Jan. 25, 1966 S. O. LAWRENCE 3,231,104

COKE WHARF GATE OPERATING MECHANISM

Filed June 25, 1963 5 Sheets-Sheet 1

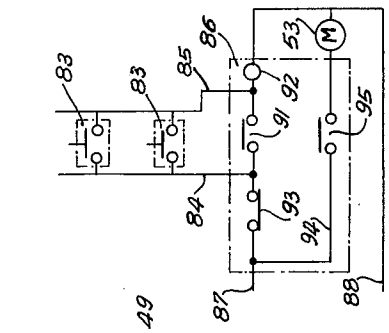

FIG. 7

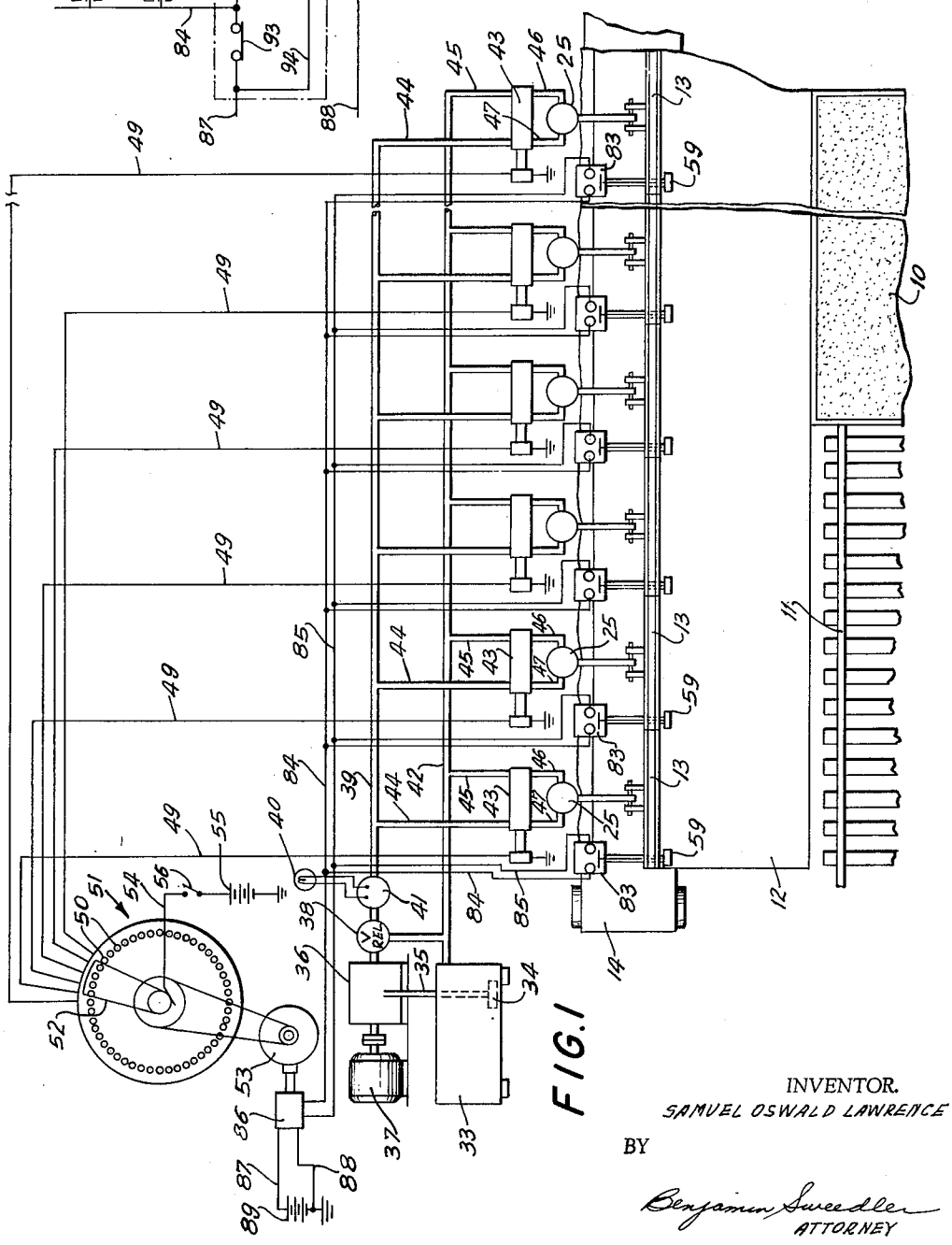

FIG. 1

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COKE WHARF GATE OPERATING MECHANISM

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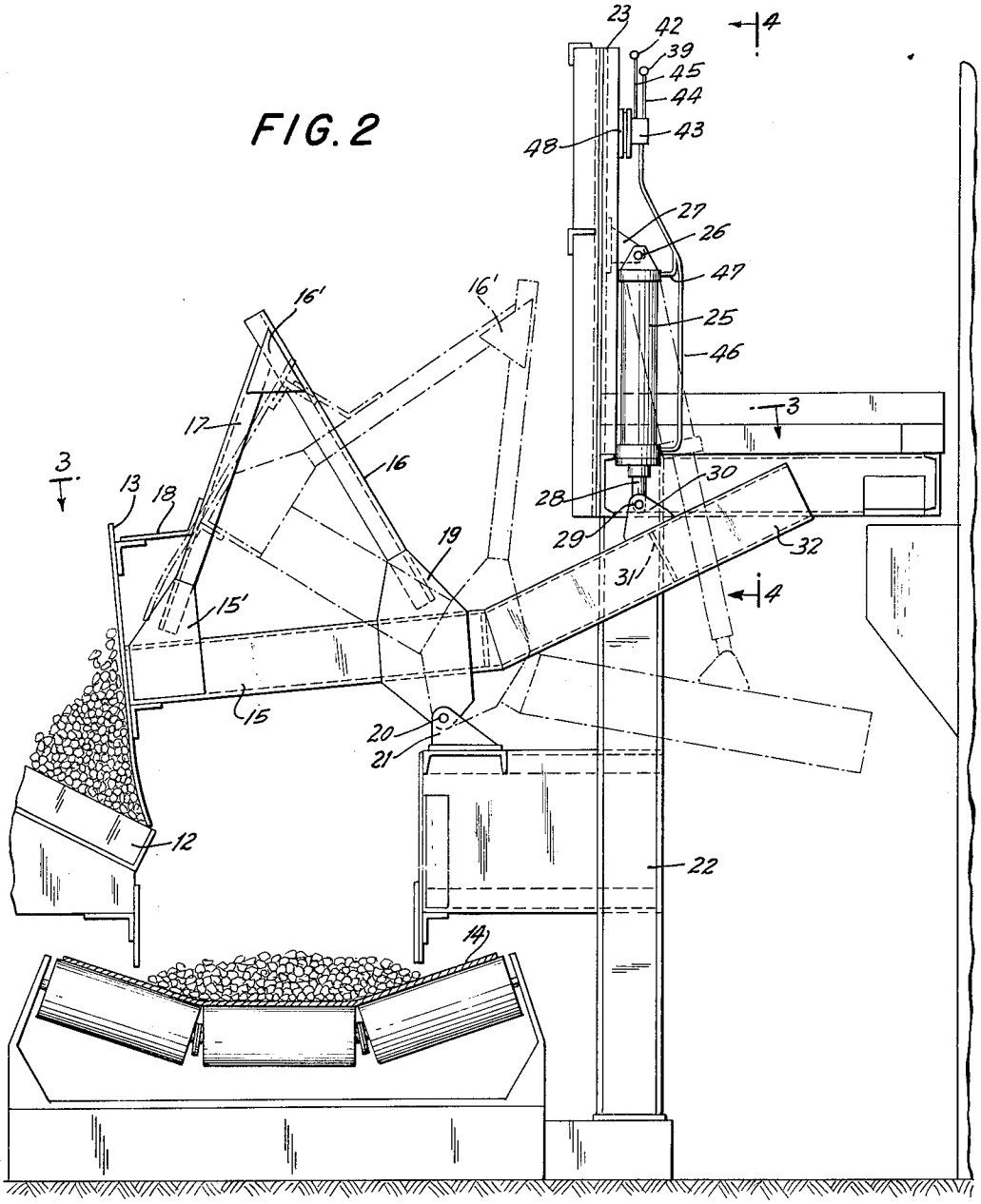
FIG. 2



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COKE WHARF GATE OPERATING MECHANISM

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FIG. 3

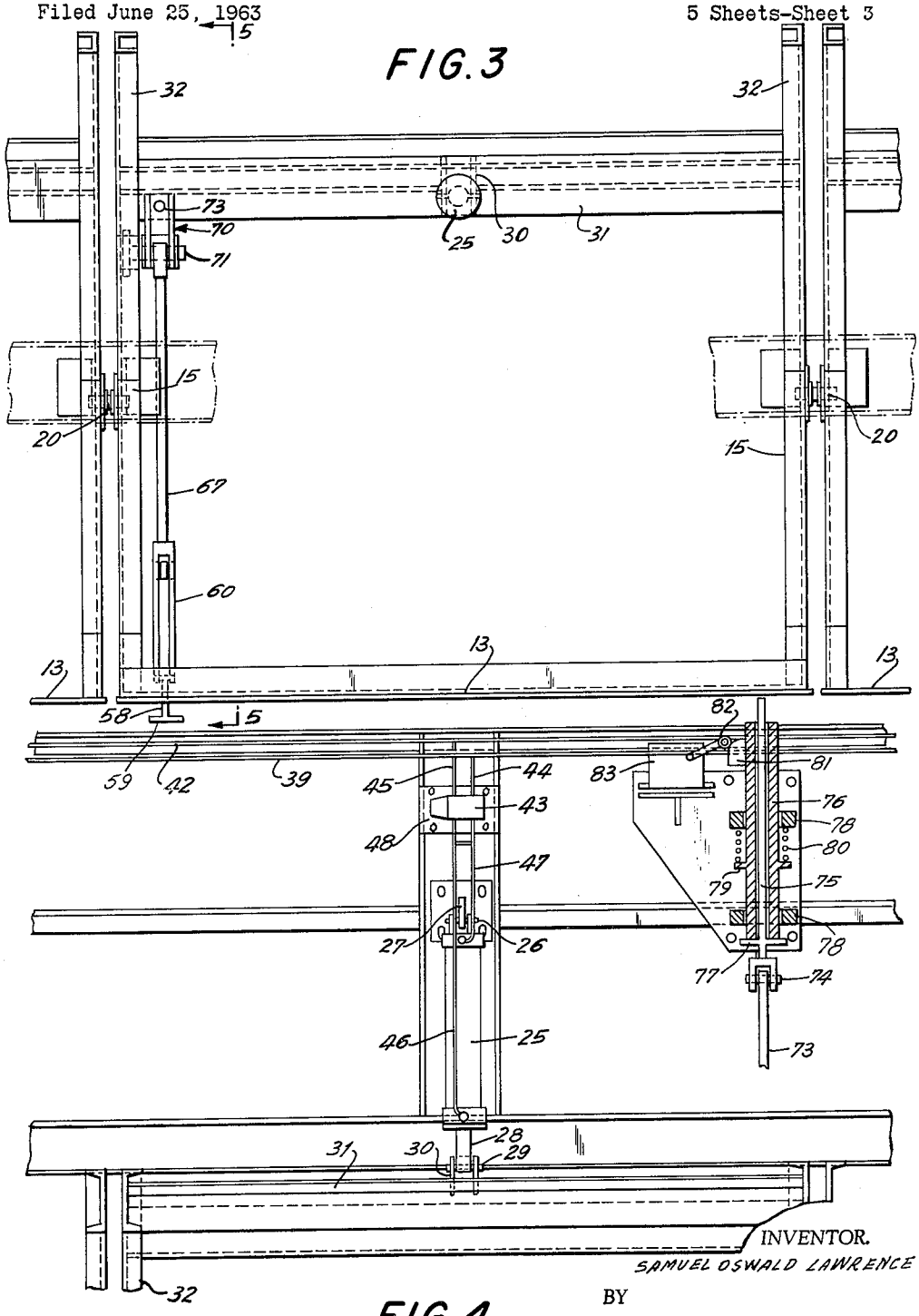

FIG. 4

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COKE WHARF GATE OPERATING MECHANISM

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FIG. 5

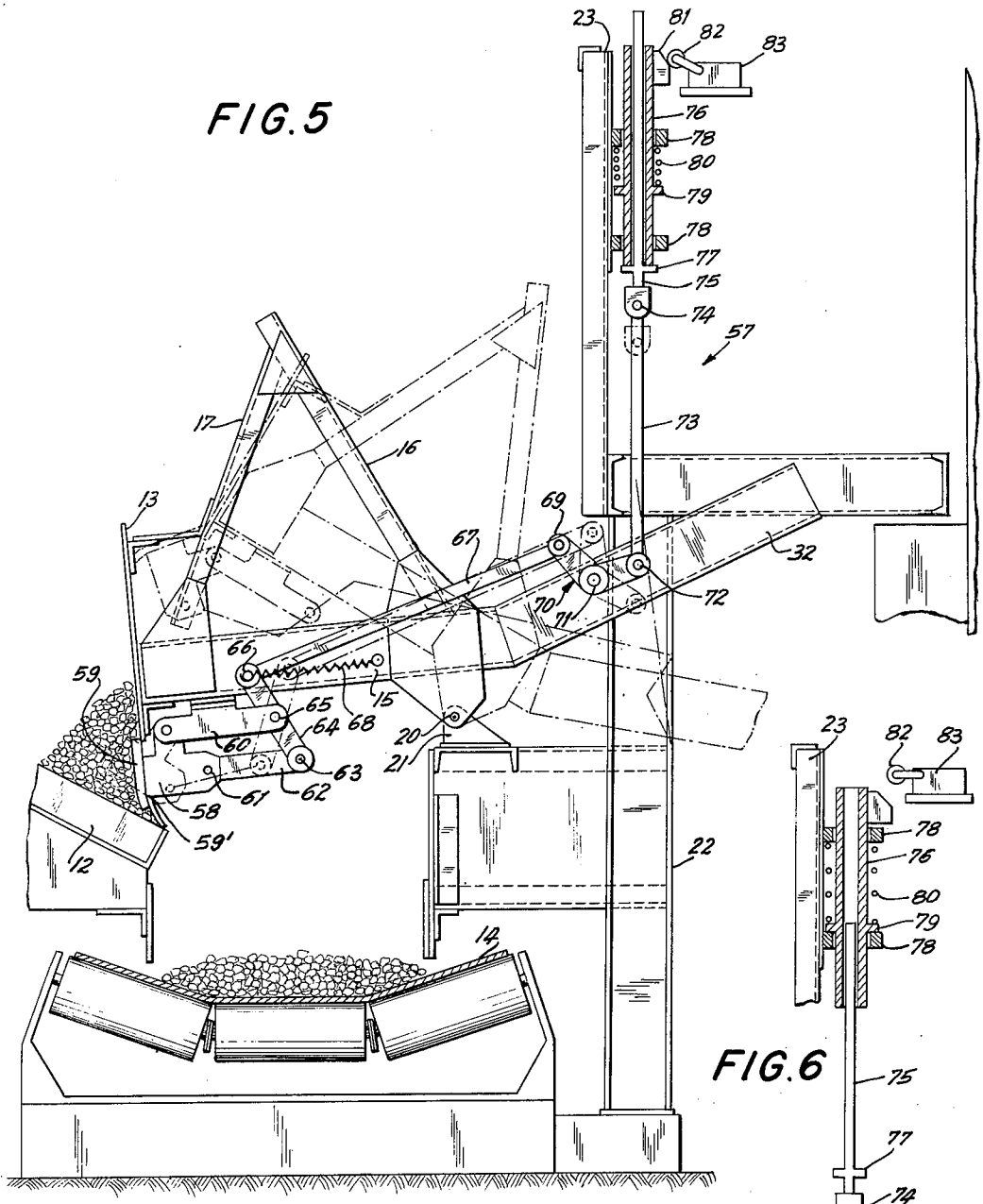

FIG. 6

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COKE WHARF GATE OPERATING MECHANISM

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FIG. 8

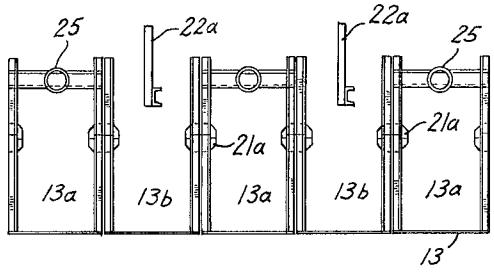


FIG. 9

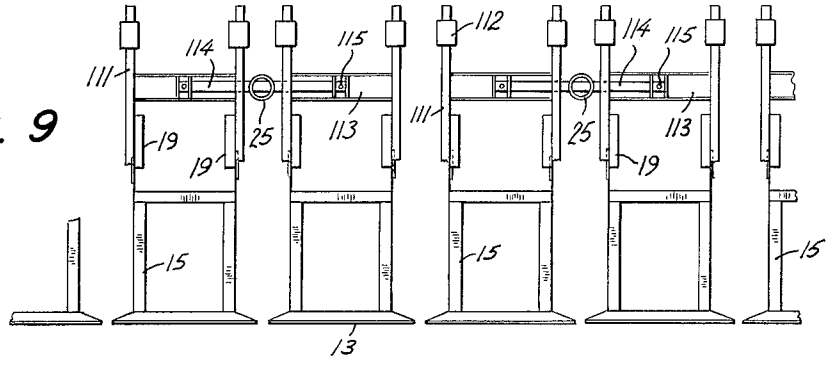
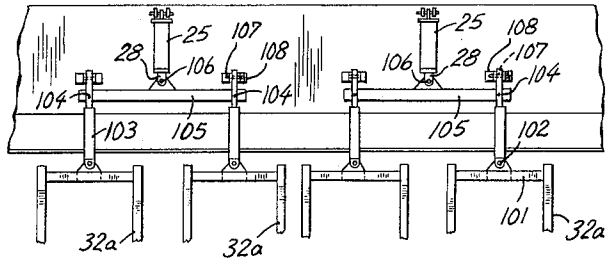


FIG. 10



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COKE WHARF GATE OPERATING MECHANISM

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Filed June 25, 1963, Ser. No. 290,441
6 Claims. (Cl. 214—17)

This invention relates to coke wharf gate operating mechanism.

In a coke plant, hot coke is pushed from the ovens of the coke oven battery in a predetermined sequence into cars traveling on rails. These cars move the hot coke first to a quenching station where water is sprayed on the coke to quench same. After quenching of the coke, the cars carry the coke to the coke wharf which is a relatively long inclined surface onto which the quenched coke is dumped in thin layers. The wharf may be 300 feet, more or less, in length depending upon the capacity of the battery or batteries from which it receives the quenched coke. The quenched coke is exposed on the inclined wharf for a predetermined period of time so as to effect further cooling thereof and draining of the quenching water therefrom, whereupon the coke is discharged by gravity from the lower longitudinal edge of the wharf onto a belt or other suitable conveyor which transports the coke to a screening plant.

In order to control the discharge of the coke from the wharf onto the conveyor, a series of gates are provided along the lower longitudinal edge of the inclined wharf. These gates when closed retain the coke on the wharf. Heretofore these gates have been tipped upwardly or raised manually, usually in adjacent pairs, so as to permit the discharge of the coke onto the belt conveyor from an adjacent narrow area or zone of the wharf, where the coke has been permitted to remain for a predetermined period of time. This manual operation of the coke wharf gates is an arduous and unpleasant task for the workmen because of the energy required to move the heavy gates to open them, and the heat and dust in the vicinity of the coke wharf.

It is a principal object of this invention to provide a coke wharf construction the gates of which are operated automatically in desired timed sequence.

Another object of the invention is to provide such a coke wharf construction in which the gates are automatically operated whenever a load of coke is present on the coke wharf, and automatically cease operating after a predetermined period of time if no coke remains on the wharf.

Other objects and advantages of this invention will be apparent from the following detailed description thereof.

In accordance with this invention, the several wharf gates are connected to power-operated actuating means for moving the respective gates between their closed positions and open positions, and the operation of the gates is controlled by a sequencing device operative to effect opening of the gates in a predetermined sequence, desirably, corresponding to the order in which the quenched coke is dumped onto the wharf.

In a preferred embodiment of the invention, the power-operative actuating means includes fluid pressure cylinders having their pistons suitably connected to the wharf gates, and supplied with fluid under pressure by solenoid controlled valves so that each hydraulic cylinder is effective to open at least one gate and thereby permit gravity discharge of coke from the area or zone of the wharf controlled thereby onto the belt conveyor upon energizing of the solenoid valve which controls operation of such gate, and the solenoid valves associated with the several fluid pressure cylinders are energized through an electric

circuit including a sequencing device providing for the energization of the solenoid valves in a predetermined order and for a specific period of time during each operating cycle.

According to a further feature of the invention, the power-operated actuating means is in circuit with a control mechanism, including a sensing member responsive to the presence of coke on the wharf, a linkage connected to the sensing member, and a switch actuated by the linkage, which switch when closed by the linkage, when a load of coke is present on the wharf, completes a circuit which supplies power to the power-operated actuating means. A timing mechanism is associated with the control mechanism to automatically de-energize the actuating means after the predetermined period of time required to complete an operating cycle, during which cycle each of the gates, intended to be operated during the cycle, is sequentially opened; the actuating means is automatically re-energized at the end of each such cycle if coke remains on the wharf. Hence, the power-operated actuating means is automatically energized when coke is deposited on the wharf and automatically de-energized after completing an operating cycle or cycles, when all or substantially all of the coke has been discharged from the wharf.

The above, and other objects, features and advantages of the invention will be apparent from the following detailed description of an illustrative embodiment thereof which is to be read in connection with the accompanying drawings forming a part hereof, and wherein:

FIGURE 1 is a schematic view of a coke wharf gate operating mechanism embodying the invention with the coke wharf shown fragmentarily in plan;

FIGURE 2 is a transverse, vertical sectional view showing the lower or discharge edge portion of the inclined wharf with a gate thereof operated automatically by a unit of the mechanism shown in FIGURE 1;

FIGURE 3 is a fragmentary view looking down on the coke wharf in the direction indicated by 3—3 on FIGURE 2;

FIGURE 4 is an end elevation taken in the direction indicated by 4—4 in FIGURE 2;

FIGURE 5 is a vertical sectional view taken in the direction indicated by 5—5 in FIGURE 3, showing the switch mechanism associated with each gate for automatically energizing the gate operating mechanism;

FIGURE 6 is a fragmentary vertical section showing a portion of the switch mechanism of FIGURE 5 in its position when the associated coke wharf gate is opened;

FIGURE 7 is a schematic circuit diagram showing the connections between the switch mechanism for each gate, the gate operating mechanism, and a timer for de-energizing the gate operating mechanism after completion of an operating cycle;

FIGURE 8 is a fragmentary plan view showing an arrangement of gates involving movable gates each separated from the next gate by a stop or abutment desirable of approximately the same longitudinal extent as the gate;

FIGURE 9 is a fragmentary plan view showing a modified arrangement in which each pressure cylinder actuates a pair of adjacent gates; and

FIGURE 10 is a fragmentary diagrammatic elevational view showing still another modification in which all gates are mounted for opening and closing movement, one pressure cylinder is connected to two adjacent gates but only one gate of the pair is operated by the pressure cylinder while the other remains stationary, and the connections between the pressure cylinder and the gates operated thereby are such that the operator can readily adapt same to the opening and closing of the desired

gates, while the remaining gates remain in fixed position and to periodically change the operation so that the movable gates become fixed and vice versa.

Referring to the drawings, and initially to FIGURE 1 thereof, it is to be understood that the coke pushed from the ovens of a coke oven battery (not shown) is received in the cars 10 movable on rails 11 which extend to a quenching tower (not shown) where the hot, glowing coke is sprayed with water, and from the quenching station along the upper longitudinal edge of an inclined wharf 12 which may be surfaced with firebrick or other heat-resistant material. The cars 10 dump the quenched coke onto wharf 12 at selected zones along the length of the latter which may be partially or completely vacant at a moment of dumping. By reason of the inclination of wharf 12, the coke dumped onto the latter forms a relatively thin layer and tends to slide downwardly toward the lower edge of the wharf. Discharge of coke from the lower longitudinal edge of the wharf is normally prevented by a series of gates 13 arranged therealong. All of the gates 13 of FIGURES 1 to 5, inclusive, 9 and 10, or alternate gates 13*a* of FIGURE 8, are mounted, as hereinafter described in detail, so as to be movable from their normal closed positions to upwardly tilted or raised open positions where the gates permit the discharge of coke from the adjacent zones or areas of wharf 12 onto a conveyer belt 14 (FIGURE 2) having its upper run extending longitudinally below the lower edge of wharf 12 and running to a screening plant (not shown).

The wharf 12 of substantial length, for example, it may have a length of three hundred feet, more or less, and be provided with fifty gates 13 each extending along about six feet or the length of the wharf. Successive loads of quenched coke are discharged at different locations along wharf 12 while the gates 13 are successively opened and closed in a predetermined order so as to insure that coke is discharged from the wharf 12 onto conveyor belt 14 after a suitable period of residency of such coke on wharf 12 to effect the cooling and draining thereof to the necessary extent and to accommodate all of the coke produced by the battery or batteries with which the wharf is associated.

As shown in FIGURES 2, 3 and 5, the mounting for each gate 13 includes members 15, extending laterally from the back of the gate adjacent the opposite ends of the latter (FIGURE 3), an elongated member 16 joined at its lower end by a bracket 19 to the end of each lateral member 15 remote from the gate and extending at acute angles relative to member 15, and a bracing member 17 connected by brackets 15' and 16' to each member 15 and its connected member 16, respectively. A mounting bracket 18 has one end fixed to bracing member 17 and the other end to the upper portion of the gate 13. The brackets 19 are rotatably mounted on pivot pins 20 carried by mounting brackets 21 which are suitably secured to a fixed support 22 extending along the side of conveyor 14 remote from the wharf 12. The described mounting structure for each gate 13 permits swinging movement of the latter about a horizontal axis from the lowered or closed position shown in full lines in FIGURES 2 and 5 to the upwardly tilted or raised open position illustrated in broken lines, and back to the closed position.

As shown in FIGURE 1, the automatic mechanism for operating the gates 13 includes a series of fluid pressure motors or cylinders 25, each connected to one of the gates 13 to open and close the same, and suitably controlled to open the gates in a predetermined sequence and to hold each gate in its open position for a predetermined interval.

Each pressure cylinder 25 is pivotally mounted at its upper end, as at 26 (FIGURE 2), on a bracket 27 secured to a rigid extension 23 of the fixed support 22 at a location above the pivoting axis and between the ends of the gate 13 operated thereby. The protruding end of piston rod 28 of each cylinder 25 is pivotally connected, as at 29, to a bracket 30 which is welded, or otherwise secured to a cross member 31 (FIGURES 2 and 3) which is welded to elongated counterbalance members 32 extending from the pivotal mounting structure for each gate in directions opposite to the lateral members 15. Thus, the cross member 31 to which the piston rod of each cylinder 25 is connected serves to rigidly connect together the counterbalance members 32 at the opposite ends of each gate.

It will be apparent that, when the piston rod 28 of a cylinder 25 is retracted into the latter by supplying air or other fluid under pressure to the lower end of the cylinder, the gate 13 operated thereby is lowered to the closed position. On the other hand, extension of the piston rod 28 of each cylinder 25 by supplying fluid under pressure to the upper end of the cylinder causes upward tilting of the gate to the raised or open position.

In the embodiment of the invention shown in the drawings (FIGURE 1), pressure fluid is provided by an accumulator or tank 33 which communicates through a strainer 34 with a pipe 35 leading to the inlet of a pump 36 driven by an electric motor 37. The outlet of pump 36 is connected through a pressure relief valve 38 to a manifold 39 carrying fluid under a predetermined pressure established by the relief valve 38. A signal lamp 40 may be provided at a suitable location, for example, at a coke holding station at the entrance to the coke wharf, and controlled by a pressure responsive switch 41 sensitive to the pressure in the manifold 39 for indicating any failure in the automatic operating system for the gates 13. Pressure fluid is returned to the tank 33 from each of the cylinders 25 by way of a return pipe or manifold 42.

The opposite ends of each pressure cylinder 25 are connected with the pressure and return manifolds 39 and 42, respectively, through a solenoid valve 43, one for each cylinder 25. These valves can be of any known type, such as the know solenoid operated 4-way valves with spring return. Each of the solenoid valves 43 is connected by pipes 44 and 45 to the pressure and return manifolds 39 and 42, respectively, and by pipes 46 and 47 to the lower and upper ends of the respective cylinders 25. Further, each solenoid valve 43 is arranged so that, when energized, pressure fluid is supplied to the upper end of the related cylinder 25 from pressure manifold 39 through pipes 44 and 47, while the lower end of the cylinder is connected with the return manifold 42 through pipes 45 and 46, thereby to actuate the piston rod 28 and effect opening of the gates 13 actuated thereby. On the other hand, each solenoid valve 43, when de-energized, causes fluid under pressure to pass from pressure manifold 39 through pipes 44 and 46 to the lower end of the related cylinder 25 while the upper end of the latter is connected through pipes 47 and 45 to the return manifold 42, thereby to retract the piston rod 28 and effect closing of the gates actuated thereby.

As shown in FIGURES 2 and 4, each solenoid valve 43 is mounted, by a bracket 48, on the extension 23 at a location adjacent and above the hydraulic cylinder 25 which is controlled thereby. The solenoids of the valves 43 are selectively energized energized by an electric circuit (FIGURE 1) that includes conductors 49 extending from the solenoids to respective fixed contacts 50 of a selector switch or sequencing device 51. This sequencing device can be of any desired type, for example, a cam type limit switch construction having a number of cams, one for controlling the operation of each solenoid valve 43; the cams can be mounted on a shaft driven through gearing by an electric motor and are set so that the proper number of cams will effect energization of the desired number of solenoid operated valves.

In the sequencing device 51 shown for purposes of exemplification on FIGURE 1 of the drawings, the fixed contacts 50, each controlling the actuation of one of the

solenoid valves 43, are arranged in a circle and are successively engaged by a movable contact 52 which may be dimensioned to simultaneously engage a plurality of the fixed contacts, for example, four of such fixed contacts 50, as shown in FIGURE 1. The movable contact 52 may be continuously rotated about an axis coinciding with the center of the circular arrangement of fixed contacts 50, for example, by an electric motor 53. The movable contact 52 is connected by a line 54 with a source of electric current 55 so that the solenoids in electrical communication with the fixed contacts 50 engaged by the movable contact 52 at any instant are energized from the current source 55 to effect opening of the gates 13 actuation of which is controlled thereby. A switch 56 in line 54 is employed to disconnect the movable contact 52 from the current source 55 when it is desired for any reason not to use the automatic gate operating mechanism.

A control mechanism 57, shown in FIGURE 5, is associated with each gate 13 for energizing the motor 53 which drives the movable contact 52 of sequencing device 51. Each control mechanism 57 includes a sensing member or acuator plate 58, the head 59 of which plate fits within a rectangular opening 59' cut in the front face of the gate 13, on the side thereof adjacent the inclined wharf 12. The actuator plate 58 is hingedly mounted on one end of a supporting link 60 secured to a member 15 of the mounting structure for the gate 13. Plate 58 is also pivoted at 61 to one end of a link 62, the other end of which is pivoted at 63 to one end of a lever 64 pivotally mounted intermediate its ends at 65 to the other end of supporting link 60. The other end of lever 64 is pivoted at 66 to one end of an elongated link 67, the other end of which is pivoted at 69 to bell-crank 70 pivotally mounted on the adjacent counterbalance member 32 at 71. The other end of the bell-crank 70 is pivoted at 72 to a vertical rod 73, which is in turn pivoted at 74 to a plunger 75 mounted for travel within a vertically movable sleeve 76. A collar 77 is positioned adjacent the lower end of plunger 75 for elevating the vertical sleeve 76 when the rod 73 raises the plunger 75 through the linkage connected to the actuator plate 58.

A spring 68, secured to the member 15, biases the actuator plate 58 towards the left viewing FIGURE 5. Thus when there is no coke on the wharf adjacent the gate 13, this spring 68 effects movement of the actuator plate 58 to the left as shown in dotted lines in FIGURE 5. When there is coke on the wharf, the actuator plate is forced thereby into the position shown in solid lines in FIGURE 5.

The sleeve 76 is mounted for vertical movement within guides 78 secured to the fixed extension 23. A flange 79 is provided on the sleeve 76 intermediate it ends and a compression spring 80 is disposed between the flange 79 and the upper fixed guide 78, biasing the sleeve downward, viewing FIGURE 5. Mounted on the sleeve 76 adjacent its upper end is a limit switch cam 81 adapted to engage a roller 82 on an arm which actuates a normally open limit switch 83 (FIGURE 5) to close the switch, when the sleeve is forced upward by the linkage connected to the actuator plate 58.

As shown in FIGURE 1, the limit switches 83 associated with each of the gates 13 are connected in parallel through conductors 84 and 85 with a timer 86. The timer is in circuit with the conductors 84 and 85 and also with the conductors 87 and 88, supplied with current from power source 89. Timer 86, which can be a known type of timer mechanism available from suppliers of such timers, comprises a switch 91 which closes instantaneously upon supply of current to the time 86 when one or more of the switches 83 are closed, a timer motor 92, normally closed switch 93, and a normally open switch 95 in the branch line 94 contatining the motor 53 which drives the movable contact 52.

The drive of the movable contact 52 by the motor 53 is designed so that the movable contact effects a complete revolution during a selected period of time, for example, one-half hour or longer. If the coke wharf has fifty gates operated by fifty hydraulic cylinders 25 under the control of fifty solenoid valves 43, so that the sequencing device 51 has a circularly arranged series of fifty fixed contacts 50, rotation of the movable contact 52 dimensioned to simultaneously engage four of the fixed contacts at a speed sufficient to effect one complete revolution in a half hour will result in the simultaneous opening of four gates, each gate being held in its open position for a period of approximately two and one-half minutes and then closed. The gates are thus opened and closed automatically in groups along the length of the wharf. After all the gates have been opened and closed, in the embodiment of the invention shown in FIGURES 1 to 5, the opening and closing in groups is repeated from one end of the wharf to the other end. Of course, the number of gates opened simultaneously may be one, two or any desired multiple by use of a movable contact 52 which engages the desired number, one or more contacts 50. Also the time cycle between opening and closing of each pair of gates may be adjusted by changing the speed of rotation of the movable contact 52 of the sequencing device 51.

In operation when a load of coke is deposited on the wharf 12, the pressure of the coke against the head 59 of each actuator plate 58 forces the plate against tthe gate 13, thereby moving the associated linkage comprising link 62, lever 64, link 67, bell-crank 70, rod 73 and plunger 75 into the positions shown in full line in FIGURE 5. The upward movement of plunger 75 lifts the sleeve 76, effecting contact between the limit switch cam 81 and roller 82 to close the normally open switch 83.

When the gate 13 is opened, as described hereinafter, the actuator plate 58, support 60, link 62, lever 64, link 67, bell-crank 70, rod 73 and plunger 75 move about the gate pivot pins 20 with the mounting for gate 13 on which they are positioned, to the positions shown in dotted line in FIGURE 5. As the gate moves upwardly, the pin 72 drops, thereby pulling rod 73 and plunger 75 downwardly and permitting sleeve 76 to move downwardly. The sleeve is thus lowered until the flange 79 thereon rests on the lower fixed guide 78; the cam 81 no longer engages roller 82 and switch 83 returns to its normally open position. Since the plunger 75 is free to slide within sleeve 76, it is not restrained by the limiting position of the sleeve but slides downward to the position corresponding to the open position of the gate 13. Hence when gate 13 is open, the switch 83 associated therewith is open.

When the gate 13 is again closed and there is no coke remaining on the wharf, the actuator plate 58 is urged outward to the position shown in dotted line in FIGURE 5; the associated linkage pulls the rod 73 and plunger 74 downward, thus permitting the spring 80 to urge the sleeve 74 downward to maintain contact with collar 77 on plunger 75. The cam 81 is thus moved out of engagement with the roller 82 and the limit switch 83 is opened.

When one or more of the normally open limit switches 83 are closed, as described above, current flowing through the circuit completed through conductors 87, 88, lines 84, 85, and switch or switches 83 (FIGURE 7) closes the instantaneous switch 91 and starts the timer motor 92. As soon as the timer motor is actuated, the normally open switch 95 is closed, thereby connecting the motor 53 with the power source 89 through conductors 87 and 88. Current thus flows to motor 53 operating the sequencing device 51 for a predetermined period required to complete an operating cycle, during which each of the gates 13 is sequentially opened, whether or not any of the normally open limit switches 83 remain closed. The sequencing device is thus operated through a complete cycle to actuate the gate opening mechanism and thus empty the coke wharf.

At the end of the pre-determined period required to complete the operating cycle, the normally closed switch

93 is opened, thereby stopping the timer motor 92 and opening switch 95; the connection between motor 53 and power source 89 is thus broken and operation of the sequencing device is terminated. If, at the completion of the operating cycle, there is stil coke on the wharf which has closed the contacts of one or more of the limit switches 83, the timer 86 is again energized, closing the instantaneous switch 91 and actuating the timer motor 92; the operation above described is thus repeated for a further predetermined period required to complete an operating cycle. The gate opening mechanism is thus repeatedly actuated until all of the coke is removed from the wharf. When, at the completion of any operating cycle, no coke remains on the wharf and all the limit switches 83 are therefore open, the gate opening operation will halt until a new load of coke is deposited on the wharf to automatically initiate the automatic gate operation.

Alternatively, when it is desired to energize the motor 53 to drive the movable contact 52 of sequencing device 51 independently of the actuation of the switches 83, the timer 86 is placed in circuit with motor 53 and with a manually operated switch (not shown). When this manually operated switch is closed, the circuit to motor 53 is completed so that this motor is energized as long as the switch remains closed. Such switch can be located at the screening plant whereby the operation of the sequencing device 51 can be conveniently initiated or halted by the operator of the screening plant to control the discharge of the coke from the wharf onto the belt conveyer 14, as desired.

In the system illustrated in FIGURE 1, the conductors 49 from the solenoids 43 associated with the pressure cylinders 25 arranged successively along the wharf 12 are connected to the succesisve fixed contacts 50 of the circularly arranged series of the latter so that, during each operating cycle of the sequencing device 51, the wharf gates will be successively opened starting at one end of the wharf and continuing to the other end of the latter. However, it will be apparent that the order of the opening and closing of the successive gates 13 can be altered by connecting the conductors 49 leading from the solenoid valves 43 with the fixed contacts 50 so that these valves are energized in the desired timed sequence.

In the modifications of FIGURES 8, 9 and 10, like parts are identified by like reference numbers, in some cases followed by a letter. In the modification of FIGURE 8, stops 13*b* alternate with the gates 13*a* mounted for pivotal movement about pivot pins supported in mounting bracket 21*a*. The stops 13*b*, each of approximately the same width as the gates 13*a*, are supported by a support 22*a* extending from the supporting structure for the coke wharf. With the gates 13*a* opening and closing and separated by the stops 13*b*, overloading of conveyer belt 14 is prevented because the stops 13*b* exercise enough control over the discharge of the coke onto the belt 14 to prevent overloading thereof.

The modification of FIGURE 10 has the same advantage as that of FIGURE 8 in preventing overloading of the conveyer belt 14 and the further advantage in that it distributes the load onto all of the gates, thus preventing excessive or uneven wear of the gates 13*a* and stops 13*b* as takes place in the modification of FIGURE 8 where the stops 13*b* take the full brunt of the hot coke delivered to and discharged from the coke wharf. In the modification of FIGURE 10 the gates are arranged in pairs with the gates of each pair connected for operation by one and the same pressure cylinder 25. The connecting linkage between the pressure cylinder and the pair of gates operated thereby is so constructed that the operator can readily control which of the two gates of each pair is moved and which remains fixed. Thus the load on the gates of each pair is distributed so that they wear evenly and uniformly.

In the construction of FIGURE 10, 32*a* are the rearwardly extending counter-balancing members of each gate, which has two such members at the opposite sides thereof, corresponding to the members 32 shown in FIGURE 3 and hereinabove described. The two members 32*a* of each gate are connected by a crossbar 101. Pivotally attached to each crossbar at 102 is an actuating arm 103 which is pivotally pinned at 104 to a connecting bar 105. A pressure cylinder 25 has its piston rod 28 pivotally joined to each connecting bar 105 at 106. Viewing FIGURE 10, the upper end of each actuating arm 103 is arranged to be fastened by a removable pin 107 to a fixed pin-receiving member 108 on the framework of the wharf.

In the arrangement shown in FIGURE 10, the right hand gates of each pair have their upper ends pinned to fixed pin-receiving member 108 so that these gates remain closed. When the cylinders 25 are actuated as hereinabove described, connecting bars 105 are actuated to pivot about right hand pivot 104 (the right hand actuating arms 103 of each pair being fixed) to exert a downward thrust on the left hand actuating arm 103 of the pair to effect opening movement of the left hand gate of each pair, which pivots about its pivot pin corresponding to pivot pin 20 shown in FIGURE 2. By removing pins 107 from the right hand actuating arms 103 of each pair and placing them in the left hand actuating arms 103 of each pair, the right hand gate of each pair, viewing FIGURE 10, is actuated while the left hand gate of each pair remains fixed. In this way, overloading of belt 14 is prevented and the load on the gates can be distributed so that the gates wear evenly.

In the structure of FIGURE 9, each gate 13 has rearwardly projecting arms 111, provided with adjustable counter-balances 112. Each gate is pivoted as in the construction of FIGURES 1 to 4 for pivotal movement about pivot pins 20. The arms 111 with the counter-balancing weights 112 correspond to counter-balance members 32 of FIGURES 1 to 4. As shown in FIGURE 9, each pair of arms 111 of each gate is connected by a cross-bar 113. The cross-bar 113 of adjacent gates are interconnected by an actuating member 114 which is connected at its opposite ends 115 to the approximate median of the cross-bar 113. Each pressure cylinder 25 through an actuating member 114 and cross-bar 113 effects pivotal movement of a pair of gates 13. Thus in the structure of FIGURE 9 each cylinder 25 effects actuation of a pair of gates 13. It will be understood such actuation can be in timed sequence and automatically controlled as hereinabove described to effect the discharge of all or substantially all of the coke from the wharf to effect the desired cooling and draining of the quenched coke.

It will be understood that various modifications of the illustrative embodiments of the invention described and shown herein may be made without departing from the scope of the present invention. Accordingly it is to be understood that the invention is not limited to the embodiment herein described or shown in the accompanying drawings.

ulate the discharge of coke from the wharf, a series of

1. In combination with a coke wharf having a series of gates arranged along one edge of the wharf and being movable between opened and closed positions to regulate the discharge of coke from the wharf, a series of fluid pressure operated actuating means connected with said gates for opening and closing the latter, means for supplying fluid under pressure to said actuating means, valve means for each of said actuating means for controlling the supply of pressure fluid to and discharge thereof from said fluid pressure actuating means, means controlling the operation of said valve means to operate said actuating means to open and close the respective gates in accordance with a predetermined sequence, means for sensing the presence of coke on said wharf and operative to actuate said controlling means for controlling the operation of said valve means to actuate said valve means to open and close the respective gates in accord-

ance with said predetermined sequence as long as coke to be discharged from said wharf remains on said wharf.

2. The combination with a coke wharf as defined in claim 1, in which each fluid pressure operated actuating means effects the operation of a pair of adjacent gates.

3. The combination as defined in claim 1, in which said means for sensing the presence of coke on said wharf and operative to actuate said controlling means comprises a sensing member associated with each of said gates responsive to the presence of coke on the wharf adjacent thereto, a switch for each gate, means connecting said sensing member for each gate with said switch for said gate to close said switch when coke is present on said wharf, and a timer mechanism responsive to the closing of said switch for energizing said controlling means for a predetermined period of time to operate said actuating means to open and close the gates.

4. In combination with a coke wharf having a series of gates arranged along the wharf and being movable between opened and closed positions to control the discharge of coke from the wharf, means for maintaining some of the gates fixed while adjacent gates are movable, fluid pressure operated actuating means for opening and closing said gates, means for connecting the pressure operated actuating means with said gates, said connecting means being constructed and arranged to permit the actuating means to selectively effect opening and closing of certain of said gates while other of said gates remain fixed, means for supplying fluid under pressure to said actuating means to selectively open and close the gates in a predetermined sequence, and control means for controlling the supply of pressure fluid to said means for supplying fluid under pressure to said actuating means, said control means being operative to supply pressure fluid to said means for supplying fluid under pressure to said actuating means as long as coke to be removed from the wharf is present on said wharf.

5. In combination with a coke wharf having a series of gates arranged along one longitudinal edge of the wharf and being movable between opened and closed positions to control the discharge of coke from the wharf, fluid pressure operated cylinders each having a movable piston, means connecting the piston of each of said cylinders to one gate of said series for moving said gate to said opened and closed positions in response to the supply of fluid under pressure to the cylinder, means for supplying fluid pressure to said cylinders and for exhausting fluid pressure from said cylinders, solenoid operated valve means for controlling the supply to and exhausting of flud pressure from said cylinders, and electrical control means operative to energize said solenoid operated valve means in a predetermined order, said electrical control means including a series of fixed contacts one for each solenoid operated valve means and connected with the latter, a movable contact engageable with said fixed contacts and being connected with a source of electric current to effect energization of the solenoid operated valve means corresponding to the fixed contacts engaged by said movable contact, and means for driving said movable contact along said series of fixed contacts to engage the latter in said predetermined order.

6. In a coke wharf, in combination, a longitudinally elongated, downwardly inclined surface for the reception of coke, pivoted upstanding gate members side by side along the lower longitudinal edge of said surface, said gate members being movable from a lower position where they prevent flow of coke over said edge to an upper position where they no longer prevent said flow, each of said gate members having an operating member extending beyond the pivot for said gate member in a direction away from said longitudinal edge, the portion of said operating member extending beyond said pivot counter-balancing the weight of said gate member, means for engaging said portion of each operating member extending beyond said pivot for effecting opening and closing movement of the gate member, a sensing member associated with each of said gates and responsive to the presence of coke on the wharf adjacent said gate, a linkage connected to the sensing member, a switch actuated by the linkage, a timing means associated with each of said switches, and means controlled by said timing means for operating the means for engaging each gate for effecting opening and closing movement of the respective gates in a predetermined sequence.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

January 25, 1966

Patent No. 3,231,104

Samuel O. Lawrence

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 15, for "a" read -- the --; line 30, after "12" insert -- is --; line 33, for "or" read -- of --; column 4, line 39, for "know" read -- known --; line 62, strike out "energized", first occurrence; column 5, line 53, for "it" read -- its --; column 6, line 27, for "tthe" read -- the --; column 7, line 5, for "stil" read -- still --; column 8, line 58, strike out "ulate the discharge of coke from the wharf, a series of".

Signed and sealed this 7th day of February 1967.

(SEAL)

Attest:

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