April 22, 1969 L. G. TUCKER, JR., ET AL 3,440,145

MATERIAL HANDLING APPARATUS

Filed March 26, 1965 Sheet 1 of 2

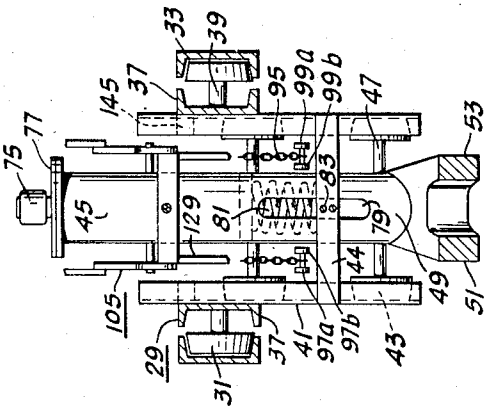


FIG. 4

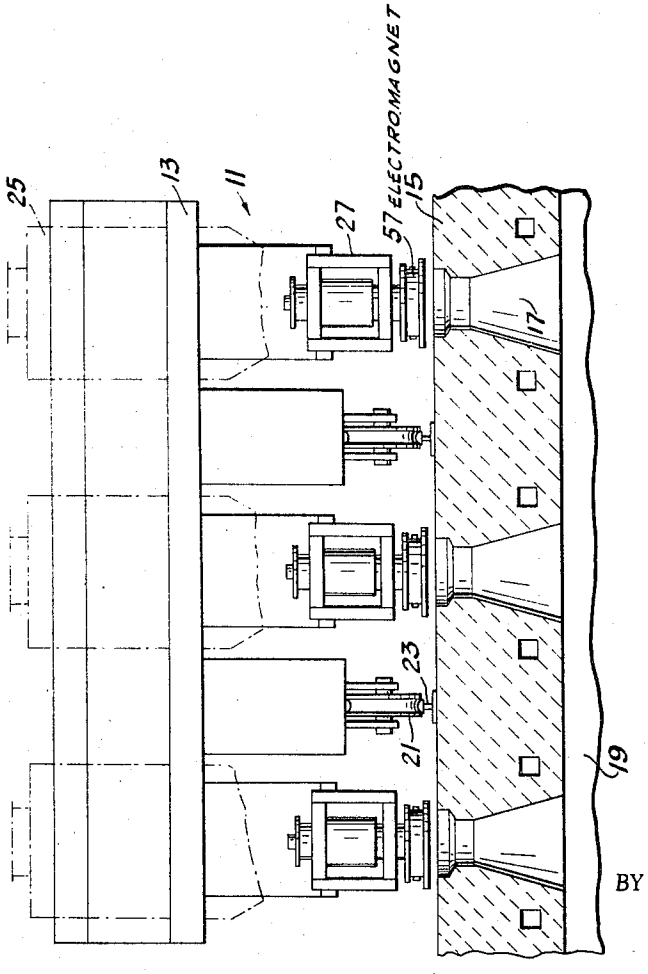


FIG. 1

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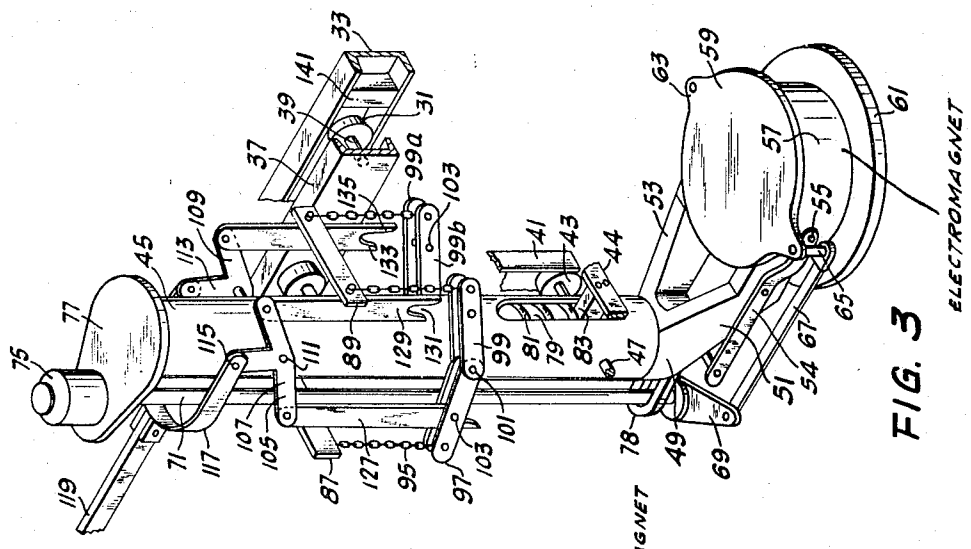


FIG. 3

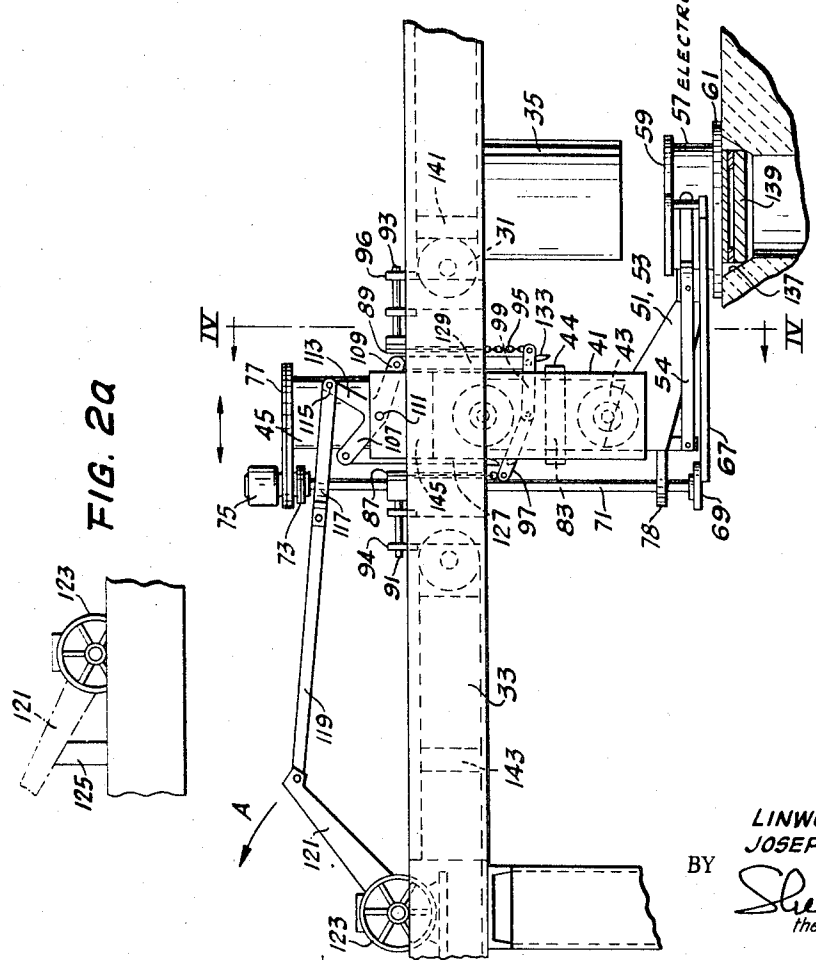


FIG. 2

FIG. 2a

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MATERIAL HANDLING APPARATUS

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U.S. Cl. 202—262 15 Claims

ABSTRACT OF THE DISCLOSURE

A carriage mounted to a larry car supports an electromagnet mechanism that lifts a coke oven charging hole cover and moves the cover in a straight line to a predetermined horizontal distance; whereupon the cover is released. The mechanism later lifts the cover and moves it backward in a straight line, the same horizontal distance and accurately replaces the cover.

This invention relates to material handling apparatus and, more particularly, to apparatus for removing and replacing the charging hole cover plates in the tops of coke oven battery coking chambers, gas producers, furnaces, and the like.

In a horizontal coke oven battery, which is typical of the installations to which the invention is applicable, the individual coking chambers are charged with coal through charging holes in the top of each chamber. The number of charging holes per chamber varies from installation to installation, but there is generally at least one charging hole and usually more than two in each coking chamber. A supply of coal, which is to be charged into the coking chambers, is usually carried in a larry car that is movable on rails over the top of the battery and over the individual coking chambers. Some form of apparatus for removing and replacing the charging hole covers or lids is generally mounted on the larry car and operated by the larry car operator from a central control station.

The individual charging holes have a flared upper end which is closed by an individual cover or lid that seats in the flared mouth.

The lid or cover for each charging hole has heretofore been removed in various ways such as, for example, by a workman stationed atop the coke oven battery who manipulated the covers as necessary. In other installations, the covers were removed and replaced by both mechanical and electro-mechanical apparatus mounted on the larry car. In any case, the apparatus and methods used heretofore required very accurate spotting of the larry car in order to remove and place the lid or cover accurately. Sometimes the car operator was not careful in replacing the cover and many times a faulty seating of the cover occurred. This faulty seating of the cover allows valuable coke even gas to escape to the atmosphere, valuable heat is also lost, and the coking time is consequently extended.

The present invention includes a carriage mounted on a larry car for horizontal movement in a straight line between stop members established a predetermined distance apart. A support mast is mounted to the carriage for vertical movement relative thereto and an electromagnet is mounted to the lower end of the mast. A first powered yoke actuates a link mechanism that simultaneously advances the carriage to a first position against one stop member and lowers the mast against resilient bias means to bring the magnet into engagement with a charging hole lid. After the magnet is energized to attract and hold the cover, the carriage is retracted from its first position and simultaneously the mast and the magnetically held cover are raised; the carriage being also movable to a second position against the second stop member. The yoke and link mechanism operate continuously and lower the mast

and cover to the top of the coke oven battery. Whereupon, the cover is releasable from the magnet, and the mast is thereafter raised to its initial at-rest position. After the cover is replaced in the charging hole, a second power driven yoke actuates links that oscillates the magnetically secured cover in order to seat it properly.

Thus, the present invention makes it possible to rapidly, accurately and satisfactorily remove and replace the lids of charging holes of a coke oven battery.

For a further understanding of the present invention and for further advantages and features thereof, reference may be made to the following description taken in conjunction with the accompanying drawings, forming a part of this application, which exemplify a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a schematic transverse sectional view of the upper portion of a coke oven battery showing typical larry car incorporating the present invention;

FIG. 2 is a schematic side elevational view of the lid lifting apparatus of the present invention in one operative position;

FIG. 2A is a schematic view showing a portion of the apparatus of FIG. 2 in another operative position;

FIG. 3 is a schematic perspective view of the major portion of the apparatus of FIG. 2; and

FIG. 4 is an elevational view along IV—IV of FIG. 2.

In FIG. 1, a conventional larry car **11** includes a main frame structure **13** which is movable along the top of a coke oven battery **15** over a plurality of coal charging chutes **17** communicating with a typical coking chamber **19**. The larry car **11** is provided with wheels **21** which are journally mounted to the frame structure **13** and which are adapted to roll upon rail members **23** affixed to the top of the battery **15**.

The larry car **11** also supports a plurality of coal storage bins **25**, and a charging hole cover handling mechanism **27** which is conveniently disposed axially above each charging hole **17**. FIGS. 2, 3 and 4 illustrate the charging hole cover handling mechanisms **27**; such mechanism being shown in one operative position.

The cover handling mechanism **27** includes a support carriage **29** (see FIG. 4) which is provided with a plurality, preferably four wheels **31** that are suitably journalled to the carriage **29**. The wheels **31** are adapted to roll on a level surface such as a flange of a conventional structural member **33** forming an outwardly extending part of the larry car **11**. The structural members **33** also support coal charging extension trunks **35** which engage the coal charging chutes for the purpose of charging coal into the chamber **17** in the usual manner.

The carriage **29** includes a pair of spaced apart channel members **37** that are arranged generally horizontally and at substantially the same level as the structural support members **33**. The wheels **31** are journally mounted to the shafts **39**, projecting outwardly from the channel members **37** as may be noticed by referring to FIG. 4. A pair of other channel members **41** are fixed, as by welding, to and extended vertically both above and below the channel members **37**. Preferably, considerably larger portions of the channel members **41** extend below the channel members **37** than above. Also, preferably, the vertical channel members face each other wherefore each channel member **41** forms a guideway for a plurality of other wheels **43**.

The lower portion of the vertical channel members **41** are welded to cross linking members **44**, for a purpose to be disclosed hereinafter.

Between the vertical legs **41**, there is a vertical hollow tubular mast **45** which may be round or square, or have any other preferable cross sectional shape. The mast **45** is provided with spaced apart diametrically opposed out-

wardly projecting pairs of stub shafts **47** (see FIG. 3) to which the wheels **43** are suitably journalled. Thus, the mast **45** is supported and movable vertically by virtue of the rollers **43** coacting with the guideways in the vertical channels **41**.

To the bottom of the mast **45** there is fixed as by welding a first collar **49** to which is integrally fixed to yoke arms **51, 53** (see FIG. 3). Each yoke arm supports an elongate member **54** which is connected by means of pivot pins **55** to a second collar **57** that is pivotable about a substantially horizontal axis. The second collar **57** surrounds and supports an electromagnet (not shown) which has a top cover plate **59** and a bottom outwardly extending flange ring **61**.

The top cover plate **59** is provided with a pair of diametrically opposed ears **63** which project outwardly from the periphery of the cover plate. Fixed to and depending from the ears are rods **65**. A horizontally disposed link rod **67** is pivotally connected to each of the rods **65** and to an arm of a yoke structure **69** that is fixed to the lower end of a vertical control rod **71** which is suitably coupled at **73** at its upper end to the drive shaft of a motor **75**. The motor **75** is mounted on a support plate **77** which is fixed to the top of the mast **45**. A U-shaped strap **78** loosely surrounds the control rod **71** adjacent its lower end and is welded to the first collar **49**.

The hollow mast **45** is provided with a pair of diametrically opposed long oval longitudinal slots **79** in the wall thereof. Within the mast there is disposed a compression spring **81** which abuts a suitable upper spring retainer (not shown) and against a lower spring retainer bar **83** extending through the slots **79** in the mast **45**. The bar **83** is fixed to the transversely disposed support bars **44** which are welded to the vertically depending channel legs **41**. Thus, the bar **83** forms a fixed support against which the spring is actionable and the mast is vertically reciprocable relative to the bars **83** and **44**.

The relative position of the bar **83** with respect to the bottom of the slots **79** is determined generally from the requirement that when the cover is raised, in the manner to be described hereinafter, the bar **83** is close to, but not contiguous with, the bottom of the slot **79**. The vertical height of the slot is likewise determined by the requirement that when the mast is reciprocated downward, in a manner to be described later, the spring being compressed accordingly, the bar **83** is close to, but not contiguous with, the upper end of the slot **79**.

Extending transversely across the top of the structural members **33** (see FIGS. 2 and 3), there are diametrically opposed compensating link bars **87, 89**, which are individually pivotally mounted on shafts **91, 93**, respectively. These shafts **91, 93** are suitably fixedly mounted to the larry car beams **33** as by the bearing supports **94, 96**.

A short length of chain **95** is suitably fixed to each end of each link bar **87, 89**, and the chain is connected at its lower end to pairs of other link bars **97, 99**. Each pair of link bars **97, 99** is mounted to a common pivot pin **101**, about as shown in FIG. 3. The pivot pins **101** are diametrically opposed, and they are fixed to and extend from the mast **45**.

Adjacent the chain connected end of the link bars **97, 99** there is another pin **103** which extends between the bars **97*a*, 97*b*** (see FIG. 4) making up each pair of the link bars **97**, and between the bars **99*a*** and **99*b*** of the link bar **99**. These pins **103** are fixed in the link bars as by welding or any other suitable manner.

Directly above each pair of commonly pivoted link bars **97, 99** there is provided a bell crank **105** having outwardly projecting arms **107, 109**. Each bell crank **105** is also pivotally mounted to the mast **45** by means of a pivot pin **111** disposed substantially vertically above pivot pin **101**, and each bell crank is provided with a vertically upwardly extending lever **113**. The upper end of each upwardly vertically extending lever is pivotally connected as at **115** to one arm of a yoke **117**. The yoke **117** is fixedly connected to one end of a push-pull bar **119** which is pivotally connected to a crank **121** (see FIG. 2). The other end of the crank **121** is operatively connected to a motor **123**. The motor **123** is mounted in fixed location on the larry car in a suitable and convenient place. Associated with the crank **121** is a stop bar **125** which is welded to the larry car about where shown in FIG. 2*a*. The purpose of this stop bar will become apparent hereinafter.

Vertical thrust bars **127, 129** (see FIG. 3) are pivotally connected to the ends of the bell crank arms **107, 109** and depend therefrom. The lower end of the thrust bars **127, 129** are slotted at **131** to form spaced apart projecting fingers **133, 135**. The bars **127, 129** are long enough so that when the bell crank **105** is moved to one operative position (see FIG. 3) the slot **131** in the bar **127** engages the pin **103** and exerts a downward force on the link bars **97**.

In the embodiment of the invention illustrated in the drawings, the apparatus is described with respect to a larry car adapted to service a coking chamber **19** having three charging chutes **17**. While this is a convenient number of charging chutes, it should be understood that the larry car would support an apparatus for each of the number of chutes in a coking chamber. That is to say if there are 4, 5 or 6 chambers, then there would be correspondingly 4, 5 or 6 lid handling apparatus mounted on the larry car.

Each coal charging chute is provided with the flared upper end **137** wherein a circular lid or cover **139** is seated to close the charging chute. Such a lid or cover **139** is illustrated generally in FIG. 2. The upper surface of the lid **137** is preferably flush with the top of the coke oven battery and the top of the cover **139** is made of magnetic material, whereby it may be magnetically coupled to the electromagnet supported by the yoke arms **51, 53**.

Since the charging hole lid handling mechanism **27** is the same for substantially all of the lids, a description of the use of the mechanism to remove and then reinstall one lid will suffice to illustrate the method of handling all of the lids. It will be assumed that the coking chamber **19** has been emptied and that the chamber is again ready to be recharged with coal. The larry car **11**, carrying the coal in storage bins **25** is then brought over the chamber **19** until the lid handling mechanism, and particularly the electromagnetic units thereof, are above respective lids. The magnet mechanisms will be in the raised or normal position about as shown in FIG. 1. In such position the resilient biased spring **81** is in the normal state of at-rest compression and the crank **121** will be in such a position that the lever **113** is substantially vertical.

The larry car need not be precisely spotted with respect to a particular cover or lid. It suffices if the magnet, when depressed into contact with a lid as described presently, engages the lid over an area sufficient to receive enough magnetic force to hold and raise the cover.

The removal of the cover from its charging chute is easy and quickly accomplished. The motor **123** is first actuated so as to move the crank **121** in a clockwise direction from its initial position to the position shown in FIG. 2. At the same time the carriage **29** is pushed by the yoke **117** toward the right, as viewed in FIG. 2, until the wheels **31** engage the stop **141**. Thereafter, as the crank **121** continues to rotate clockwise, the yoke **117** pivots the bell cranks **105** and levers in a clockwise direction also. During the rotation of the bell cranks, the depending thrust bars **129** move downward and the fingers **133, 135** straddle the pin **103** forcing it into the slot **131**. Then, as the thrust bars **129** continue to move downward, they act on the pins **103** and urge the link bars **97, 99*a*, 99*b*** downward. However, one end of the link bars **99** is fixed relative to the carriage **29** via the chains **95** and the transverse journally mounted equalizing bar **89**. And so, the fixed end of the link bars **99** cannot move downward, but the other end of the link member **99** being pivotally connected to the mast as at **101** causes the mast itself to move downward. The mast **45** descends against the resil-

ient biased member or spring **81**, which is internally biased between the mast and the fixed bar **83**. Thus, the downward movement of the mast causes the spring **81** to be compressed. As the mast descends, it is, of course, guided by the wheels **43** coacting with the guideways in the vertical channel legs **41**.

The lid lifting mechanism or carriage **29** is rollably supported by the frame **13** and, as mentioned previously, is pushed toward the right, as viewed in FIG. 2, until the wheels **31** engage a right hand stop member **141**, fixed to the horizontally extending channel **33** of the larry car. In such a first position, the magnet may be substantially concentric with the charging hole and lid but not necessarily so. Actually, the magnet needs to engage only so much of the lid as is necessary to hold it when the magnet is energized. The motor **123** continues to actuate the bell crank mechanisms until the magnet engages the lid **139** whereupon the motor **123** stops. It should be mentioned that one purpose of the pivotally mounted link bars **87**, **89** and chains **95** is to insure equal symmetrical loadings on the mast during its movement downward and upward, as will be explained hereinafter.

The magnet may be now energized from any available source of power and, of course, the lid will be magnetically coupled to the magnet.

Thereupon, the motor **123** is reversed and the crank **121** now rotates in a counterclockwise direction, as indicated by the arrow A in FIG. 2. The bell cranks **105** then pivot about pivot pin **111** in a counterclockwise direction, and the force in the compressed spring **81** urges the mast upward, raising the lid from the charging hole until the upper set of wheels **43** engage a stop member **145**, fixed in the channel guide legs **41**.

After the mast has stopped raising, the crank **129** continues ot rotate counterclockwise. The push-pull bar **119** pulls the carriage **29** toward the left, as viewed in FIG. 2, and the carriage rolls on the rails **23** until the left hand carriage wheels **31** engage the left hand stop member **143**. When this occurs, the lid will have been moved from the charging hole a distance substantially equal to the distance between the opposed inner surfaces of the right and left hand stops **141**, **143** respectively. However, the crank **121** continues to rotate counterclockwise and the bell cranks **105** do likewise. The thrust bar **127**, being pivotally connected to the bell crank arm **107**, descends and the fingers of the bar **127** straddle the thrust pin **103** urging it into the slot **131**. Thereafter, the further movement of the bar **127** urges the link bar **97** downward also. Because one end of the bar **97** is fixed relative to the carriage via the chain **95** and equalizer bar **87**, it cannot move downward. Thus, the free end of bar **97**, which is pivotally connected to the mast, moves downward and causes the mast to again move downward against the spring **81**. The crank **121**, meanwhile, continues to rotate counterclockwise and urges the mast and lid to descend until the crank engages the stop **125** (see FIG. 2*a*). By this time, the lid will be substantially resting on the top of the battery, and the magnet may be deenergized to release the lid in that position. The stop **125** is positioned so that the lid will be practically in contact with the top of the battery, and when the magnet is deenergized the lid drops practically not at all.

Thereupon, the motor **123** may be reversed and the crank **121** will be rotated clockwise to a convenient position between the end stops at which the spring **81** is compressibly at rest. The extension trunk **35** may now be brought into operative engagement with the coal charging chute in the usual manner and thereafter the coking chamber **19** may be loaded with coal. Thereupon, the extension trunk may be elevated to a position about as shown in FIG. 2.

The larry car is now ready to be moved along the top of the battery to the next coking chamber where the same procedure to remove the lids and load the chamber with coal can be repeated.

The procedure for replacing the lids is substantially a reversal of the removal action except that the larry car will be moving in the opposite direction along the top of the coke oven battery. When the lids of a coking chamber are to be replaced, the larry car is moved to a position adjacent the charging chutes where the extension trunk is approximately but not necessarily concentric with the coal charging chute.

It is a feature of the present invention that it is not necessary to precisely position the larry car with respect to the charging chute. That is, it is not necessary to bring the larry car back to the precise spot where it was located when the lid was removed. It suffices that the magnet engages sufficient surface area of the lid to effect a magnetic coupling force capable of raising the lid. Now, with the crank **121** and the carriage **129** at the extreme left hand position as viewed in FIG. 2, the magnet may be energized to couple the lid thereto, and, by reversing the steps delineated hereinbefore, the lid can be moved to an accurate center position with respect to the charging chute **17** from which it was originally removed. It will be appreciated that the centering is accurate because the distance the lid was moved horizontally when it was removed (being the distance between the carriage stops **141**, **143**) is the very same distance it is moved horizontally when the lid is replaced. That this horizontal distance is constant regardless of the relative position of the magnet with respect to the lid makes the centering accurate.

After the lid engages the seat in the charging chute, the lid may be seated by actuating the motor **75**. This motor mechanism is preferably one which will cause the control rod and yoke to oscillate about the vertical axis of the rod **71**. The cover plate **59**, being connected to the yoke by means of the link rod **67**, also oscillates as does the magnet and the lid coupled thereto. Hence, the lid may be oscillated to effect a grinding-in of the cover when it is replaced in its seat.

During the seating of the lid, a pressure substantially equal to the weight of the lid and the magnet acts on the lid. This vertical grinding force may be increased if desired by making a suitable adjustment in the angular rotation of the crank **121**. Moreover, the angular oscillatory motion of the lid may also be adjusted to include a wide range if desired.

It is a feature of the present invention that the oscillating motion for seating of the lid in place is without radial forces which tend to cant the lid out of its horizontal seated position. Also, the lid is accurately seated into the charging hole since the flanged rim **61** which encases the magnet is larger in diameter than the charging hole, whereby there is no tendency for the lid to become biased in the seat portion of the charging hole.

Another feature of the present invention is that a single power unit **123** moves the carriage longitudinally between the carriage stops and also actuates the mast to raise and lower the lid.

We claim:

1. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a larry car movable along the top of said battery over said charging holes;

a carriage mounted on said larry car for movement in a substantially straight line;

stop members fixed to said larry car a predetermined distance apart thereby establishing first and second extreme positions between which said carriage is movable;

a support column mounted on said carriage;

means for vertically reciprocating said column relative to said carriage;

a first yoke member affixed to said column with arms extending therefrom;

an electromagnet mounted to the arms of said first yoke and movable about a substantially vertical axis;

means for oscillating said magnet about said axes whereby when said cover is replaced and oscillated said cover is seated in said charging hole;

a pair of first lever members centrally pivotally mounted to said carriage and disposed on opposite sides of said column, each said link member extending longitudinally of said carriage away from said central pivot;

second lever members pivotally mounted to said column below each pair of said first links and extending longitudinally of said carriage away from their respective pivot;

means for fixing the ends of said second lever members relative to said carriage;

a link member pivotally connected adjacent each end of each pair of first lever members and extending downward therefrom;

a spring biased between said carriage and said column whereby when said column moves downward said spring is compressed;

a second yoke having arms pivotally connected to said first pair of lever members;

means to move said larry car to a position where said magnet is in operative juxtaposition to one of said covers;

means to advance said second yoke in the direction of said carriage whereby said carriage moves relative to said first position and said first lever members pivot in one direction whereby one pair of said depending link members engage a first opposed pair of said second levers and urge said column and said magnet downward into operative proximity to said cover;

means to energize said magnet whereby the same is coupled to said cover; and

means to retract said second yoke whereby said first lever members pivot in the opposite direction and said spring urges said column and magnetically held cover upward from its charging hole and said carriage is moved from said first position to said second position, said cover being moved in a straight line from said charging hole a distance substantially equal to the distance between said first and second positions, and the other pair of opposed depending link members engage a second pair of said second levers and urge said column and said magnetically held cover downward; and

means to de-energize said magnet and release said cover.

2. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a structure movable along the top of said battery over said charging holes;

a carriage mounted on and movable in a substantially straight line on said movable structure;

first and second stop means fixed to said movable structure a predetermined distance apart thereby establishing first and second extreme positions between which said carriage is movable in said straight line;

a support member mounted on said carriage;

means for reciprocating said support member relative to said carriage;

an electromagnet fixed to said support member;

means to advance said carriage to said first extreme position locating the electromagnet in operative relation to the cover and simultaneously to lower said support member until said magnet is in operative juxtaposed relation to one of said covers;

means to energize said magnet and couple said cover thereto; and

means to raise said support member and said cover from its charging hole and simultaneously retract said carriage in said straight line from said first extreme position to said second extreme position.

3. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a structure movable along the top of said battery over said charging holes;

a carriage mounted on said movable structure and movable in a substantially straight line;

means limiting the linear movement of said carriage to a predetermined distance between first and second terminal positions;

a support member mounted on said carriage;

means for reciprocating said support member with respect to said carriage;

an electromagnet mounted to said support member;

means for oscillating said electromagnet about a substantially vertical axis;

resilient means biased between said carriage and said support member whereby when said support member reciprocates downward said resilient means is stressed;

means to advance said carriage to said first terminal position;

means to move downward said support member against said resilient bias means until said magnet is operatively juxtaposed to one of said covers;

means to energize said magnet and couple said cover thereto;

means to release said support member whereby said resilient bias means urges said support member upward and the magnetically held cover is raised from its charging hole;

means to retract said carriage from said first terminal position to said second terminal position and thereafter reciprocate downward said support member against said resilient bias means;

means to deenergize said magnet and release said cover.

4. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a larry car movable along the top of said battery over said charging holes;

a carriage mounted on said larry car and movable in a substantially straight line;

stop members fixed to said larry car a predetermined distance apart thereby establishing first and second extreme positions between which said carriage is movable;

a support column mounted on said carriage;

means for vertically reciprocating said column relative to said carriage;

a first yoke member affixed to said column with arms extending therefrom;

an electromagnet mounted to the arms of said first yoke and movable about a substantially vertical axis;

means for oscillating said magnet about said axes whereby when said cover is replaced and oscillated said cover is seated in said charging hole;

means to advance said carriage to said first extreme position and simultaneously lower said support member until said magnet is in operative juxtaposition to one of said covers;

means to energize said magnet and couple said cover thereto; and

mean to raise said support member and said cover from its charging hole and simultaneously retract said carriage from said first extreme position to said second extreme position.

5. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a larry car movable along the top of said battery over said charging holes;

a carriage mounted on said larry car and movable in a substantially straight line;

stop members fixed to said larry car a predetermined distance apart establishing first and second extreme positions between which said carriage is movable;

a support column mounted on said carriage;

means for vertically reciprocating said column relative to said carriage;

a first yoke member affixed to said column with arms extending therefrom;

an electromagnet mounted to the arms of said first yoke and movable about a substantially vertical axis;

means for oscillating said magnet about said axis whereby when said cover is replaced and oscillated said cover is seated in said charging hole;

resilient means biased between said carriage and said support member whereby when said support member reciprocates downward said resilient means is stressed;

means to advance said carriage to said first extreme position;

means to move downward said support member against said resilient bias means until said magnet is operatively juxtaposed to one of said covers;

means to energize said magnet and couple said cover thereto;

means to release said support member whereby said resilient bias means urges said support member upward and the magnetically held cover is raised from its charging hole; and

means to retract said carriage from said first extreme position to said second extreme position and thereafter reciprocate downward said support member against said resilient bias means.

6. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a structure movable along the top of said battery over said charging holes;

a carriage mounted on said movable structure and movable in a substantially straight line;

means limiting the linear movement of said carriage to a predetermined distance between first and second terminal positions;

a support member mounted on said carriage;

means for reciprocating said support member vertically with respect to said carriage;

an electromagnet mounted to said support member;

resilient means biased between said carriage and said support member whereby when said support member reciprocates downward said resilient means is stressed;

means to advance said carriage to said first terminal position;

means to move downward said support member against said resilient bias means until said magnet is operatively juxtaposed to one of said covers;

means to energize said magnet and couple said cover;

means to release said support member whereby said resilient bias means urges said support member upward and the magnetically held cover is raised from its charging hole;

means to retract said carriage from said first terminal position to said second terminal position and thereafter reciprocate downward said support member against said resilient bias means; and

means to deenergize said magnet and release said cover.

7. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a structure movable along the top of said battery over said charging holes;

a carriage mounted on said movable structure for movement in a substantially straight line;

means limiting the linear movement of said carriage to a predetermined distance between first and second terminal positions;

a support member mounted on said carriage;

means for reciprocating said support member vertically with respect to said carriage;

an electromagnet mounted to said support member;

a pair of first lever members centrally pivotally mounted to said carriage and disposed on opposite sides of said column, each said link member extending longitudinally of said carriage away from said central pivot;

second lever members pivotally mounted to said column below each pair of said first links and extending longitudinally of said carriage away from their respective pivot;

means for fixing the ends of said second lever members relative to said carriage;

a link member pivotally connected adjacent each end of each pair of first lever members and extending downward therefrom;

a spring biased between said carriage and said column whereby when said column moves downward said spring is compressed;

a yoke having arms pivotally connected to said first pair of lever members;

means to move said larry car to a position where said magnet is in operative juxtaposition to one of said covers;

means to advance said second yoke in the direction of motion of said carriage whereby said carriage moves relative to said first position and said first lever members pivot in one direction whereby one pair of said depending link members engage a first opposed pair of said second levers and urge said column downward and said magnet into operative proximity to said cover;

means to energize said magnet whereby the same is coupled to said cover;

means to retract said second yoke whereby said first lever members pivot in the opposite direction and said spring urges said column and magnetically held cover upward from its charging hole and said carriage is moved from said first position to said second position, said cover being moved in a straight line from said charging hole a distance substantially equal to the distance between said first and second positions, and the other pair of opposed depending link members engage a second pair of said second levers and urge said column and said magnetically held cover downward.

8. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a carriage movable relative to said charging holes;

stop means spaced apart a predetermined distance establishing first and second extreme positions between which said carriage is movable in a substantially straight line with respect to a charging hole cover;

a support column mounted on said carriage;

means for vertically reciprocating said column relative to said carriage;

an electromagnet fixed to said support member;

means to position said carriage in a first position related to the position of charging hole cover;

means to lower said support member until said magnet is in operative juxtaposition to said cover;

means to energize said magnet and hold said cover;

means to raise said support member and said cover from its charging hole and simultaneously retract said carriage in said straight line from said first extreme position to said second extreme position; and

means to deenergize said magnet and release said cover.

9. Apparatus for handling a cover for a charging hole in a coke oven battery comprising:

a carriage movable relative to said charging holes;

stop means spaced apart a predetermined distance and establishing first and second terminal positions between which said carriage is movable in a substantially straight line with respect to a charging hole cover;

a support column mounted on said carriage;

means for vertically reciprocating said column relative to said carriage;

an electromagnet fixed to said support member;

means for oscillating said electromagnet about a substantially vertical axis;

resilient means biased between said carriage and said support member whereby when said support member reciprocates downward said resilient means is stressed;

means to advance said carriage to said first terminal position;

means to move downward said support member against said resilient bias means until said magnet is operatively juxtaposed to one of said covers;

means to energize said magnet and hold said cover;

means to release said support member whereby said resilient bias means urges said support member upward and the magnetically held cover is raised from its charging hole; and

means to retract said carriage from said first terminal position to said second terminal position and thereafter reciprocate downward said support member against said resilient bias means.

10. The invention according to claim **9** including:

means to deenergize said magnet and release said cover.

11. The method for handling a cover for a charging hole in a coke oven battery having a structure movable along the top of said battery over said charging holes and a carriage mounted on and movable in a substantially straight line on said movable structure comprising the steps of:

(a) fixing first and second stop means to said movable structure a predetermined distance apart thereby establishing first and second extreme positions between which said carriage is movable in said straight line;

(b) positioning said carriage in operative relation to a charging hole cover at said first extreme position;

(c) lowering an electromagnet mounted to said carriage into juxtaposition with said cover:

(d) energizing said magnet to couple together said cover and said magnet;

(e) raising said cover; and

(f) moving said carriage and said cover through a finite fixed distance from the first extreme position to the second extreme position in a straight line away from said charging hole.

12. The method of claim **11** including the step:

(a) moving said carriage and said cover in a straight line from said second position to said first position through said finite fixed distance to replace said cover;

(b) releasing said cover when said carriage is at said first position.

13. The method of claim **11** including the steps:

(a) releasing said cover when said carriage is at the second position; and

(b) removing said carriage from said second position.

14. The method of claim **13** including the steps:

(a) relocating said carriage adjacent said cover at said second position;

(b) engaging and raising said cover;

(c) moving said carriage and said cover from said second position through said finite fixed distance in a straight line to said first position;

(d) replacing said cover in said charging hole; and

(e) releasing said cover.

15. The method for handling a cover for a charging hole in a coke oven battery having a structure movable along the top of said battery over said charging holes and a carriage mounted on and movable in a substantially straight line on said movable structure comprising the steps of:

(a) establishing first and second stop means to said movable structure a predetermined distance apart thereby establishing first and second extreme positions between which said carriage is movable in said straight line;

(b) positioning said carriage in operative relation to a charging hole cover at said first extreme position;

(c) lowering an electromagnet mounted to said carriage in juxtaposition with said cover;

(d) energizing said electromagnet and coupling said cover to said magnet;

(e) raising said magnet and said cover;

(f) moving said carriage and cover through a finite distance in a straight line from said first extreme position to said second extreme position;

(g) releasing said cover at said second position;

(h) engaging and lifting said cover;

(i) moving said carriage through said finite fixed distance in a straight line from said second extreme position to said first extreme position;

(j) lowering and placing said cover in said charging hole; and

(k) releasing said cover.

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