuated by said first arm for actuating said second flow control valve;

p. second cam means actuated by said second arm for actuating said first flow control valve, whereby in sequence said timer actuates said first fluid control device and fluid flows through said first flow control device into said first fluid actuated means and said fuel gas valve actuator rods move to reverse the position of said valves, and in sequence said fluid flows into said second fluid actuated means and said air and waste heat valve actuator rods move to reverse the position of said valves;

q. normally open valve means in said conduit means connecting said first and second flow control devices with said first and second fluid actuated means, said valve means being closable automatically in response to a signal indicating an emergency situation in said system;

r. said first and said second fluid actuated means each include a cylinder wherein there are two pistons

with a wall between the pistons subdividing the cylinder into two chambers, and wherein;

s. one piston is secured to a piston rod that is fixed, whereby only the other piston and the cylinder are movable.

4. The invention of claim **3** including:

a. interlocking means for preventing the inadvertent actuation of said fuel gas valves until said air and waste heat valve are in a preselected proper position.

5. The invention of claim **4** wherein:

a. said interlocking means is actuated by movement of said air and waste heat valve actuating rods.

6. The invention of claim **3** including:

a. interlocking means for preventing the inadvertent actuation of said air and waste heat valves until said fuel gas valves are in a preselected proper position.

7. The invention of claim **6** wherein:

a. said interlocking means is actuated by movement of said fuel gas valve actuating rods.

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