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METHOD FOR CHARGING A COKE-OVEN BATTERY

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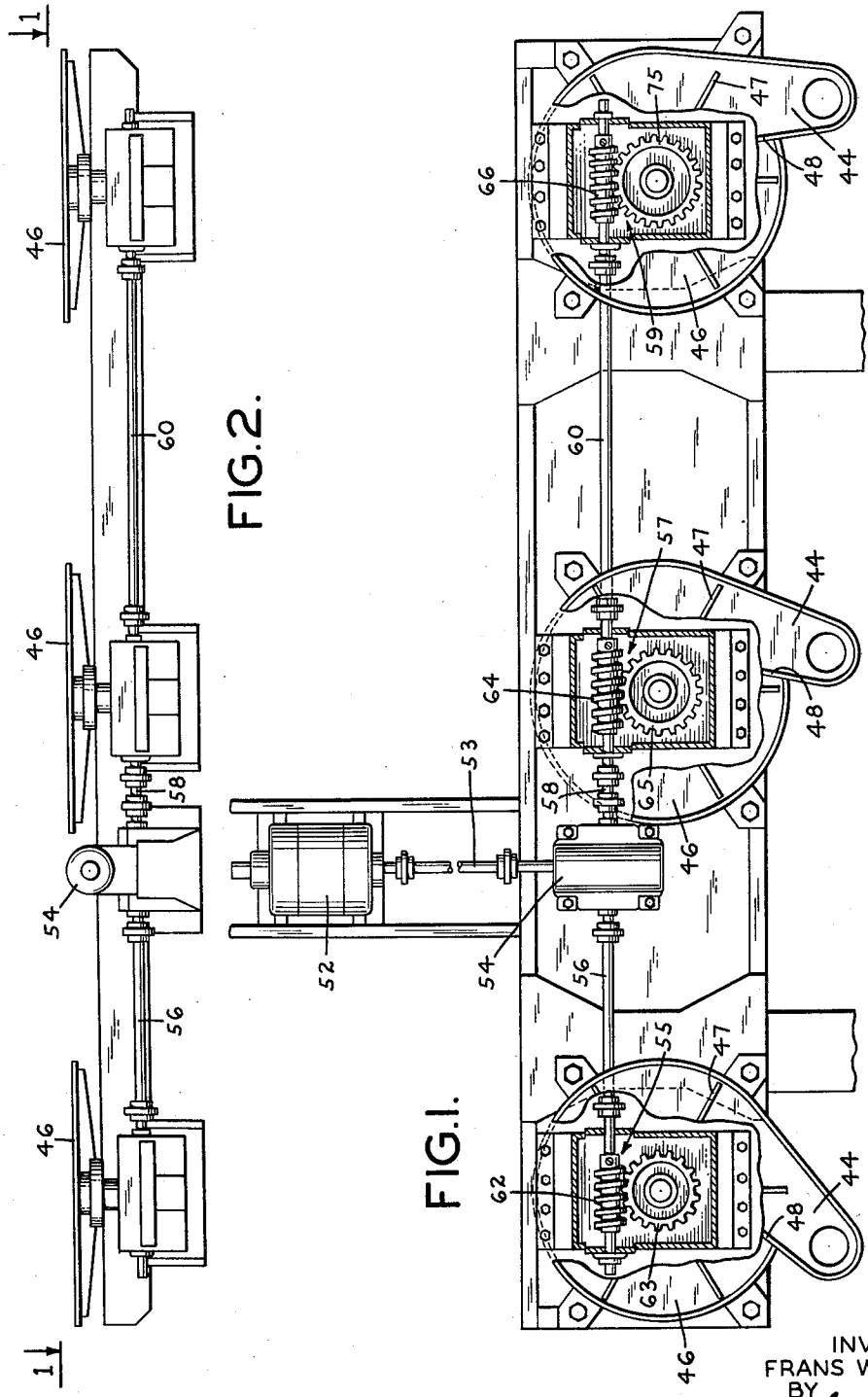



FIG. 2.

FIG. 1.

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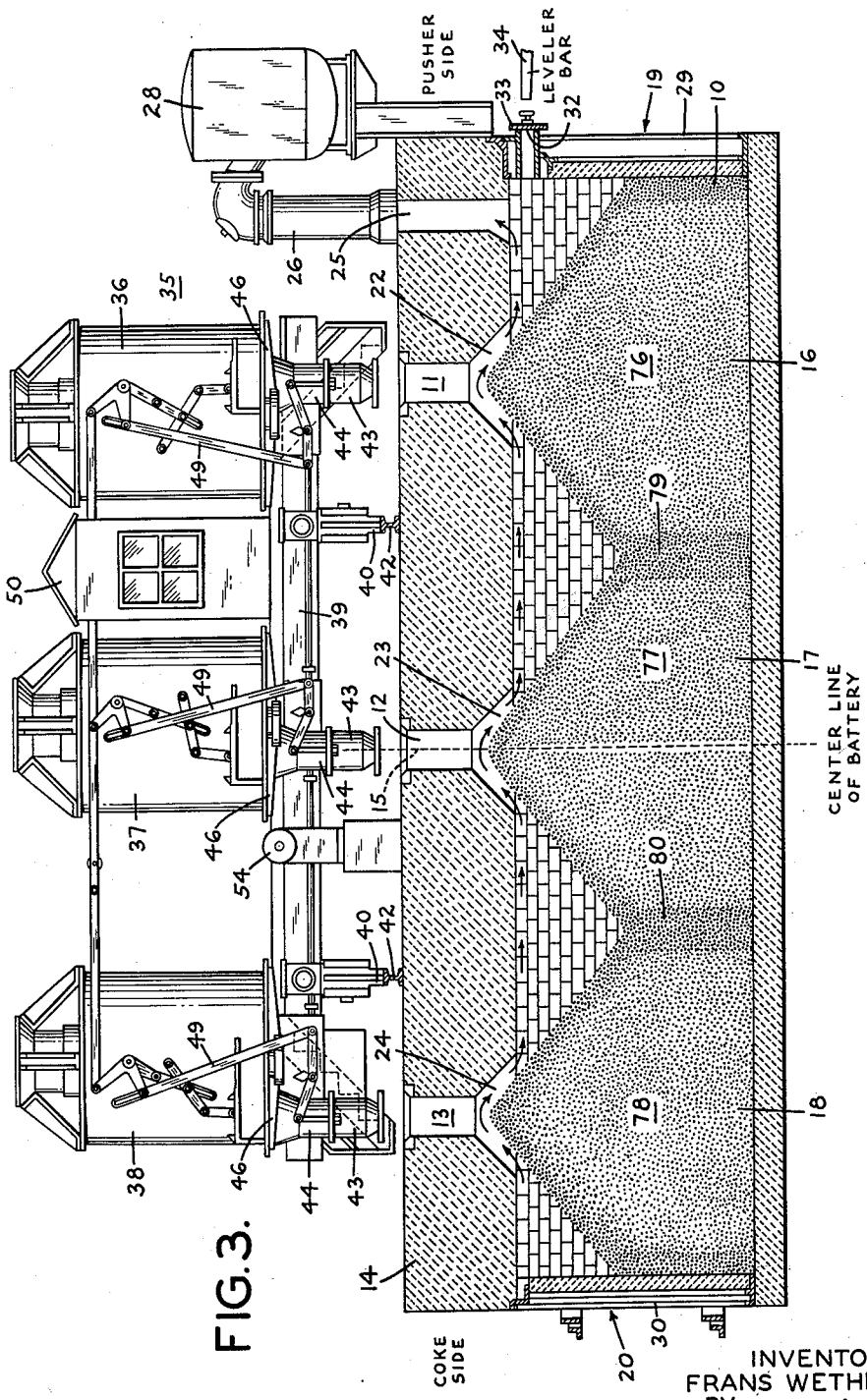



FIG. 3.

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# 3,070,516
# METHOD FOR CHARGING A COKE-OVEN BATTERY

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2 Claims. (Cl. 202—36)

This invention relates to charging a coke oven with coal.

In coke-oven batteries, three or more charge holes are provided in the roof of each oven and are aligned longitudinally of the battery so that each oven may be charged at predetermined intervals from a larry car supporting the same number of coal feed hoppers as charge holes for each oven. The coal, discharged simultaneously from the hoppers, accumulates in the oven as contiguous piles having peaks under the charge holes, which are leveled off by a leveling bar to leave a gas collecting space over the entire surface of the coal.

Control of the quality of coke obtained is partly through the length of the heating cycle. However, uniformity of coke quality throughout the length of each oven is a function of the uniformity of the depth of coal charge. Localized differences in height of charge result in correspondingly localized differences in quality of coke produced.

When, as is highly desirable, the coke oven is tapered to facilitate pushing of the coked mass without damage to oven structure, the volume of oven per foot of length changes materially from one end of the oven to the other. This fact plus other structural requirements of the coke oven walls and roof, result in battery construction in which the charge holes are so placed in the ovens that the individual volumes served by each are unequal. With either equal or unequal spacing of the charge holes it is often difficult to arrive at a practical, economical design without compromising on some other important structural or operational feature in which the difference between the largest and smallest of such individual volumes is less than about 15%. The problems attending design and allocation of individual volumes to be served by the several charge holes exist in the erection of a new battery but are particularly difficult when an existing installation is expanded by addition of new ovens. In the latter instance the charging holes must be aligned and the same tracks and larry car must be used on the entire structure.

In prior practice, substantial uniformity of level of coal charge has been achieved by utilizing different volumes of the individual hoppers in the larry car corresponding to the actual individual oven volumes. This practice, however, has resulted in discharge of the individual hoppers in unequal time.

In charging an operating battery of coke ovens it is extremely improtant that the charge of coal be completely transferred quite rapidly. As the coal comes into contact with the hot oven walls, the process of distillation begins and proceeds through the mass of coal charged, releasing toxic, inflammable and/or smoky gaseous products which, if allowed to escape into the atmosphere through the open charge holes, create an atmosphere in the working area above the ovens which is a deterrent to efficient operation and is sometimes hazardous to personnel. Provision of boots over the coal chutes connecting the hoppers and charge holes mitigates but does not always completely eliminate the escape of gases into such areas. While the coal is flowing into the charge holes it tends to reduce the emission of such gases from the oven except through discharge ports and conduits provided to receive them. Within a matter of seconds after



completion of flow through a charge hole, the larry car should be moved away and the charge hole covers put in place. Hence, delay of this operation after completing charging at one hole to complete charging at one or more other holes favors accumulation of the undesirable atmosphere in the working area.

One object of the present invention is to provide a method for the improved charging of coke oven coking chambers having oven chamber sections of different volumetric capacities.

Another object is to provide a method for charging coke ovens achieving a considerable reduction in the time required for charging the coking chambers and for the subsequent leveling operation.

Another object is to provide a method for the practically smokeless charging of coke ovens.

A further object is to provide a method for the charging of coke ovens which will comply with anti-smoke ordinances and laws and will provide for safer and more healthful working conditions for people working in the immediate vicinity and on top of the battery.

Additional objects and advantages will be apparent as the invention is hereafter described in detail.

In accordance with the present invention three or more unequal volumes of coking coal, for instance bituminous coal contained in a corresponding number of hoppers of the charging car are spotted, i.e. positioned or established above a corresponding number of spaced charging holes for the coke oven coking chamber by spotting the car above the charging openings. The charging openings or holes are spaced apart distances such that the volumetric capacities of the oven chamber sections therebeneath, individual thereto and fed therethrough are unequal with the volumetric capacity of the oven chamber section at the coke side of the battery being usually at least 15% greater than that of the chamber section at the pusher side of the battery. The volumes of coal in the hoppers of the charging car are each of size sufficient to substantially completely fill the corresponding oven chamber section except for a gas collecting space in the upper portion of the chamber section and extending substantially uniformly the full length of the oven chamber. The coal is force fed simultaneously from each of the unequal volumes through the charging openings into the oven chamber sections at a rate ratio about the same as the ratio of the unequal volumes of coal. The result is the completion of discharging all coal from all of the volumes into the chamber sections substantially simultaneously, generally within a time of one minute. Thereafter the piles of coal thus charged into the oven coking chamber are leveled, generally by less than two strokes of the leveler bar. The method is a considerable improvement by reason of accomplishing the following results: (1) material reduction in the time required to charge the coke ovens; (2) practically smokeless charging of the ovens; (3) more economical and efficient than the prior art charging; (4) complying with anti-smoke and anti-atmosphere pollution ordinances and laws; and, (5) providing healthful working conditions for workers in the vicinity of the ovens.

For a better understanding of the present invention, reference is now made to the following drawings wherein:

FIG. 1 is a plan view taken generally along line 1—1 of FIG. 2 of the turntable feeders of the coal feeding apparatus of the invention with parts broken away to show the drive mechanism associated therewith;

FIG. 2 is a vertical elevation of the turntable feeders having drive mechanism therefor; and

FIG. 3 is a vertical elevational section through a horizontal coking chamber of a coke oven battery of the invention.

With reference to FIG. 3, a horizontal coking cham-

ber is designated at **10**, the coking chamber being of a coke-oven battery comprising horizontal tapered coking chambers and interposed flued heating walls disposed side by side in a row. The heating walls are supported by pillar walls between which are regenerator chambers, the regenerator chambers alternately supplying preheated air to and receiving gaseous combustion products from the vertical heating oven flues. Such a coke-oven battery is disclosed in U.S. Patent No. 2,155,954, issued April 25, 1939. Three charging holes or openings **11**, **12** and **13** are provided in roof **14** of each coking chamber **10**. Central charging opening **12** has its axis coinciding with center line **15** of the battery and charging openings **11** and **13** are spaced substantially equidistant from central charging opening **12**. Consequently, due to the spacing of charging openings **11**, **12** and **13** and the taper of the coking chamber **10** which is considerably wider at the coke side of the battery than at the pusher side to facilitate pushing of the coke from the chamber upon completion of the coking, the volumetric capacities of chamber sections **16**, **17** and **18** are unequal with chamber section **18** at the wider coke side usually having a volumetric capacity at least 15% greater than that of chamber **16** at the pusher side. Central chamber section **17** also has greater volumetric capacity than that of pusher side chamber section **16**, chamber section **17** typically having volumetric capacity about 7½% greater than that of chamber section **16**. Coking chamber **10** has typical dimensions as follows: width at the pusher side **19** of 16½", width at the coke side **20** of 19½", height of 13', overall length of 42'6" and length between doors of 40'. The axis of charging opening **11** is typically spaced a distance of 12' from the axis of charging opening **12** and a distance of 9'3" from pusher side **19** of the battery. The axis of charging opening **13** is typically spaced the same distance from the axis of charging opening **12** as the axis of charging opening **11** is spaced from the charging opening **12** axis, and the axis of charging opening **13** is spaced a distance of 9'3" from coke side **20** of the battery.

Charging openings **11**, **12** and **13** each have their lower portion undercut crosswise of the battery to provide lower flared outlet portions **22**, **23** and **24** respectively which materially increase the capacity of coking chamber **10** for the piles of coal received during the charging operation without the piles reaching the top of the coking chamber and blocking passage of gas to the gas offtake **25**. Gas offtake **25** is located at the pusher side of each coking chamber **10** and connects with offtake pipe **26** communicating with collector main **28** which in turn leads to the coke plant by-product recovery system. Door closures **29** and **30** are provided at the ends of each coking chamber **19**, and leveler door opening **32** closed (as shown) and opened by leveler door **33** is provided in door **29**. Leveler bar **34** is inserted through leveler door opening **32** when leveler door **33** is removed from the opening and the leveler bar is moved within coking chamber **10** to level the coal charges in each of chamber sections **16**, **17** and **18** as hereafter described.

Charging car **35** having three hoppers **36**, **37** and **38** mounted on and supported by carriage **39** has wheels **40** on which carriage **39** is mounted, the charging car **35** being adapted to travel along the roof of the battery by reason of wheels **40** traveling on tracks **42** located on the battery roof. The hoppers **36**, **37** and **38** of the charging car have unequal volumetric capacities corresponding to the volumetric capacities of the corresponding oven chamber sections **16**, **17** and **18**, and each contain a mass or volume of coal of size sufficient to substantially completely fill the corresponding oven chamber section except for the gas collecting space in the upper portions of chamber sections and extending the full length of the coking chamber **10**. Hence once charging car **35** is spotted in charging position over the charging openings and its drop sleeves **43** lowered to bridge the gap between discharge chutes **44** of the charging car and the charging openings, the entire coal charge of each hopper passes into the corresponding coking chamber sections to substantially completely fill the coking chamber except for the gas collecting space previously mentioned.

Referring now to FIGS. 1 and 2, rotatable turntable feeders **46** are mounted at the bottom of each of hoppers **36**, **37** and **38**, turntable feeders **46** each having spaced radial ribs **47** thereon. Plows are provided at **48** so that when turntable feeders **46** are rotated and the coal caused to travel with the rotating turntables by reason of ribs **47**, the traveling coal will be moved into contact with plow **48**. The plows cause the coal to be discharged through the chutes **44**, shown in FIG. 3, which connect with drop sleeves **43**. Sleeves **43**, also shown in FIG. 3, are adapted to be lowered into position to bridge the gap between chutes **44** and the charging holes when desired to charge the coking chamber. Operation of the drop sleeves **43** is effected by the conventional lever mechanism designated collectively by **49**. Cab **50**, shown in FIG. 3, is mounted on carriage **39** of the charging car and the operating mechanism for actuating the motor **52**, shown in FIG. 2, for driving the turntable feeders of the hoppers and the motor (not shown) for driving the carriage as well as for actuating the lever **49** and other mechanism of the charging car is located in this cab.

Referring now to FIGS. 1 and 2, drive motor **52** is connected through drive shaft **53** to speed reducer **54** which in turn drives gearing **55** for rotating turntable feeder **46** through drive shaft **56**, drives gearing **57** for rotating its turntable feeder **46** through drive connection **58**, and also drives gearing **59** for rotating its turntable feeder **46** through drive shaft **60**. Gearing **55** comprises worm **62** and worm wheel **63** in mesh therewith and is mounted to rotate turntable feeder **46** to feed coal to the oven chamber section **18** at the coke side of the battery. Gearing **57** comprises worm **64** and worm wheel **65** in mesh therewith and is mounted to rotate the central turntable feeder **46** to feed coal to the central oven chamber section **17**. Gearing **59** comprises worm **66** and worm wheel **67** engaged therewith to rotate its turntable feeder **46** for charging coal to the oven chamber section **16** at the pusher side of the battery.

In accordance with the invention, different gear ratios are employed in the gearing **55**, **57** and **59** for operating the turntable feeders **46** of the hoppers at different rotational speeds proportional to the different volumes of coal in hoppers **18**, **17** and **16** so that all hoppers will be completely emptied substantially simultaneously within a period of one minute. Expressed in different words, different gear ratios are employed in gearing **55**, **57** and **59** such that the turntable feeders **46** are operated at a rotational speed ratio which is the same as the ratio of the unequal volumes of coal in the corresponding hoppers thereby completing discharging all coal from all hoppers into the respective chamber sections substantially simultaneously within a period of one minute. For example, if the ratio of the unequal volumes of coal in hoppers **36**, **37** and **38** is 1:1.05:1.15 respectively, then the turntable feeders **46** for the corresponding coking chamber sections are operated at a rotational speed ratio of 1:1.05:1.15 by employment of different gear ratios in the gearing **59**, **57** and **55** suitable to provide this speed ratio. If the ratio of the volumes of coal in hoppers **36**, **37** and **38** are 1:1.10:1.20 respectively, then the turntable feeders **46** are operated at a rotational speed ratio of 1:1.10:1.20 respectively by use of different gear ratios in the gearing **59**, **57** and **55** suitable to provide this speed ratio. Further, if the ratio of the unequal volumes of coal in hoppers **36**, **37** and **38** is 1:1.10:1.16 respectively, then the turntable feeders **46** are operated at a rotational speed ratio of 1:1.10:1.16 respectively by use of the appropriate gear ratios in the gearing **59**, **57** and **55**. Bevel gears or spur gears can be employed for the gearing instead of the worm gears if desired.

The gearing units having the particular gear ratio desired are obtainable in commerce. The coal is fed from each of the unequal coal volumes in hoppers **36**, **37** and **38** into discharge chutes **44** during the charging at rates greater than that of gravity flow, and the coal then passes downwardly through chutes **44** and drop sleeves **43** and into coking chamber sections **76**, **77** and **78** at about gravity flow rates.

In charging the oven coking chamber **10**, charging car **35** is moved on rails **42** and spotted in proper position over charging openings **11**, **12** and **13** of coking chamber **10**. The covers are then removed from the charging openings and the drop sleeves **43** for the hoppers **36**, **37** and **38** are lowered into position to register with the charging openings **11**, **12** and **13**. The rotatable turntable feeders **46** for the coking chamber sections **16**, **17** and **18** are then operated through their gearing **59**, **57** and **55** having appropriate different gear ratios such that a rotational speed ratio of the turntable feeders is achieved which is the same as the ratio of the unequal volumes of coal in hoppers **36**, **37** and **38** respectively to complete emptying of all coal from all hoppers substantially simultaneously within a period of one minute. Three piles of coal **76**, **77** and **78** are formed in chamber sections **16**, **17** and **18** respectively with the piles being of such height and their apexes extending upwardly within the flared lower portions of the charging openings in such manner as to not obstruct the passage of gas across the upper portion of the coking chamber to gas offtake **25**. Meeting line **79** is present between piles **76** and **77** and meeting line **80** is present between piles **77** and **78**, the coal being of increased density within the region of these meeting lines and these meeting lines generally always occurring in the same relative positions within the coking chamber. Increased quantities of heating gas can be supplied to the flues in the heating walls opposite where these meeting lines occur to provide more heat to compensate for the increased density of coal in these regions. The leveler bar **34** is then moved across the top of the coking chamber to level the coal charge with no more than two strokes of the leveler bar generally being sufficient to accomplish the leveling. The covers are placed back over the charging openings substantially immediately after completion of the emptying of the hoppers. The charging car **35** is then moved for refilling of its hoppers and charging of another coking chamber.

The invention is also applicable to the charging of coke oven coking chambers having four or more chamber sections of unequal volumetric capacaties. A four hopper charging car having hoppers of correspondingly different volumetric capacities is employed for charging the four coking chambers. As is the case with charging the three section coking chamber, in accordance with the invention, the turntable feeders are operated at a rotational speed ratio which is the same as the ratio of the volumetric masses of coal contained in the corresponding hoppers. The result achieved is completion of discharging all coal from all hoppers into the chamber sections substantially simultaneously within a period of one minute.

The invention is a considerable improvement and of particular merit because it achieves charging of the ovens with a material reduction in time, typically about 15% less time than that required to charge the coking chambers using the larry car containing the unequal volumes of coal and having the mechanical feeders operated at the same or equal speeds previously mentioned. Consequently, the covers can be placed over the charging openings in a much shorter time employing the charging of this invention than is the case with the prior art charging to seal off the openings and achieve practically smokeless charging of the ovens and comply with the anti-smoke and anti-atmosphere pollution ordinances and legislation. Due to the large quantities of smoke generated by coking in even a single coking chamber, for the covers to be off one or more of the charging openings an additional time period of a matter of seconds, for instance as small as 5 seconds, will let out into the atmosphere considerable quantities of smoke in violation of the anti-smoke ordinances. Hence, it can be readily seen that by completing the charging and closing off of all the charging openings in substantially the same time is a considerable improvement in this art.



Coke ovens each having 3 charging holes, one on the battery center line and two equidistant therefrom with coking chamber sections therebeneath, individual thereto and fed therethrough of volumetric capacity of 219 cubic feet at the pusher side, 230 cubic feet at the central chamber section and 251 cubic feet at the coke side had a turntable feeder-equipped three hopper charging car spotted over its charging holes, the hoppers of the car having unequal volumetric capacities corresponding to those of the respective coking chambers. Installation of gearing having a gear ratio of 5 to 1 for operating the turntable feeder of the hopper at the coke side, gearing having a gear ratio of 5½ to 1 for operating the turntable feeder of the central hopper and gearing having a gear ratio of 6 to 1 for operating the turntable feeder of the hopper at the pusher side results in all the coal hoppers being emptied substantially simultaneously within the time limit of 1 minute without emission of material quantities of smoke from the coking chambers in violation of antismoke ordinances.

Although certain preferred embodiments of the invention have been disclosed for purpose of illustration, it will be evident that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

What is claimed is:

1. A method for charging a coke over coking chamber of a coke-oven battery comprising horizontal tapered coking chambers and interposed flued heating walls disposed side by side, the coking chambers each being wider at the coke side than at the pusher side, which comprises spotting at least three unequal volumes of coking coal above a corresponding number of spaced charging openings for the coke oven coking chamber, the charging openings being spaced apart distances such that the volumetric capacities of oven chamber sections therebeneath, individual thereto and fed therethrough are unequal with the volumetric capacity of the chamber section at the coke side being at least 15% greater than that of the chamber section at the pusher side, the volumes of coal each being of size sufficient to substantially completely fill the corresponding oven chamber section except for a gas collecting space in the upper portion of the chamber section and extending the full length of the oven chamber, force feeding the coal simultaneously from each of said volumes through the charging openings into the chamber sections at a rate ratio about the same as the ratio of the unequal volumes of coal thereby completing discharging all coal from all of said volumes into the chamber sections substantially simultaneously, and thereafter leveling the piles of coal thus charged into the coking chamber.

2. A method for charging a coke oven coking chamber of a coke-oven battery comprising horizontal tapered coking chambers and interposed flued heating walls disposed side by side, the coking chambers each being wider at the coke side than at the pusher side, which comprises spotting three unequal volumes of coking coal contained in turntable feeder-equipped hoppers of a three hopper charging car above a corresponding number of spaced charging openings for the coke oven coking chamber, the charging openings including a central charging opening having an axis coinciding with the longitudinal center line of the battery and two charging openings on opposite sides of the central opening and substantially equidistant therefrom with the volumetric capacities of the chamber sections therebeneath, individual thereto and fed there-

through being unequal, the volumetric capacity of the chamber section at the coke side being at least 15% greater than that of the chamber section at the pusher side, the volumes of coal contained in the hoppers each being of size to substantially completely fill the corresponding over chamber section except for a gas collecting space in the upper portion of the chamber section and extending the full length of the oven chamber, force feeding the coal simultaneously from each of the hoppers through the openings into the oven chamber sections by operating the turntable feeders at a rotational speed ratio which is the same as the ratio of the unequal volumes of coal in the corresponding hoppers thereby completing



discharging all coal from all hoppers into the chamber sections substantially simultaneously within a period of one minute, and thereafter leveling the piles of coal thus charged into the oven coking chamber.

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