Jan. 17, 1967 R. E. JONES 3,298,546

DOOR OPERATOR FOR A TUNNEL KILN CERAMIC PLANT

Filed Sept. 1, 1964 2 Sheets-Sheet 1

FIG. 2

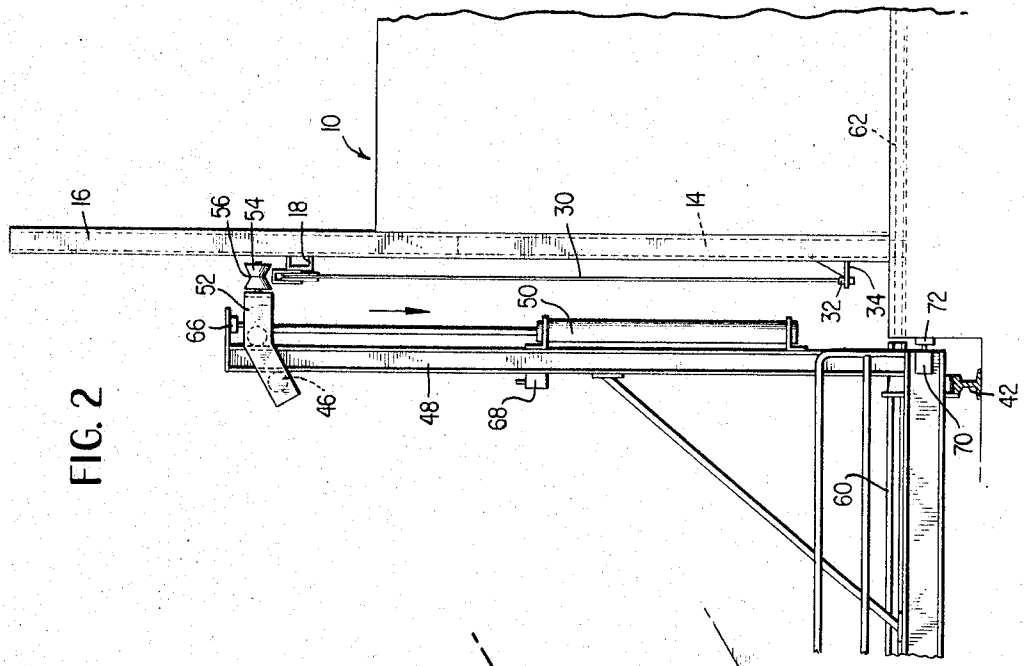
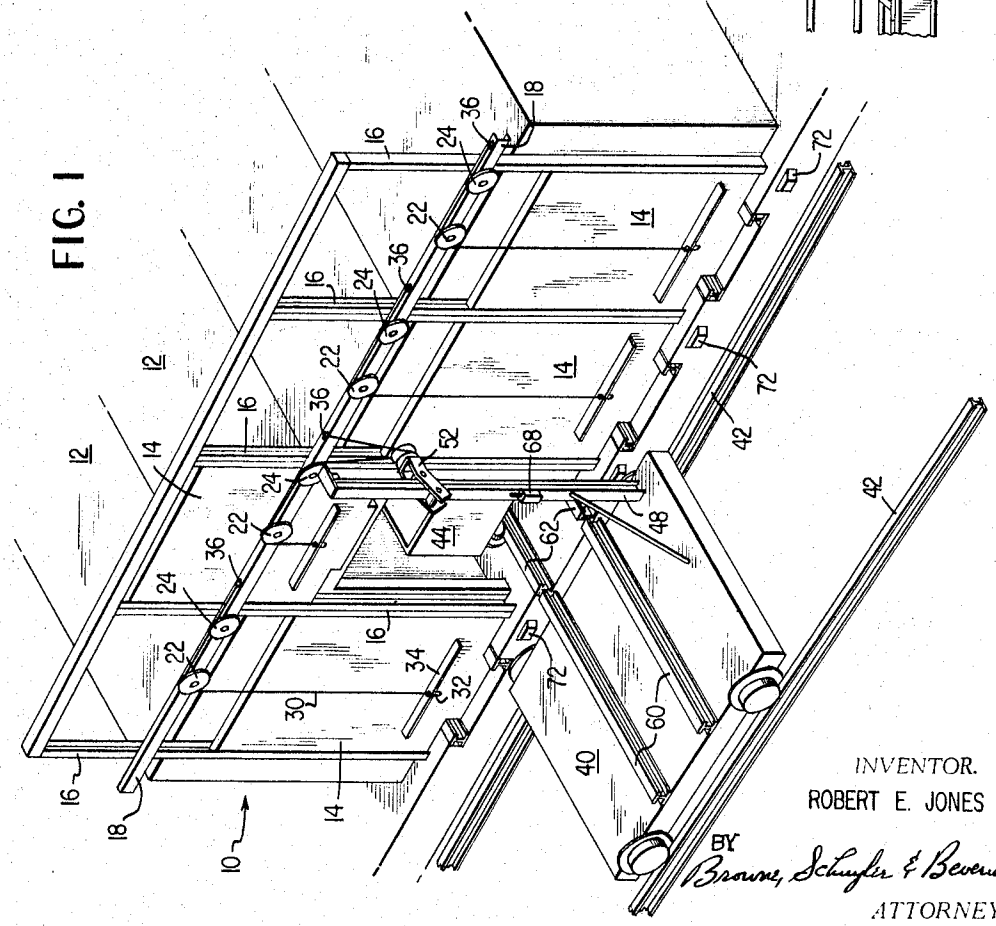


FIG. 1



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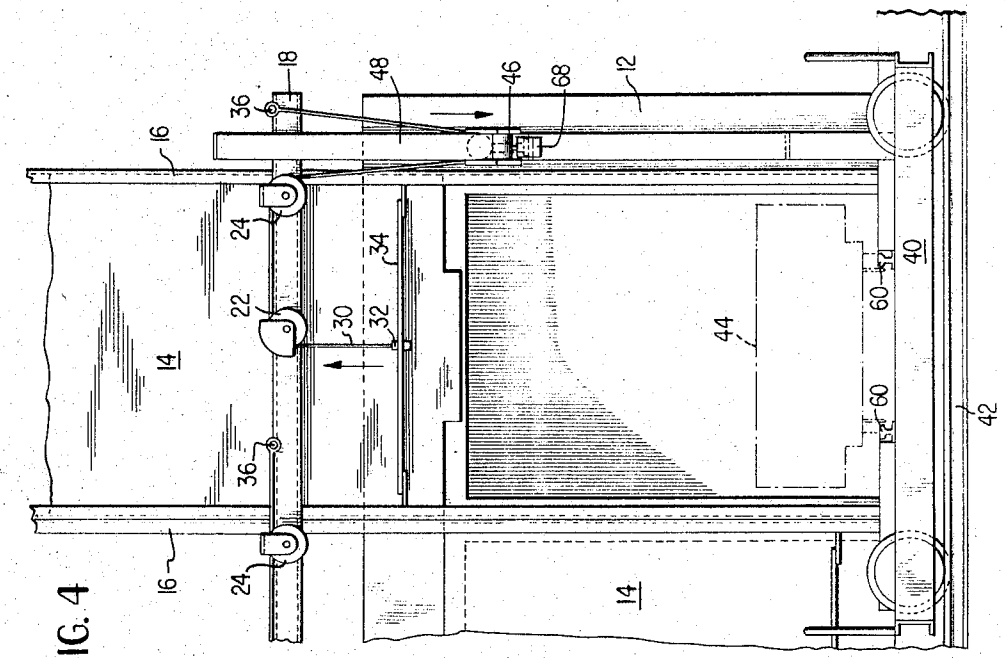


FIG. 4

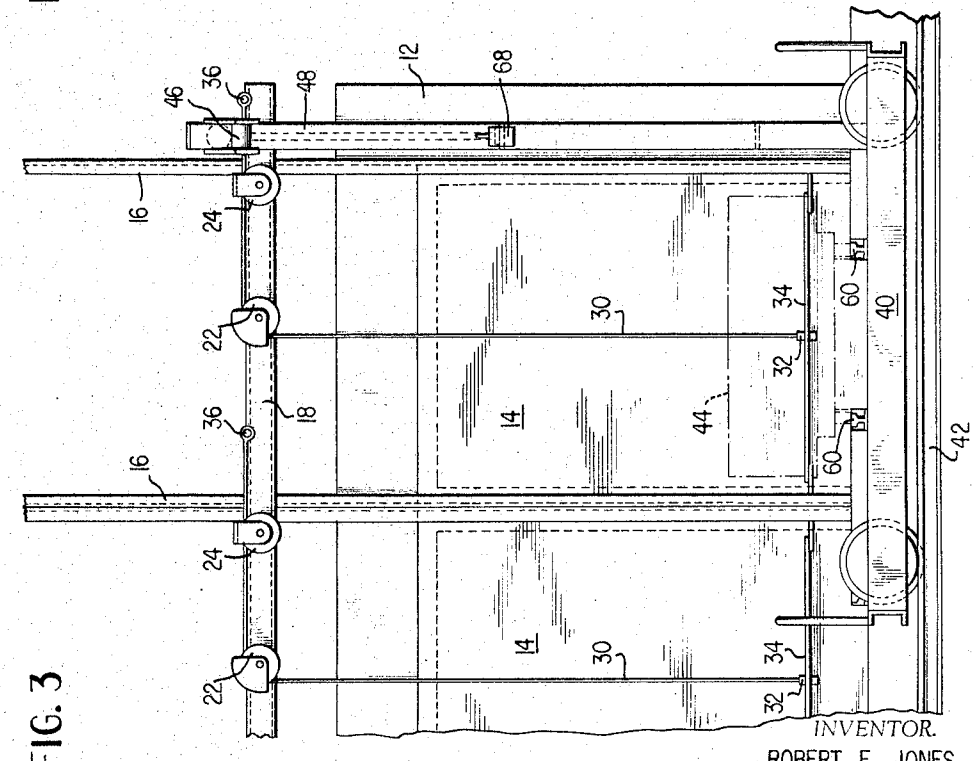


FIG. 3

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DOOR OPERATOR FOR A TUNNEL KILN CERAMIC PLANT

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5 Claims. (Cl. 214—18)

This invention relates to a door operating mechanism for a tunnel kiln ceramic plant and more particularly to a door operating mechanism for selectively opening the doors of the individual kilns and dryers of a ceramic plant.

In the manufacture of ceramic products, the green ware is pushed on kiln cars through long tunnel kilns in which the ware is burned, or fired, to form a hard and durable product. The process of burning the ware is expedited by taking waste heat from the tunnel kiln and passing it through a first set of closed chambers, called dryers, and then through a second set of closed chambers called warming rooms, through which the green ware is first passed. In the dryers the greater portion of the moisture is driven from the ware, and the temperature is elevated to several hundred degrees fahrenheit, while the warming rooms commence the drying process and protects the ware from the elements of the weather. A normal plant may have three or four tunnel kilns, as many as ten to twelve dryers and twenty or more warming rooms positioned in parallel side-by-side relation. The kiln cars used to move the ware through the plant roll along railroad-like tracks. However, due to plant space limitations, the kiln cars cannot be switched to transfer them from one track to another, thus necessitating the use of a transfer car operating in a pit in front of the warming rooms, dryers, and kilns to transfer the cars. The normal process is to take a kiln car from successive ones of a predetermined group of dryers, in order, and place them in a particular kiln, so that each time a kiln car is pushed through a tunnel kiln, it is replaced with a car from a predetermined one of the dryers. The car removed from the dryer is then replaced with one from a predetermined one of the warming rooms.

Since the warming rooms and dryers are positioned in side-by-side relation and structurally somewhat similar, they will be referred to collectively throughout this specification as dryers.

Normally, the tunnel kilns and dryers are provided with vertical lift doors and the transfer car moves along a track extending perpendicular to the longitudinal axis of the kilns and dryers and positioned as close to the doors as possible in order to conserve plant floor space. The transfer car may be provided with a pusher mechanism for reaching into a dryer to pull or roll a kiln car onto the transfer car, and to push the kiln car from the transfer car into the tunnel kiln. Preferably, the transfer car is remotely controlled in order to eliminate the necessity of an operator riding on the individual transfer cars in closed proximity to the intense heat of the kilns and dryers.

To transfer a kiln car from a dryer to a tunnel kiln, it is necessary to position the transfer car in front of the dryer, open the vertical lift door, and move a car from the dryer onto the transfer car, then close the door to the dryer and move the transfer car into position in front of the appropriate tunnel kiln. The vertical lift door of the tunnel kiln is then opened and the kiln car pushed from the transfer car onto the track extending through the tunnel kiln, and the vertical lift door is again closed.

It is an object of this invention to provide a single door lifting mechanism which may be employed to open any of the vertical lift doors of a tunnel kiln ceramic plant selectively.

It is another object of the invention to provide a single door lifting mechanism for operating the vertical lift doors of a tunnel kiln ceramic plant which is operable to lift a selected door only when the transfer car is positioned in front of the door to be opened.

In the attainment of the foregoing and other objects an important feature of the invention resides in providing a door lifting mechanism on the transfer car so that a door can only be lifted or moved when the transfer car is positioned in front of the door. An appropriate interlock is provided to prevent actuation of the lift mechanism until the transfer car is properly positioned, and a second interlock prevents actuation of the transfer car pusher mechanism until the door lifting mechanism has been actuated to open the door.

Other and further objects and advantages of the invention will become apparent from the following description taken in conjunction with the drawings in which:

FIGURE 1 is a perspective view of a portion of a tunnel kiln ceramic plant employing a door lift mechanism according to the present invention;

FIGURE 2 is a side elevation view of the door lift mechanism shown in FIGURE 1;

FIGURE 3 is a front elevation view showing the transfer car in position in front of a vertical lift door with the door shown in the closed position, and;

FIGURE 4 is a front elevation view similar to FIGURE 3 with the door shown in the open or lifted position.

Referring now to the drawings in detail, the numeral **10** illustrates a tunnel kiln ceramic plant including a plurality of elongated tunnel kilns and dryers **12** constructed in parallel side-by-side relation. As shown in FIGURE 1, each of the individual kilns and dryers are equipped with a door **14** mounted for vertical sliding movement within vertically extending tracks or guides **16**. A structural frame member **18** is mounted on the front of the kilns and dryers at a point spaced above the top of the doors when the doors are in the lowered position. Frame member **18** supports a plurality of fair lead pulleys **22**, **24** mounted in pairs with one pulley **22** of each pair positioned along the vertical center line of each of the respective doors and the other pulley **24** of each pair spaced laterally from the first at a point substantially in alignment with one of the vertical edges of each of the doors. An elongated flexible cable **30** has one end **32** mounted near the bottom of each of the respective doors, as by angle bracket **34**, and extends upwardly over fair lead pulley **22**, then laterally across fair lead pulley **24**, and has its other end **36** pivotally secured to structural member **18** at a point laterally spaced from fair lead **24**.

A transfer car **40** is mounted for movement along rails **42** positioned in front of the kilns and dryers **12** to transfer kiln cars **44** within the plant. Car **40** is provided with a carriage **46** mounted for vertical reciprocable movement on a track **48**. A fluid cylinder **50** is mounted on transfer car **40** adjacent track **48** to move carriage **46** along track **48**.

Carriage **46** includes an arm **52** projecting laterally in the direction of the kilns and dryers, and carries a roller **54** having a groove **56** around its outer periphery in position to engage one of the flexible cables **30** between fair lead pulleys **24** and end **36** when transfer car **40** is in position in front of the door and carriage **46** is moved downwardly. As best seen in FIGURES 1 and 4, this downward movement of carriage **46** acting through cable **30**, lifts the door in front of the transfer car.

As best seen in FIGURE 1, transfer car **40** is provided on its upper surface with a set of tracks **60** of equal elevation and gage as the tracks **62** in each of the tunnel kilns and dryers so that kiln cars **44** may be pushed direct-

ly onto or off of the transfer car, as desired, when the transfer car is positioned in front of a tunnel kiln or dryer in such manner that the tracks 60 and 62 are in alignment. The vertical track 48 and carriage 46, as well as fair lead 24 and end 36 of cable 30, are spaced laterally from track 60 to provide an unobstructed path into the kiln when the door is lifted.

A limit switch 66 is mounted on the upper end of track 48 in position to engage and be actuated by carriage 46 when the carriage is in its upper most position. Switch 66 is suitably connected to the transfer car drive means to prevent movement of the car when carriage 46 has moved downwardly from its uppermost position. Thus, the transfer car cannot be moved so long as a door remains open. Also, if the carriage should drift down so that insufficient clearance is provided between roller 54 and fair lead pulleys 22, 24 or structural member 18, switch 66 will prevent movement of car 40.

A second limit switch 68 is mounted on track 48 in position to engage carriage 46 when the carriage is in the lower position. Switch 68 is suitably interconnected with the pusher mechanism (not shown) of the transfer car to prevent actuation of the pusher mechanism until the carriage 46 engages switch 68, thereby effectively preventing actuation of the pusher mechanism until the door has been fully opened.

A third limit switch 70 is carried by car 40 in position to engage and be actuated by a cam surface 72 accurately located with respect to each of the respective doors. Switch 70 is suitably interconnected with the cylinder 50 to prevent movement of carriage 46 except when switch 70 is actuated, thereby assuring the car 40 is accurately positioned in front of a door before the lifting mechanism can be actuated.

While I have described and illustrated a preferred embodiment of my invention, I wish it understood that I do not intend to be restricted solely thereto, but that I do intend to cover all embodiments thereof which would be apparent to one skilled in the art and which come within the spirit and scope of the invention.

What is claimed is:

1. In a ceramic plant having a plurality of tunnel kilns, dryers, and warming rooms in side-by-side relation, a transfer car operating in a pit in front of the kilns, dryers, and warming rooms for transferring kiln cars within the plant, and a vertically movable door on the end of each of the respective kilns, dryers, and warming rooms adjacent the pit, a door operating mechanism comprising an arm mounted on the transfer car and projecting laterally therefrom in the direction of the doors, hoist means carried by the transfer car for moving said arm along a vertical path adjacent each of said doors, and means on each of said doors projecting into said vertical path and movable therealong by said arm during movement thereof along said vertical path to operate the vertically movable doors individually when said transfer car is in position in front of the door.

2. In a ceramic plant having a plurality of tunnel kilns, dryers and warming rooms in side-by-side relation, a transfer car operating on a fixed track in a pit in front of the kilns, dryers and warming rooms for transferring kiln cars within the plant, a vertically movable door on the end of the respective kilns, dryers and warming rooms adjacent the pit and movable between a closed position and an open position spaced vertically above the closed position, a door operating mechanism comprising a vertically extending track mounted on the transfer car, a carriage mounted on said track and movable vertically thereon, said carriage including an arm projecting laterally from said transfer car in the direction of the doors, hoist means carried by the transfer car for moving said carriage along said vertical track, and supporting means mounted on each of said doors and extending into the path of said arm and engageable therewith during movement of said arm along said track, said supporting means being moveable along said path by said arm to move the doors between the open and closed position when the transfer car is in position in front of the respective doors.

3. In a ceramic plant having a plurality of tunnel kilns, dryers and warming rooms in side-by-side relation, a transfer car operating in a pit in front of the kilns, dryers and warming rooms for transferring kiln cars within the plant, a vertically movable door on the end of each of the respective kilns, dryers and warming rooms adjacent the pit, and means moving the respective doors between a closed position and an open position vertically above the closed position comprising an elongated flexible door lifting cable having one end attached to the door, a first section extending upward from said one end to engage a first fair-lead then laterally from said first fair-lead across a second fair-lead and having its other end fixed to a rigid structural element, a hoist on said transfer car including an arm projecting laterally therefrom in the direction of the doors and fluid motor means moving said arm vertically to engage the lateral portion of said flexible support means between said second fair-lead and said other end to move said door between said open and closed positions.

4. In a ceramic plant having a plurality of tunnel kilns, dryers and warming rooms in side-by-side relation, a transfer car operating in a pit in front of the kilns, dryers and warming rooms for transferring kiln cars within the plant, a vertically moving door on the end of each of the respective kilns, dryers and warming rooms adjacent the pit, the doors being movable vertically upward to an open position to permit the transfer of kiln cars between the transfer car and the respective kilns, dryers and warming rooms and means operating the respective doors when the transfer car is in position in front of the door comprising an elongated flexible lifting cable having one end fixed to the door, said cable extending vertically upward from said one end to engage a first fair-lead then laterally to engage a second fair-lead and having its other end fixed to a rigid structural element, a hoist on the transfer car including an arm projecting laterally therefrom in the direction of the doors, fluid actuated means moving said arm along a vertical track to engage said cable between said second fair-lead and said other end, means preventing the operation of said fluid actuated means when said transfer car is not in position in front of one of the doors.

5. In a ceramic plant having a plurality of tunnel kilns, dryers and warming rooms in side-by-side relation, a transfer car operating in a pit in front of the kilns, dryers and warming rooms for transferring kiln cars within the plant, and a vertically movable door on the end of each of the respective kilns, dryers and warming rooms adjacent the pit, a door operating mechanism comprising a vertically extending track on the transfer car, a carriage mounted on said track for vertical movement therealong and having an arm projecting laterally therefrom in the direction of the doors, fluid actuated means carried by said transfer car for moving said carriage vertically along said track, means on each of said doors extending laterally therefrom in position to be engaged by said carriage and moved vertically thereby to operate the vertically movable doors individually when said transfer car is in position in front of the door, and means preventing actuation of said fluid actuated means until said transfer car is in position in the front of the door.

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