Aug. 21, 1962 G. E. C. RANDELL ETAL 3,049,738

COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

Filed June 30, 1959 5 Sheets-Sheet 1

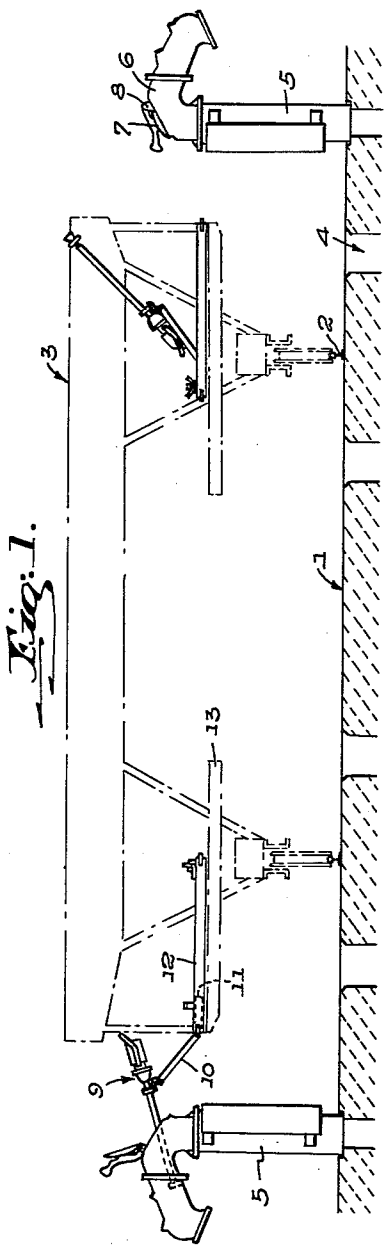


Fig. 1.

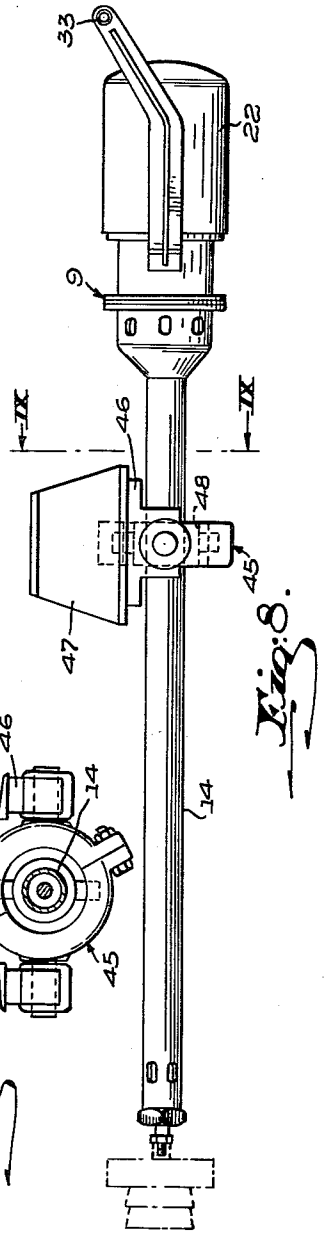


Fig. 8.

Fig. 9.

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COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

Filed June 30, 1959 5 Sheets-Sheet 2

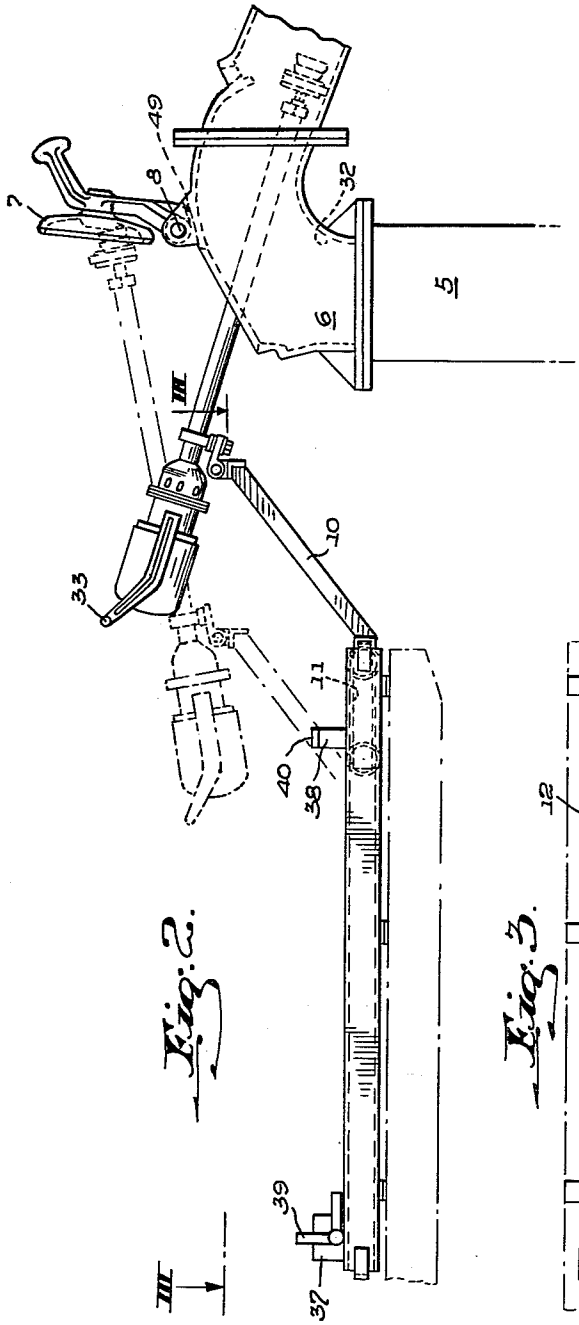


Fig. 2.

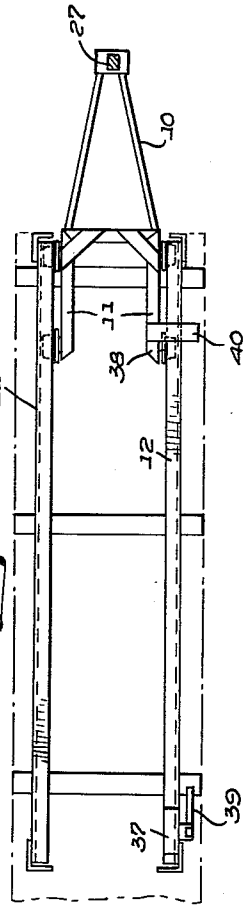


Fig. 3.

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COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

Filed June 30, 1959 5 Sheets-Sheet 3

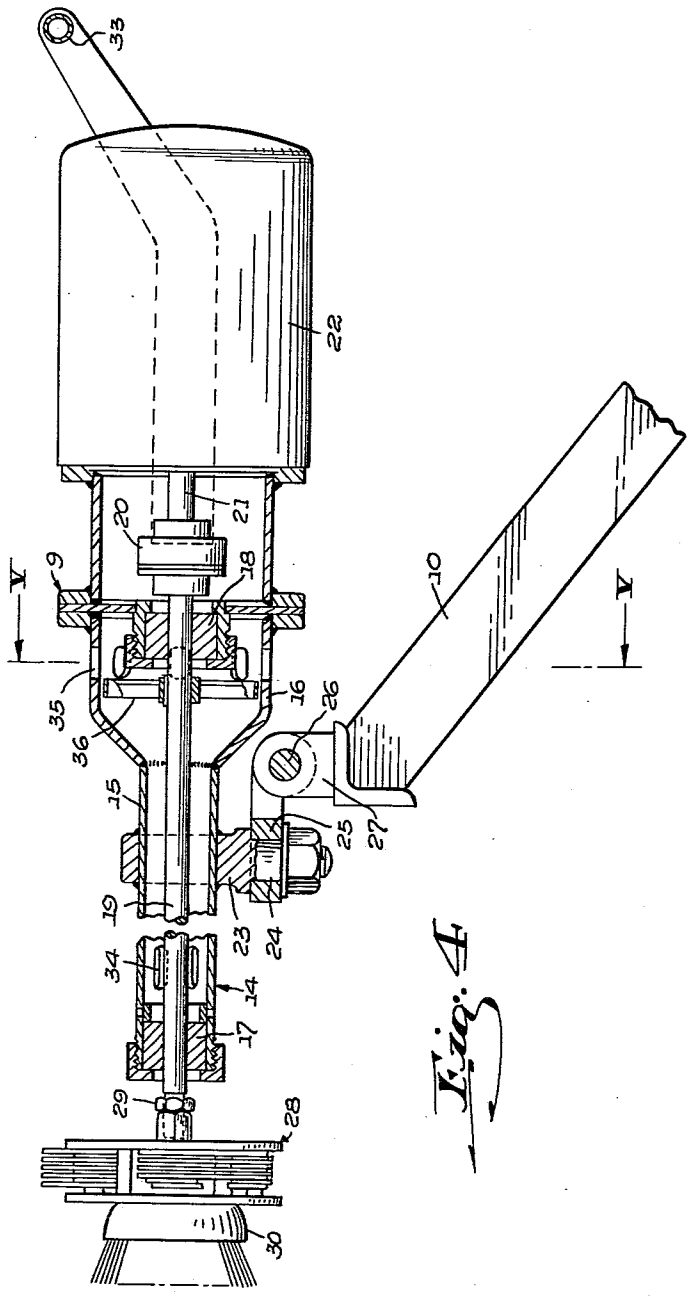


Fig. 4

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COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

Filed June 30, 1959 5 Sheets-Sheet 4

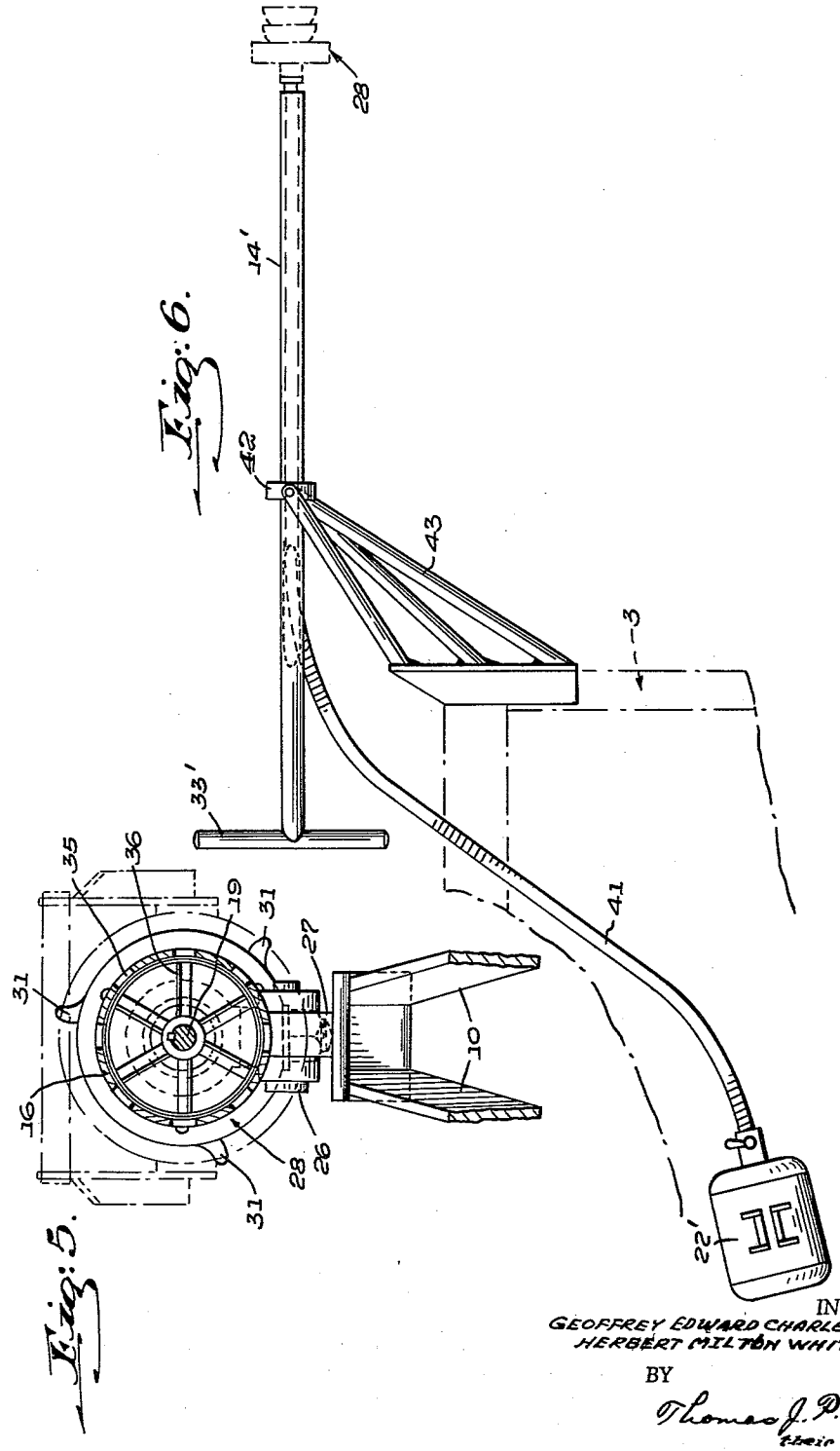


Fig. 6.

Fig. 5.

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COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

Filed June 30, 1959 5 Sheets-Sheet 5

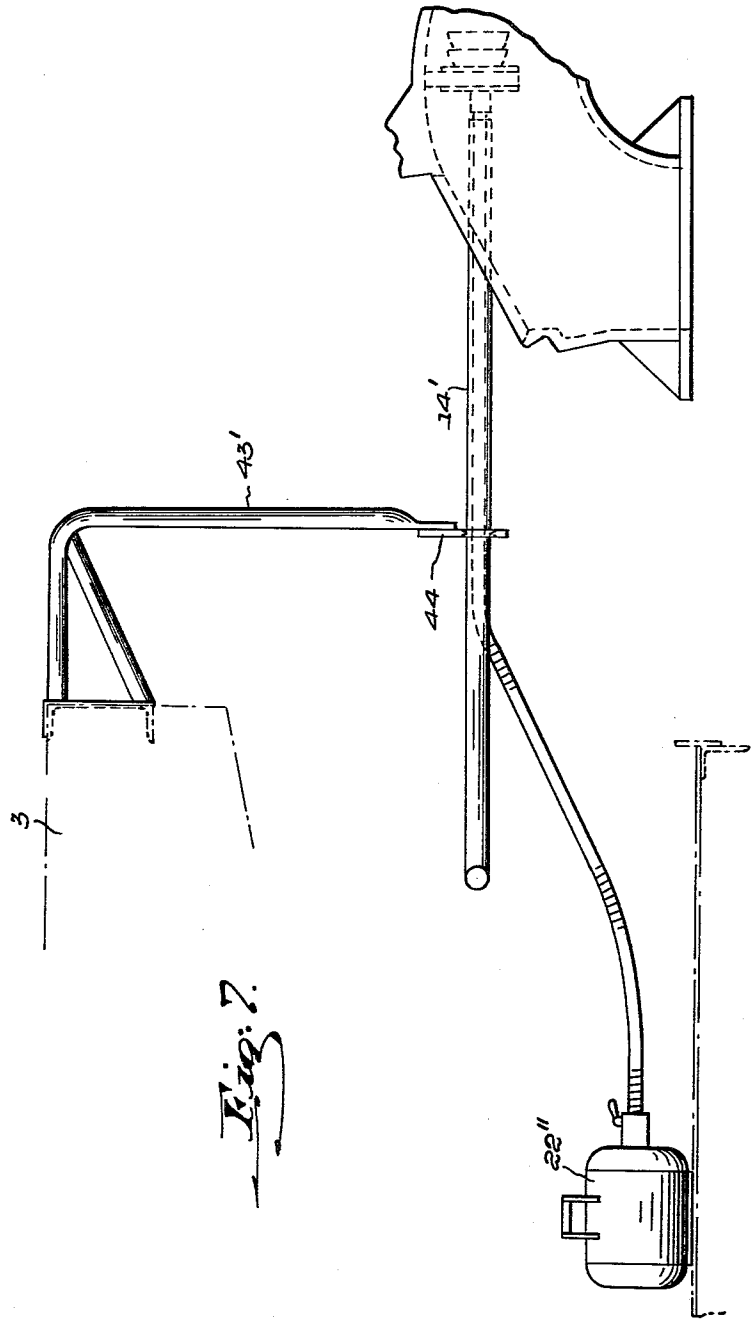


Fig. 7.

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3,049,738
COKE OVEN ASCENSION PIPE DECARBONISING DEVICE

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Filed June 30, 1959, Ser. No. 823,995
3 Claims. (Cl. 15—5)

This invention concerns improvements in or relating to the removal of hard deposits from the interiors of pipes and the like of industrial plants and has especial reference to the removal of carbon and like deposits from the ascension or riser pipes (hereinafter called "ascension pipes") of coal carbonising plants and, in particular, of horizontal coke ovens with respect to which the invention will hereinafter be more particularly described.

In horizontal coke oven batteries it is customary to have an ascension pipe extending upwardly from at least one end of each oven chamber to lead away the gases produced therein. Sometimes there is an ascension pipe at only one end of each oven chamber but frequently there is one such ascension pipe at each end of each chamber. The ascension pipes are connected at their upper ends to elbows which connect the ascension pipes to the gas main or mains, each elbow having at its upper part an oblique face sloping downwardly towards the top of the battery of ovens and furnished with an inspection opening covered by a hinged or removable lid. It is customary for rails to be provided on the top of the coke oven battery, on which rails a charging car is traversable for charging the oven chambers in a predetermined sequence.

Heavy and hard deposits of carbon accumulate upon the interior surface of the elbows of the ascension pipes, and these deposits are particularly thick and intractable in the vicinity of the necks of the ascension pipes. It is therefore customary, after the discharging of an oven chamber, and before the re-charging of such chamber, to remove at least the heavier carbon deposits from the elbows and adjoining parts of the ascension pipes. This operation is at present performed manually by an operator standing upon a platform at one end of the charging car, who inserts a crow-bar-like implement through the opened inspection hole of the ascension pipe which he is to decarbonise and, by a chipping type of operation, proceeds to decarbonise the pipe. This manual method of decarbonising the ascension pipes is unsatisfactory, since it is slow and arduous as well as being uncomfortable for the operator due to the high temperature prevailing in the neighbourhood of the ascension pipe elbows, this temperature usually being somewhere in the region of 500°–800° C.

It is therefore an object of this invention to provide a means whereby ascension pipe and like decarbonising operations may be effected by power operated means instead of purely by manual effort.

According to one aspect of this invention there is provided apparatus for use in the removal of hard deposits from, or decarbonising or cleaning (hereinafter all referred to as "decarbonising"), the interiors of pipes and the like of industrial plants, such apparatus comprising a rotary abrading element, means for driving said abrading element, and means for supporting said element adjacent the pipe to be decarbonised whilst leaving the element free for movement relatively to said supporting means in the direction of the axis of rotation of the element and also transversely of such axis, whereby the abrading element may be advanced into or withdrawn from the said pipe and whilst in the pipe may be traversed around the interior of the latter and along the same to effect the decarbonising thereof.

The invention is particularly applicable to the decarbonising of the elbows and necks of the ascension pipes of a horizontal coke oven battery, and where used for this purpose the said supporting means are preferably adapted for mounting on, or are incorporated in the structure of, the charging car of the battery so as to traverse along the battery with the charging car, although, if desired, the said supporting means could be mounted on a separate carriage traversable along the battery independently of the charging car. Where the battery has two rows of ascension pipes the decarbonising apparatus would preferably be duplicated, there being one such apparatus for decarbonising the ascension pipes of each of said rows.

Thus, according to a further aspect of the invention, there is provided a charging car for a horizontal coke oven battery, such charging car having at or near at least one end thereof apparatus for decarbonising the interior of the elbows and necks of ascension pipes of the battery, such apparatus comprising a rotary abrading element, means for driving said abrading element, and means for supporting said element on the charging car for movement relatively to the latter in such manner that the abrading element can be introduced into the elbow and neck of an ascension pipe and moved along and around the interior surfaces of these parts to decarbonise the same.

According to a further feature of the invention, the said rotary abrading element is fixed upon a shaft borne by an arm carried by said supporting means, such shaft being capable of adjustment both in the direction of its length and angularly, in order that said abrading element may be traversed along and around the surfaces to be decarbonised thereby.

Thus, according to a further aspect of the invention, there is provided apparatus for use in the decarbonising of the interiors of pipes and the like of industrial plants, such apparatus comprising a rotary abrading element, a shaft to one end of which said rotary abrading element is attached so as to rotate with the shaft, bearing means for such shaft, an arm carrying said bearing means, supporting means by which the said arm is carried so as to be adjustable both angularly and in the direction of its length in order that the said rotary abrading element may be introduced into or withdrawn from the pipe or the like to be decarbonised and, after insertion into such pipe or the like, may be adjusted along and around the latter to decarbonise the internal surface thereof, and power operated means for driving the said shaft.

The said arm is preferably so mounted on the said supporting means as to be swivellable with respect thereto and conveniently is attached to said supporting means by a universal joint or a gimbal ring arrangement.

Preferably, rather than the said arm being axially or longitudinally adjustable with respect to the supporting means, the latter are mounted for adjustment towards and away from the pipe or the like to be decarbonised. However, alternatively or in addition, the arm may be adjustable in the direction of its length with respect to the said supporting means, e.g. it may be axially slidable with respect to the said universal joint or the said gimbal ring.

Preferably, in applying the invention to the decarbonising of the ascension pipes of coke ovens, said supporting means are mounted on a carriage itself carried by the charging car of the battery and which is traversable along this charging car in the direction of the length of the latter.

With such an arrangement means are preferably provided for preventing the movement of the charging car in the direction of the length of the coke oven battery until the decarbonising apparatus has been withdrawn to its inoperative position.

The shaft by which the abrading element is carried is conveniently driven by an electric motor but it may be

operated by any other suitable power unit, such as a pneumatic or hydraulic motor for example.

Preferably the abrading element is fixed to one end of its driving shaft and the said motor is arranged at the opposite end of such shaft. Desirably this shaft is rigid, the abrading element being arranged at one end of the arm by which the shaft is carried and said motor being located at the other end of such arm, this arm being preferably swivellingly mounted at a substantially fixed position between its ends upon the said supporting means, so that the weight of the abrading element at one end of the arm is substantially counterbalanced by that of the motor at the other end of the latter.

Preferably handle means, whereby the arm may be manipulated, are furnished adjoining the end of said arm remote from the abrading element.

The said arm is preferably of tubular form to constitute a housing for said shaft and its bearings, and desirably means are provided for cooling at least those parts of the abrading apparatus that are inserted into the pipe or the like to be decarbonised. Thus the said tubular arm may be furnished with longitudinally spaced ports for the circulation of air therethrough, an impeller or fan being provided to effect such circulation.

Preferably the said tubular arm is enlarged at one portion thereof to form a housing for the said impeller or fan, the latter being carried by the said shaft so as to be driven by the said motor. This arrangement is particularly suitable where the power unit is an electric motor, but where a pneumatic motor is employed the cooling may be effected by cool air currents exhausted from such motor. Alternatively the cooling air may be provided by an entirely separate fan or cooling unit. In a still further alternative water or other cooling liquids could be employed if desired.

The said abrading element may be of the flail type or may compromise or include a rotary wire brush. Preferably it will be a combination of the flail and wire brush types, having peripheral flails and an axially directed wire brush, the flails serving primarily to clean the peripheral internal surfaces of the pipes being decarbonised and the wire brush serving to decarbonise surfaces more readily accessible by such brush than by the said flails, for example the internal surfaces of the lids of ascension pipes of horizontal coke oven batteries.

In order that the invention may be more readily understood, certain embodiments of the same will now be described, by way of example, as applied to the cleaning or decarbonising of the ascension pipes of a horizontal coke oven battery, these embodiments of the invention being illustrated in the accompanying drawings, in which:

FIGURE 1 illustrates an application of this invention to a horizontal coke oven battery which is diagrammatically illustrated in the figure partly in transverse cross-section;

FIGURE 2 is a side elevation of the embodiment of the invention illustrated in FIGURE 1, FIGURE 2 being drawn to a larger scale than FIGURE 1 and only showing one of the decarbonising apparatus;

FIGURE 3 is a sectional plan on line III—III, FIGURE 2;

FIGURE 4 is an enlarged part longitudinal vertical section through a part of the decarbonising head of the apparatus;

FIGURE 5 is a section on line V—V, FIGURE 4;

FIGURE 6 illustrates diagrammatically in side elevation a further embodiment of the invention;

FIGURE 7 diagrammatically illustrates a modification of the arrangement shown in FIGURE 6;

FIGURE 8 illustrates a still further alternative embodiment of the invention; and

FIGURE 9 is a section on line IX—IX, FIGURE 8.

Referring to FIGURE 1 it will be seen that the roof of a coke oven battery is depicted at **1**. On the roof of the battery are longitudinally arranged rails **2** on which rides

a charging car **3** shown in dot-and-dash lines in the figure. At each end of each oven chamber **4** of the battery is provided an upstanding riser or ascension pipe having an elbow **6** at its upper end furnished with a lid **7** hinged to the ascension pipe at **8** so as to be capable of being opened as indicated at the left of FIGURE 1 and in FIGURE 2.

In all the embodiments of the invention illustrated in the accompanying drawings the decarbonising apparatus is carried by the charging car of the coke oven battery but it will be realised that, if desired, a separate car could be provided to carry the decarbonising apparatus. In FIGURE 1 of the drawings each oven of the battery is shown having an ascension pipe **5** at each end but it will be appreciated that in some cases only one ascension pipe may be provided for each oven, in which cases decarbonising apparatus will be required only at one end of the charging car.

By the "ends" of the charging car as referred to herein are meant those portions of the latter which lie nearest to the ascension pipes **5**.

In the embodiment of the invention illustrated in FIGURES 1 to 5, the decarbonising apparatus comprises a decarbonising head generally indicated by the reference **9**, which is supported for substantially universal pivoting upon an upwardly and outwardly (with reference to the charging car) directed outrigger arm or bracket **10** fixed to a carriage **11** reciprocable in guide rails **12** extending longitudinally of the charging car **3** upon a horizontal platform **13** suspended from the chassis of the charging car.

The decarbonising head comprises an arm **14** in the form of a tubular housing **13** enlarged in diameter at its inner end **16**, this housing containing bearings **17** and **18** which are journalled to a shaft **19** which is coaxial with the housing **15** and is coupled at **20** to the shaft **21** of an electric motor **22** fixed to the inner end of the enlarged portion **16** of the housing. The arm **14** is rigidly fixed intermediate its ends, and relatively near to the junction of the enlarged end portion **16** with the narrower portion of the housing **15**, to a collar **23** having a dependent stud **24** which is pivotal about a vertical axis in a bifurcated lug **25** mounted on a horizontal pivot **26** carried by an upstanding lug **27** fixed to the upper end of the supporting bracket **10**, the arm **14** thus being capable of substantially universal movement, it being adjustable both about the vertical axis of the pivot bolt **24** and about the horizontal axis of the pivot **26**. Because the carriage **11** is reciprocable along the horizontal rails **12**, the arm **14**, and consequently the entire decarbonising head **9**, is movable towards and away from the corresponding ascension pipe **5** of the battery **1**.

The outer end of the shaft **19** carries a rotary abrading head **28** which is interchangeably screwed on the end of the shaft and fixed thereon by a lock nut **29**. This abrading head **28** may be of any appropriate form with peripheral abrading means, but is conveniently of the flail type and preferably includes a wire brush **30**.

As will be seen from FIGURES 4 and 5, the abrading head shown comprises a pair of coaxial plates between which are arranged groups of peripheral flails **31** at intervals therearound, these flails being flung outwardly by centrifugal force as the abrading head **28** rotates in use. The flails **31** are particularly suitable for decarbonising the peripheral surfaces of an ascension pipe elbow, whilst the wire brush **30** is directed axially and is primarily intended for use in cleaning the inside surface of the ascension pipe lid **7** as shown in dash-and-dot lines in FIGURE 2, but also serves for use in cleaning the interior of the ascension pipe elbow particularly around the inner bend **32**.

The decarbonising head is of substantially balanced form, the motor **22** and the adjoining parts that are on the right of the pivot **26** (as the apparatus is seen in FIGURE 4) substantially counterbalancing the abrading head

28 and the other parts of the apparatus to the left of the pivot 26.

To assist in the manipulation of the decarbonising head, a stirrup type handle 33 is provided at the motor end of the head.

As the temperature in the vicinity of an elbow 6 of an ascension pipe of a horizontal coke oven battery, at the time when decarbonising of such an elbow is likely to take place, is very high and generally in the region of 500–800° C., it is desirable not only to use suitable heat resistant materials in the construction of the parts of the decarbonising apparatus, or at least of those parts which are subjected to the highest temperatures, but also to provide cooling means for these parts of the apparatus.

Thus the bearing or bearings for the shaft 19 may be formed of sintered cast iron impregnated with molybdenum di-sulphide and the shaft itself may be made of heat resistant steel. Whilst any appropriate cooling system may be used it is convenient to provide radial vents 34 and 35 at opposite ends of the housing 15 and to provide the shaft 19 with an impeller 36 which circulates air through the housing for cooling the latter and the parts therein. This cooling may be supplemented by additional cooling air or by water or other cooling liquids.

If desired, a removable heat shield may be inserted into the ascension pipe in advance of the decarbonising apparatus to protect the parts of the latter which are inserted into such pipe.

The carriage 11 will preferably be traversed along the guide rails 12 merely by manual action on the stirrup handle 33, although power operated means could be provided for moving the carriage if desired. In any case, it is preferred to provide an interlocking arrangement between the driving mechanism of the charging car and the carriage 11 so that the charging car cannot be traversed along the roof of the coke oven battery until the carriage 11 has been withdrawn to its innermost position, i.e. the position shown at the righthand side of FIGURE 1 of the drawings. It is usual for the charging car to be propelled electrically along the roof of a coke oven battery and it is therefore convenient to include in the control circuit of such charging car a limit switch 37 which is adapted automatically to interrupt the drive to the charging car whenever the carriage 11 is moved from its innermost position shown at the right of FIGURE 1. In a simple arrangement the limit switch may be operated by a bracket 38 on the carriage 11, which co-operate with the two arms of a bell crank lever 39 forming the operating member of the limit switch 37, a horizontal portion 40 of the bracket 38 effecting the movement of the lever 39 to and from its on and off positions according to the movement of the carriage 11, as will be clear from consideration of FIGURES 1 and 2 of the drawings.

In FIGURE 6 is illustrated an alternative form of the invention in which the drive to the abrading head 28 is effected with the aid of a flexible shaft 41 which replaces or supplements the rigid shaft 19, the flexible shaft 41 passing into the interior of the arm 14'. In this case the electric driving motor 22' is conveniently carried on the charging car 3 independently of the arm 14'. Furthermore, the arm 14' is in this case slidable axially through a gimbal ring 42 diagrammatically illustrated in FIGURE 6 and supported upon a triangulated tubular outrigger arm or bracket 43 fixed to the charging car. The inner end of the arm 14' is furnished with a handle 33'.

The arm 14' is thus capable of axial movement through the gimbal ring 42 and also of being adjusted angularly in all directions.

FIGURE 7 illustrates a modification of the arrangement shown in FIGURE 6, the arm 14' being carried by a dependent bracket 43' fixed at its upper end to the charging car 3. In this arrangement the arm 14' is mounted in a bearing 44 readily detachable from the outrigger arm or bracket 43' so that the arm 14' may be readily disconnected from the bracket when desired. The motor 22'' may, if desired, be mounted on castors or rollers and rails so as to be freely traversable on the charging car as the arm 14' is moved endwise. A flexible shaft may be readily detachable from the motor.

In the modification illustrated in FIGURES 8 and 9 the arrangement is similar to that described with reference to FIGURES 1 to 5 but instead of the decarbonising head 9 being carried on a bracket 10 it is mounted on a reciprocable carriage, the head 9 being mounted in a gimbal ring 45 carried by a bracket 46 suspended from any appropriate part 47 of the charging car. The arm 14 of the decarbonising head is axially slidable through the inner ring 48 of the gimbal ring 45.

Where the abrading element is of the flail type above described and where it is of about six to eight inches in diameter, it may be arranged to rotate at between 1,500 and 2,000 revolutions per minute but, of course, the peripheral speed of the rotary abrading element will depend upon the form of this element and the type of work it is expected to perform. In using a decarbonising or cleaning apparatus according to this invention and any of the alternative embodiments of the same above described, the lid 7 of the ascension pipe to be decarbonised or cleaned is opened and the charging car 3, if not already over that oven chamber of the battery which corresponds with the said ascension pipe, is registered with the latter so as to dispose the supporting member or bracket 10, 43, 43' or 47 for the arm 14, 14', in alignment with the ascension pipe, and then the arm 14, 14' (which is so far in a retracted position, for example as indicated at the right of FIGURE 1) is advanced axially with its carriage or through its supporting bracket or member so as to introduce the rotary abrading element into the neck of the ascension pipe. The electric motor 22, 22' or 22'' is then started and the arm 14 is adjusted longitudinally and angularly as is necessary to cause the rotary abrasive element to traverse the internal surface of the elbow 6 both peripherally and along the same thereby stripping or abrading from such surface any hard deposits thereon.

It will readily be understood that the decarbonising head can be used for cleaning or decarbonising the inside surfaces of the ascension pipe lids, and to facilitate this operation it is preferred to arrange stop means such as an abutment 49 (FIGURE 2) to limit the opening movement of the ascension pipe lid, so that the latter will be presented to the abrading head in a position somewhat as indicated in FIGURE 2 of the drawings.

What is claimed:

1. Apparatus for decarbonising the interior of the elbows and necks of a row of gas ascension pipes each in a row at the top of a battery of horizontal coking chambers having a coal charging car movable over the top of the battery alongside the row of ascension pipes into position for charging the chambers of the battery severally, said apparatus comprising: a portion of said coal charging car located alongside said row of ascension pipes, a rotary abrading element, means including a rotary shaft for driving said abrading element, supporting means for supporting said shaft for movement toward and from the ascension pipes, so that the abrading element can be introduced into and withdrawn from the elbow and neck of each ascension pipe, and for movement of the shaft so that the abrading element can be moved along and around the interior surfaces of the elbows and necks when the abrading element is inserted in the ascension pipes to decarbonise the same, said supporting means being mounted on said portion of the coal charging car in a position on said portion to spot the abrading element in line with the elbows and necks of the ascension pipes for the respective oven chambers when the coal charging car is in position over the several oven chambers for charging the same, and means for preventing movement of the charging car in the direction of the length of the

coke oven battery until the decarbonising apparatus has been withdrawn to its inoperative position.

2. Apparatus for decarbonising the interior of the elbows and necks of a row of gas ascension pipes each in a row at the top of a battery of horizontal coking chambers having a coal charging car movable over the top of the battery alongside the row of ascension pipes into position for charging the chambers of the battery severally, said apparatus comprising: a portion of said coal charging car located alongside said row of ascension pipes, a rotary abrading element, means including a rotary shaft for driving said abrading element, supporting means for supporting said shaft for movement toward and from the ascension pipes, so that the abrading element can be introduced into and withdrawn from the elbow and neck of each ascension pipe, and for movement of the shaft so that the abrading element can be moved along and around the interior surfaces of the elbows and necks when the abrading element is inserted in the ascension pipes to decarbonise the same, said supporting means being mounted on said portion of the coal charging car in a position on said portion to spot the abrading element in line with the elbows and necks of the ascension pipes for the respective oven chambers when the coal charging car is in position over the several oven chambers for charging the same, said shaft being supported by bearings in a tubular arm which is furnished with longitudinally spaced ports for the circulation of air therethrough, and an impeller fan being provided on the shaft to effect circulation of cooling air.

3. Apparatus for decarbonising the interior of the elbows and necks of a row of gas ascension pipes each in a row at the top of a battery of horizontal coking chambers having a coal charging car movable over the top of the battery alongside the row of ascension pipes into position for charging the chambers of the battery severally, said apparatus comprising: a portion of said coal charging car located alongside said row of ascension pipes, a rotary abrading element, said abrading element comprising an axially directed wire brush and peripherally arranged series of flails, means including a rotary shaft for driving said abrading element, supporting means for supporting said shaft for movement toward and from the ascension pipes, so that the abrading element can be introduced into and withdrawn from the elbow and neck of each ascension pipe, and for movement of the shaft so that the abrading element can be moved along and around the interior surfaces of the elbows and necks when the abrading element is inserted in the ascension pipes to decarbonise the same, said supporting means being mounted on said portion of the coal charging car in a position on said portion to spot the abrading element in line with the elbows and necks of the ascension pipes for the respective oven chambers when the coal charging car is in position over the several oven chambers for charging the same.

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