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 problem of 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 unequal in time.

In charging an operating battery of coke ovens it is extremely important 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 throughout 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 cooking 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 cooking 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, a big amount of 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 cooking 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 thereunto, 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 forced 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 cooking 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 fluid heating walls disposed side by side in a row. The heating walls are supported by pillar walls between which are regenerator chambers, and 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 a greater volumetric capacity than that of pusher side chamber section 16, chamber section 17 typically having volumetric capacity about 7/8% greater than that of chamber section 16. Coking chamber 10 has typical dimensions as follows: width at the pusher side 19 of 162", width at the coke side 20 of 194", height at 15", overall length of 426" 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 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 charging chamber and blocking passage of gas to the gas off-take 25. Gas off-take 25 is located at the pusher side of each coking chamber 10 and connects with off-take 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 28. 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 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 unequal volumetric capacities of the corresponding chamber sections 16, 17 and 18, and each contain a mass or volume of coal of size sufficient to substantially completely fill the corresponding chamber section except for the gas collecting space in the upper portions of chamber sections and extending the full length of the coking chamber.

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 hopper 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 which will then push the coal through the chutes 44, shown in FIG. 3, which consist 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 another lever 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 continuously charged at the rate of the slowest hopper in 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 completely 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 1:10.51:1.15 respectively, then the turntable feeders 46 for the corresponding coking chamber sections are operated at a proportional rotational speed ratio of 1:10.51:1.15 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 1:1:1.10:1:120 respectively, then the turntable feeders 46 are operated at a rotational speed ratio of 1:10.1:1.20 respectively by employment 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 1:1:1.10:1:16 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 40 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 completely exhaust all of 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 apertures for 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 flared lower portions of the charging openings sub substantially parallel to the plane of the charging openings with the volumetric capacities of the 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 coking 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 5:1 for operating the turntable feeder of the hopper at the coke side, gearing having a gear ratio of 5:1 for operating the turntable feeder of the central hopper and gearing having a gear ratio of 6:1 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 oven coking chamber of a coke-oven battery comprising horizontal tapered coking chambers and interposed fluid heating walls disposed side by side, the coking chambers each being wider at the coke side than at the pusher side, which comprises spot 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 said coking 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 sections 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 fluid heating walls disposed side by side, the coking chambers each being wider at the coke side than at the pusher side, which comprises spot three unequal volumes of coking coal contained in turntable feeder-equipped hoppers having a 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 centerline 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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