Oct. 2, 1962 G. E. C. RANDELL ETAL 3,056,699

CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS

Filed Dec. 16, 1958 14 Sheets-Sheet 1

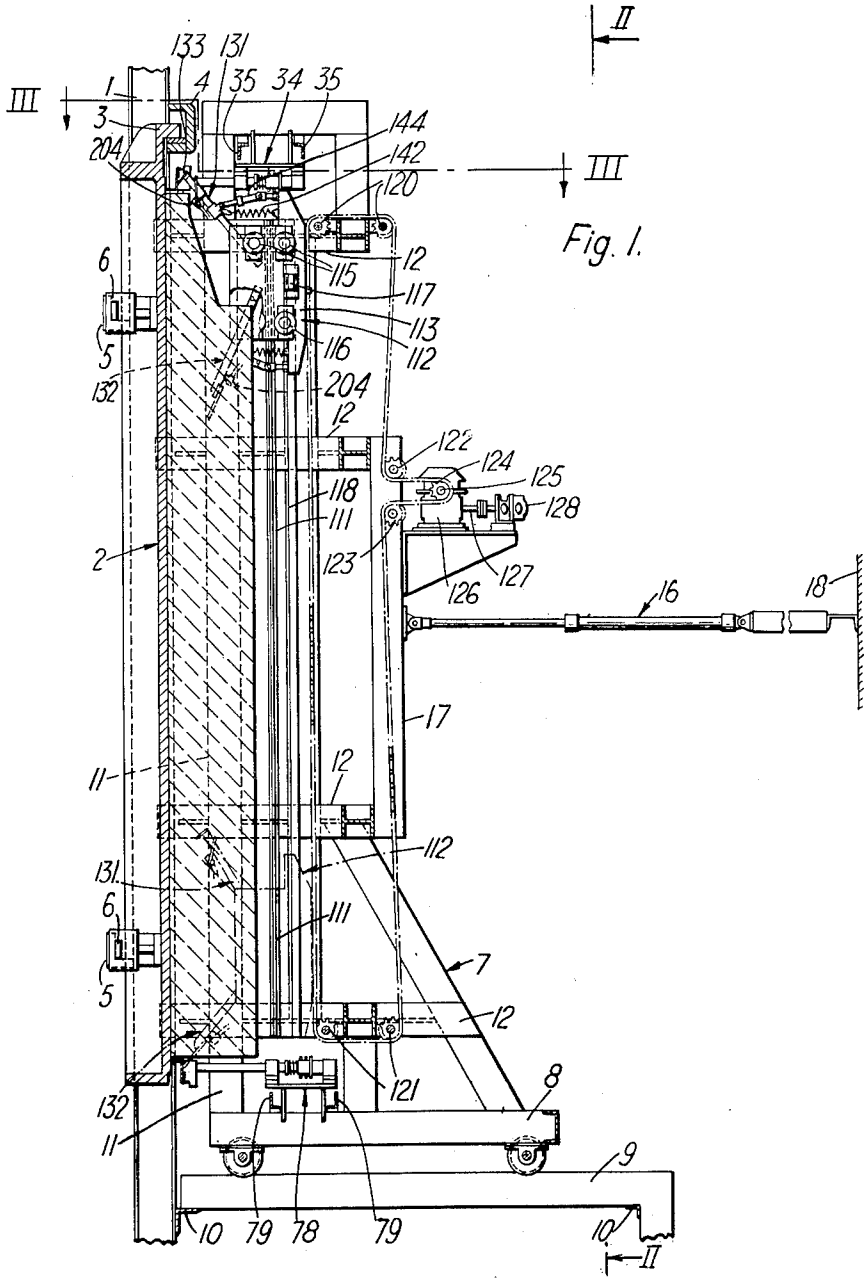


Fig. 1.

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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 2.

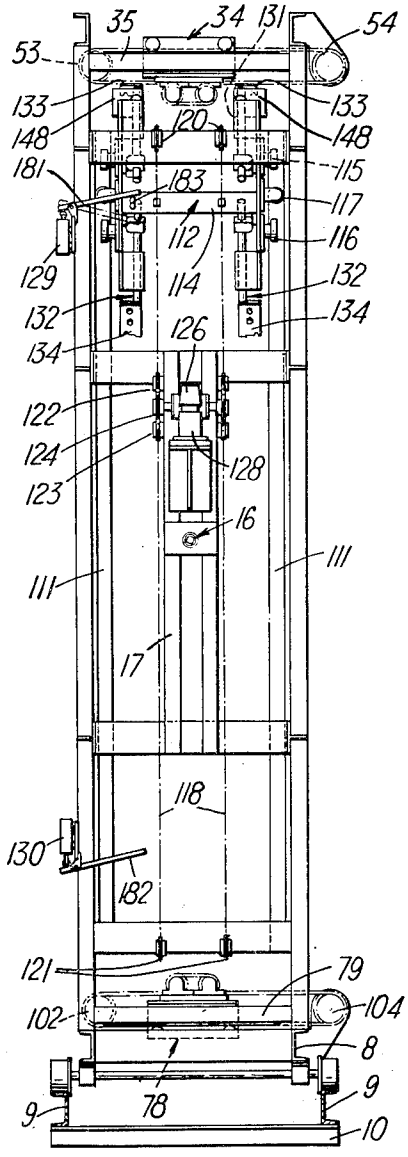
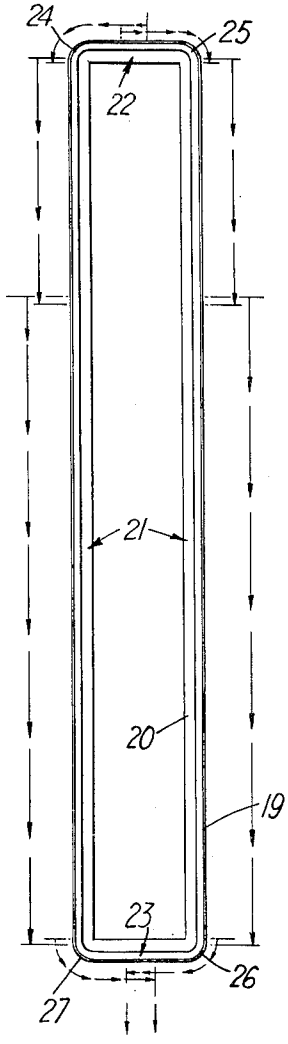
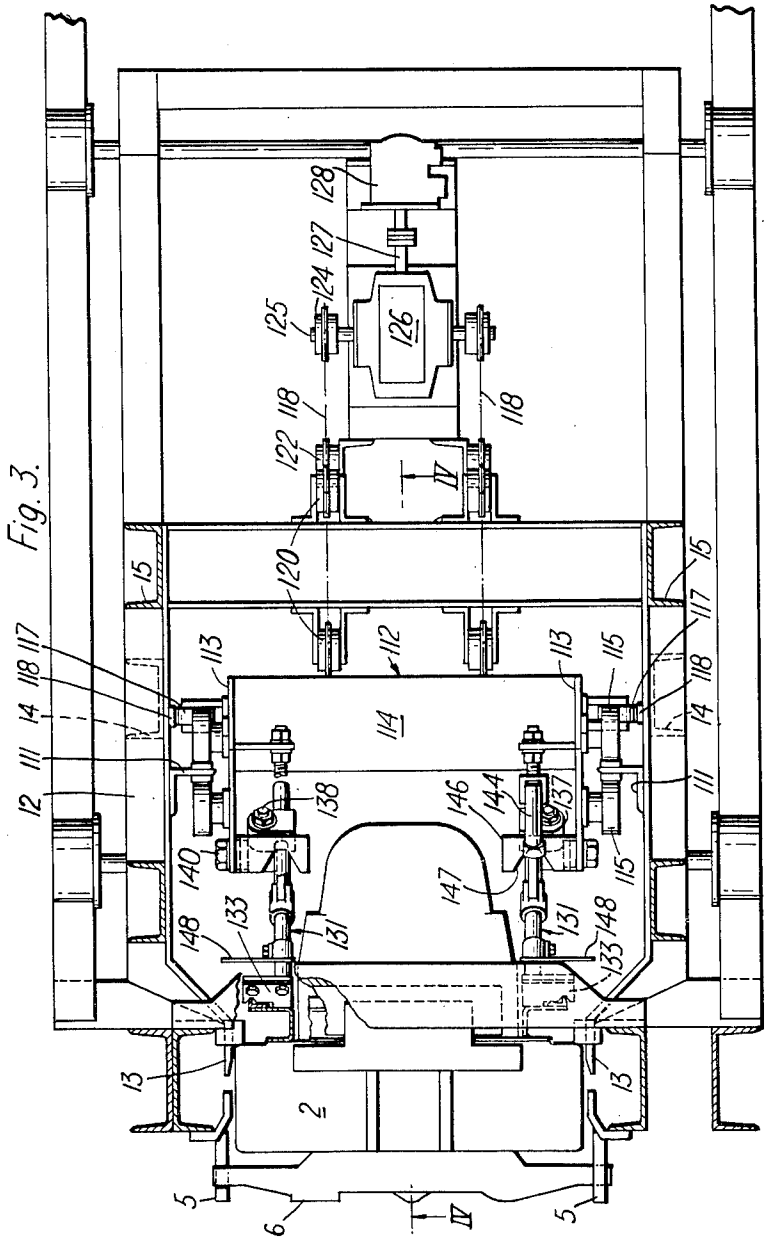


Fig. 15.



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 3.



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 4.

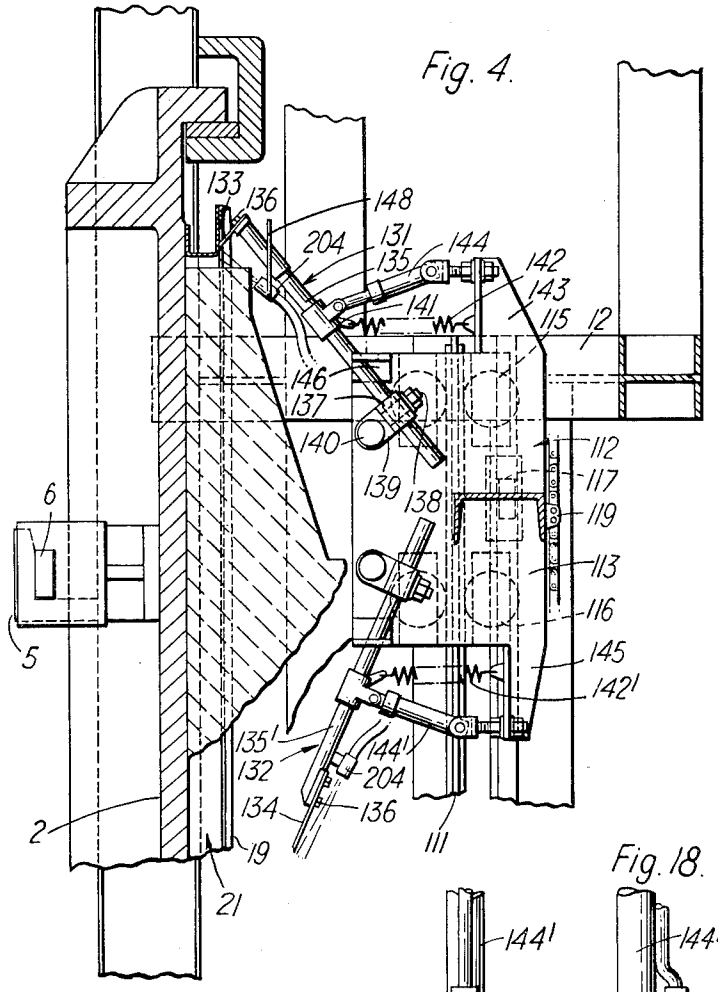


Fig. 18.

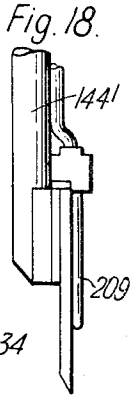
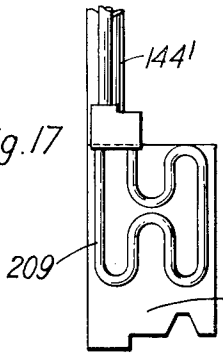


Fig. 17



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 6.

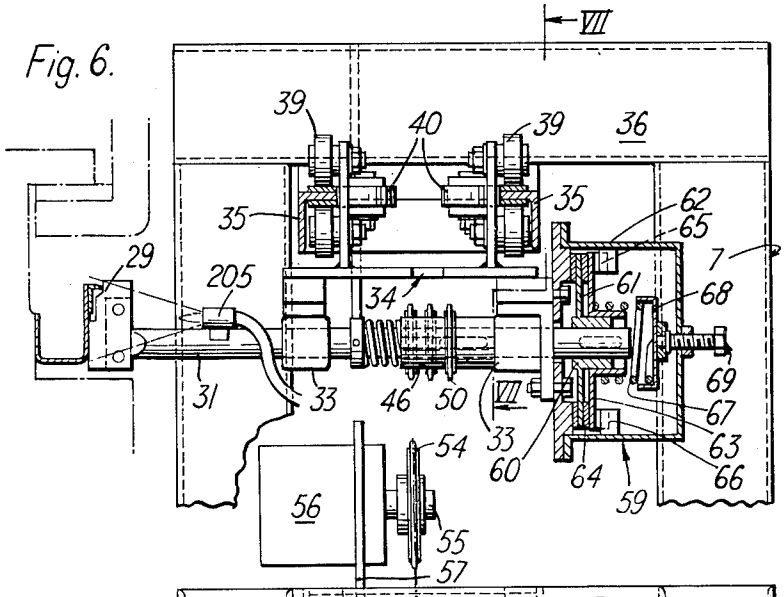
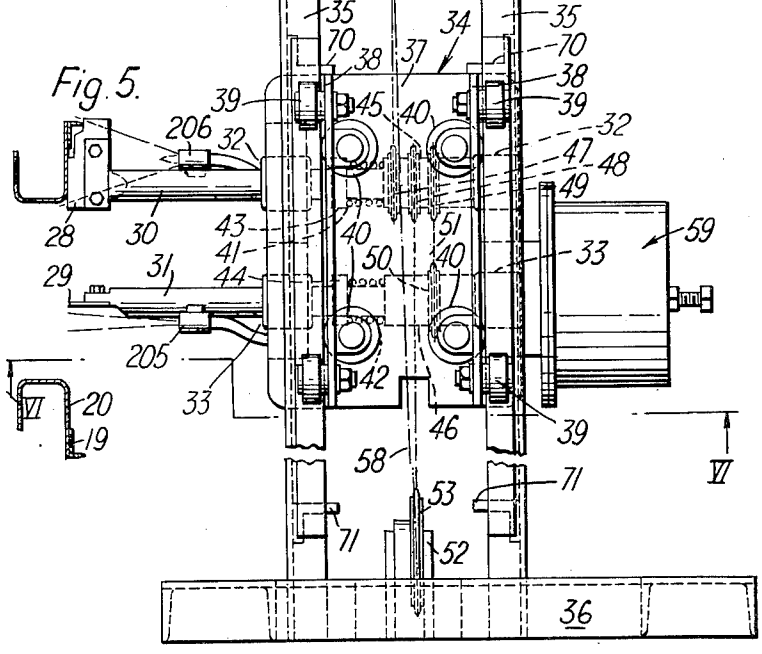


Fig. 5.



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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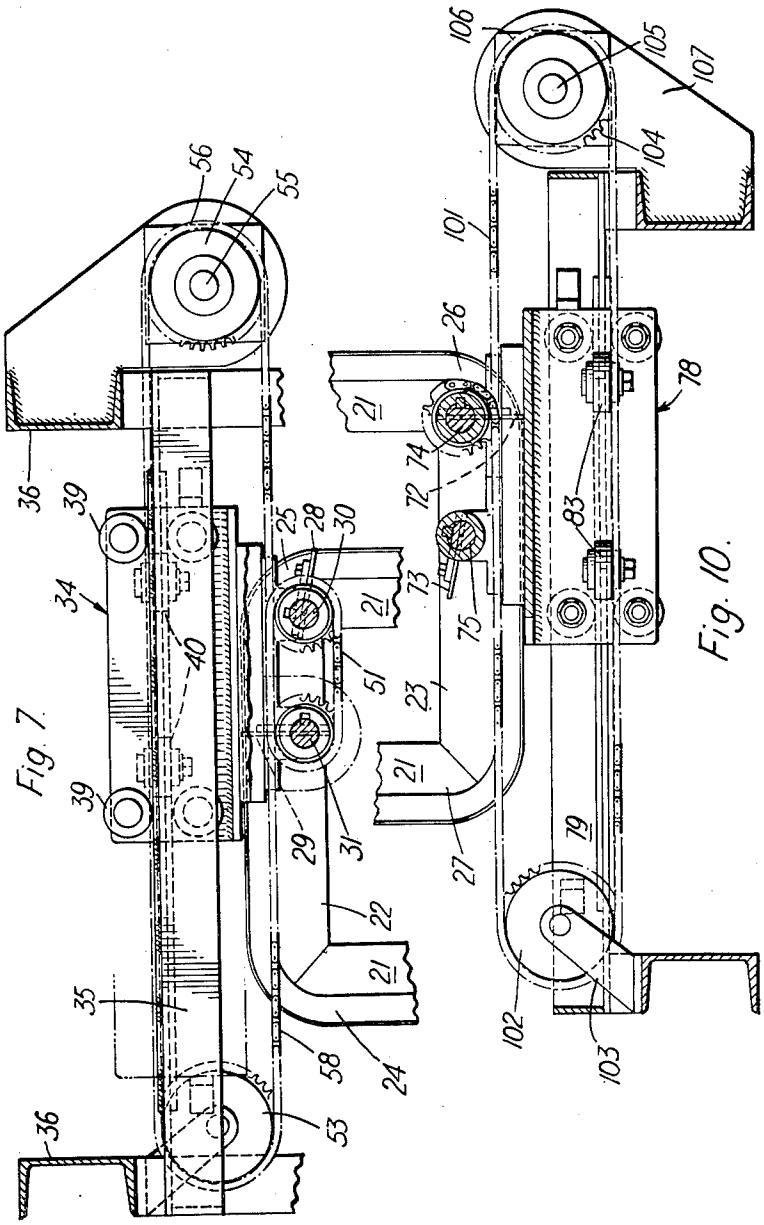


Fig. 7

Fig. 10.

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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 9.

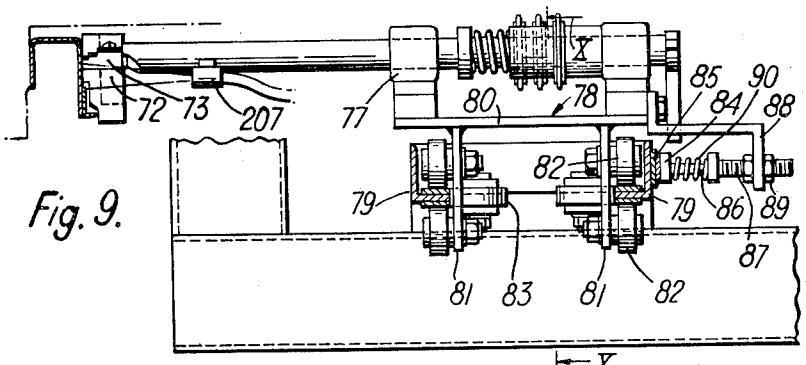
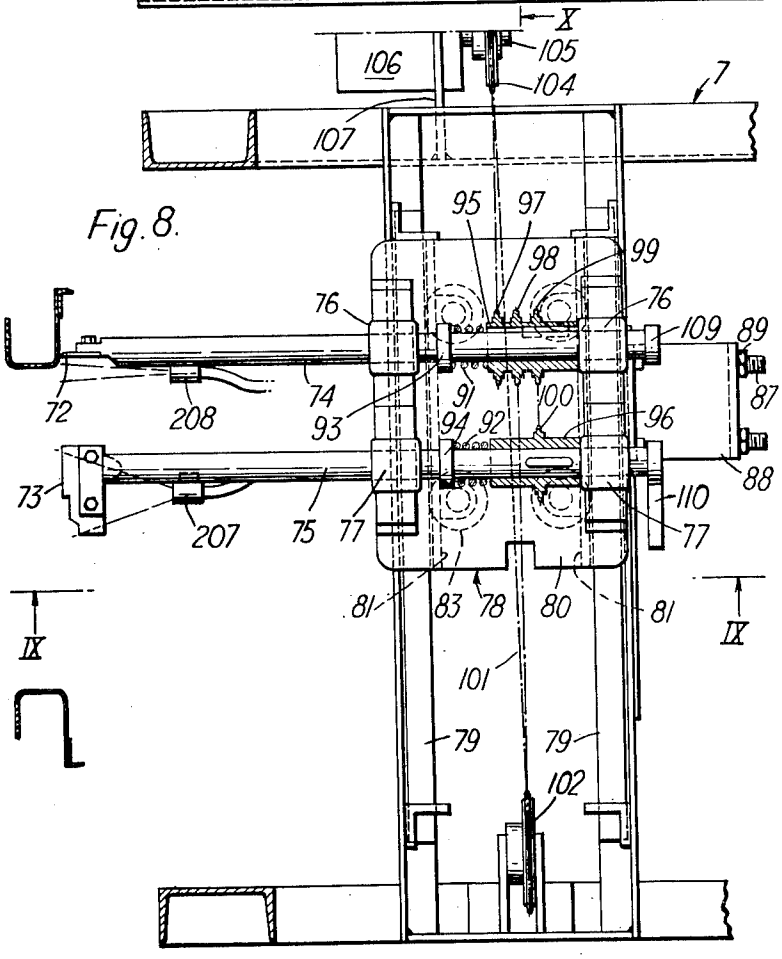


Fig. 8.



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 11.

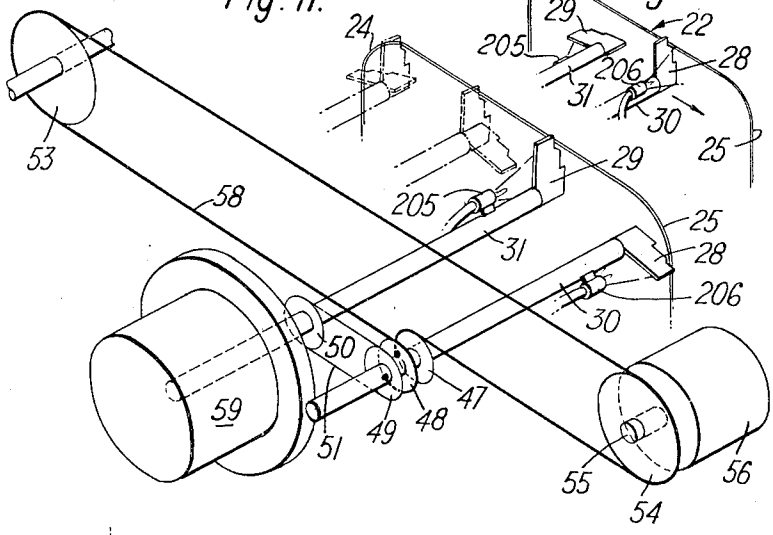


Fig. 12.

Fig. 14.

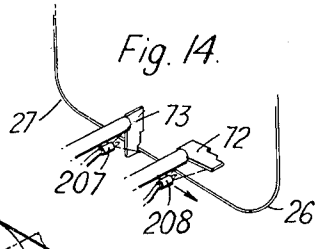
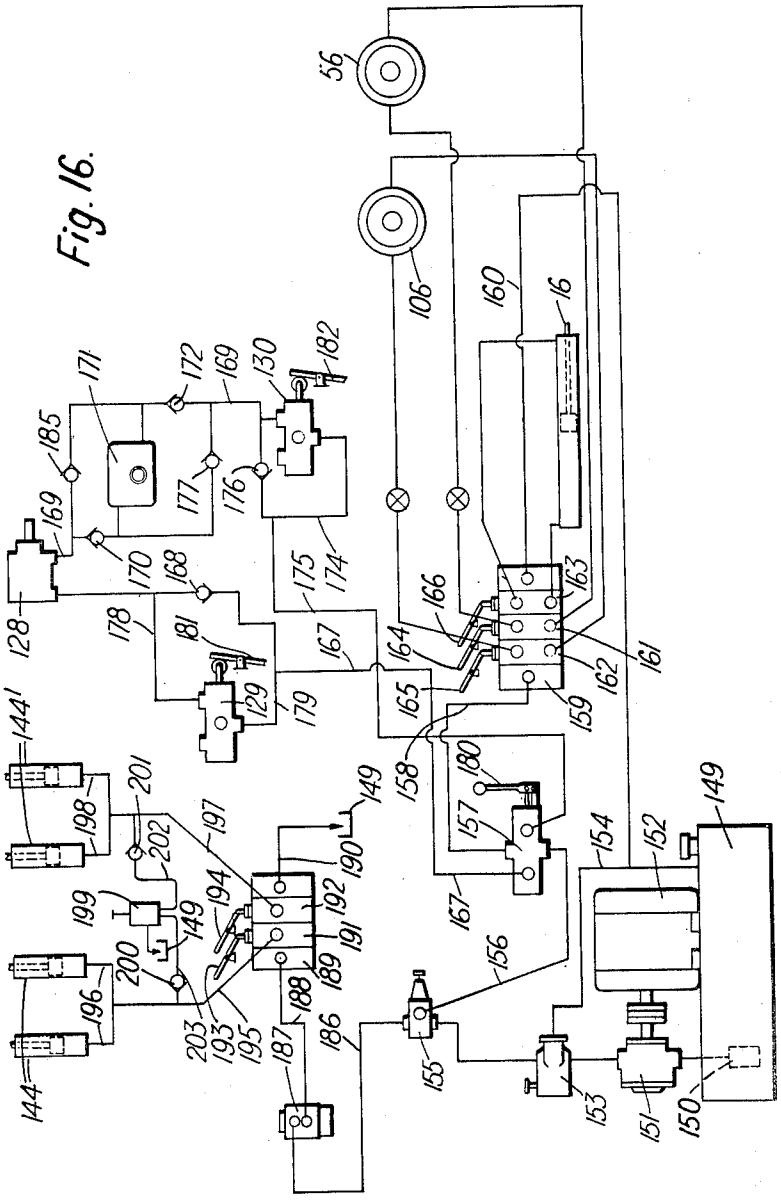


Fig. 13.

Fig. 16.


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Fig. 19.

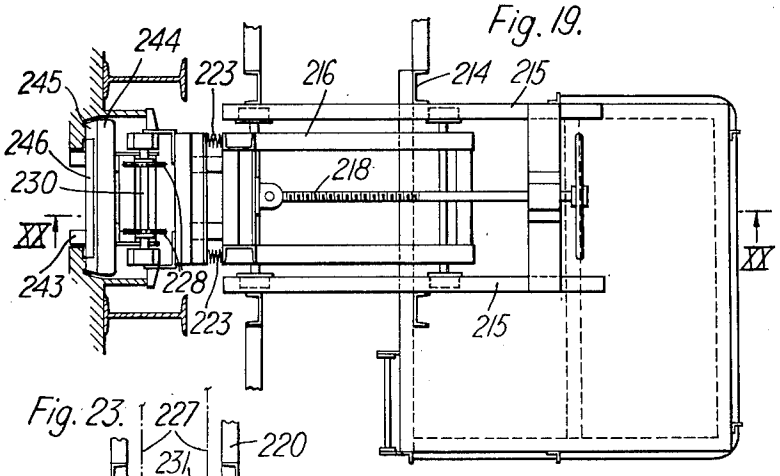


Fig. 23.

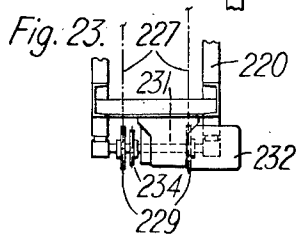
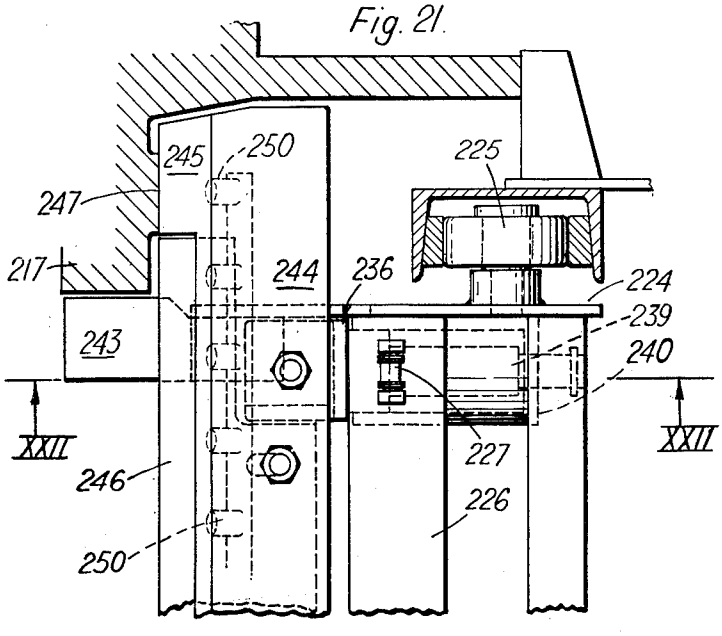


Fig. 21.



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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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Fig. 20.

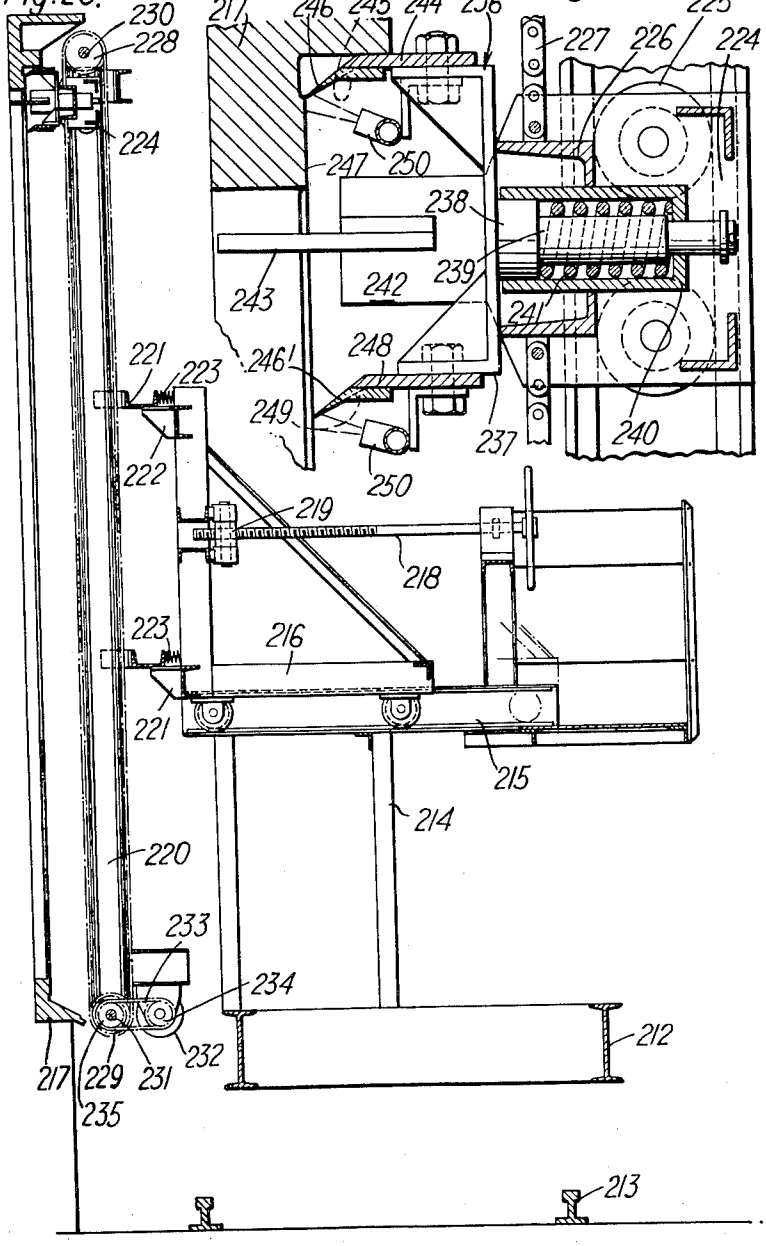


Fig. 22.

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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS
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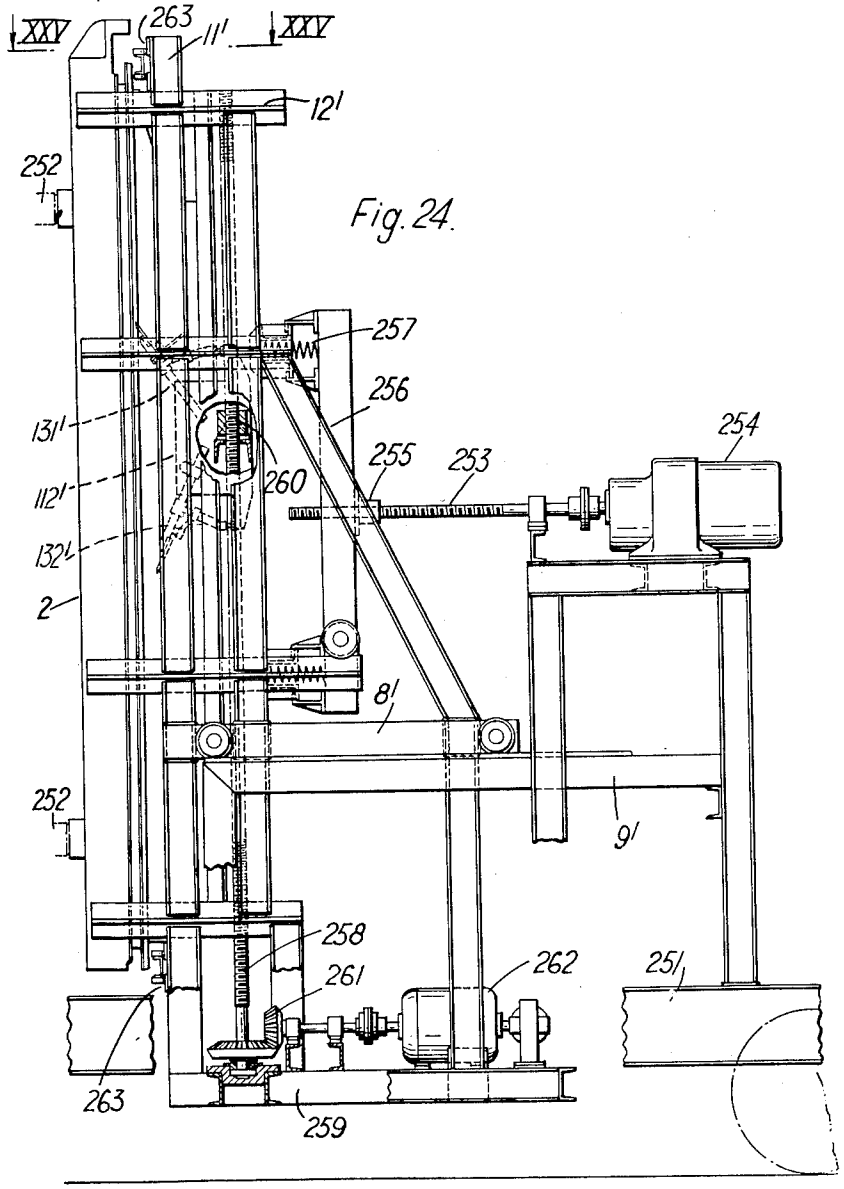


Fig. 24.

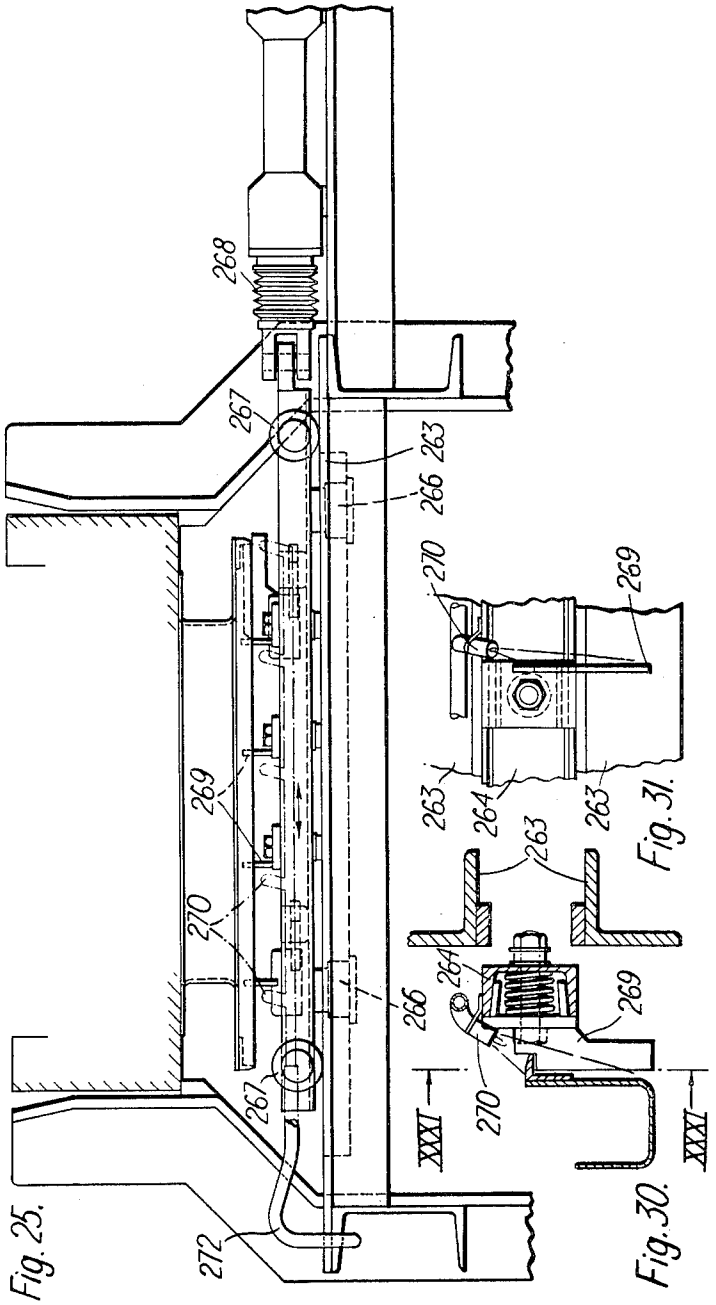


Fig. 25.

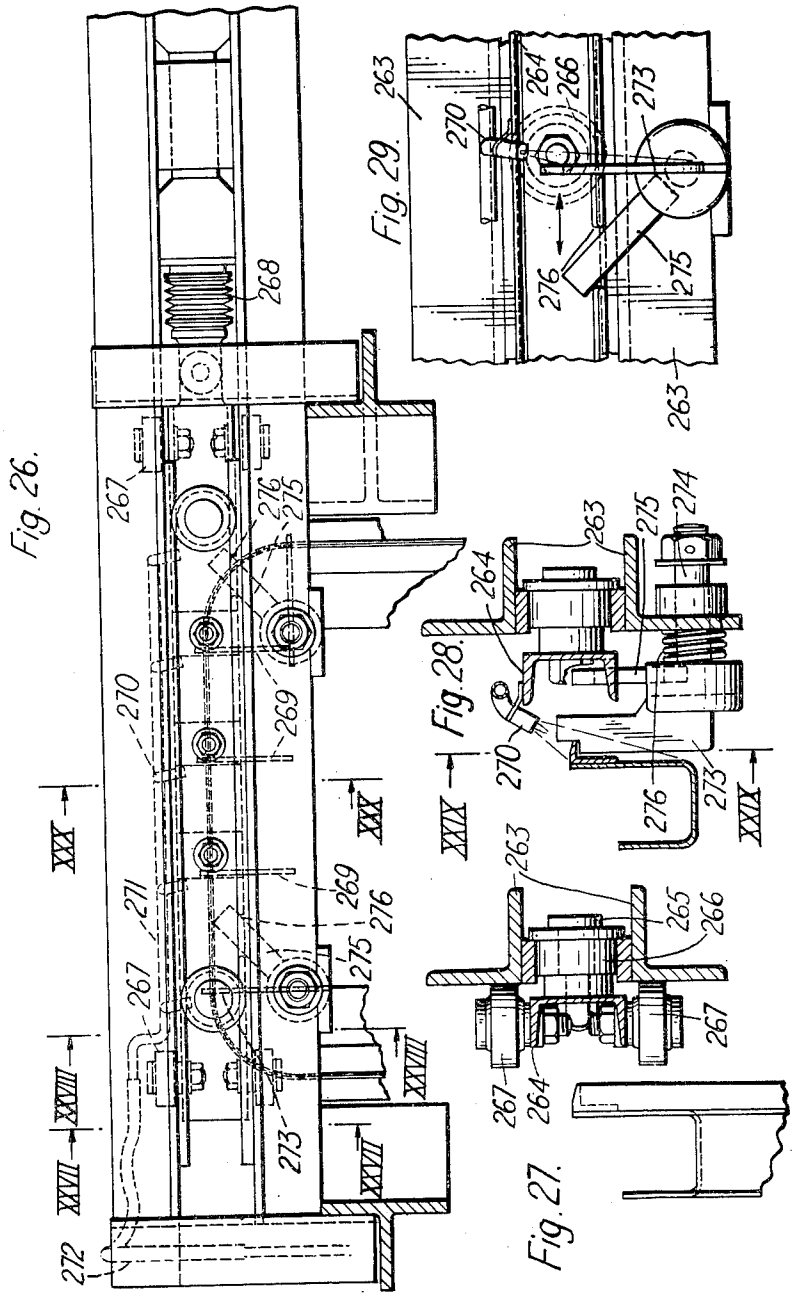
Fig. 31.

Fig. 30.

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CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS

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United States Patent Office

3,056,699
Patented Oct. 2, 1962

3,056,699

CLEANING OF SEALING SURFACES OF DOORS AND DOOR FRAMES OF HORIZONTAL COKE OVENS

Geoffrey Edward Charles Randell, Herbert Milton Whitworth, and Jack Holme, all of London, England, assignors to Woodall-Duckham Construction Company Limited, London, England, a British company

Filed Dec. 16, 1958, Ser. No. 780,782
19 Claims. (Cl. 134—5)

This invention concerns a new or improved method of and apparatus for cleaning the sealing surfaces of the doors and door frames of horizontal coke ovens, especially where the doors are of the so-called "self-sealing" type.

Self-sealing doors for coke ovens have a sealing strip extending therearound and presenting a knife edge to the door frame for sealing therewith. Desirably the sealing strip is resiliently mounted on the door and frequently is furnished along one edge of, or forms part of, a carrier member of angular, approximately U-shaped, or Z-shaped cross-section secured to the door, such sealing strip and carrier member comprising parallel vertical or side portions and horizontal top and bottom portions connected by corner portions to the said vertical or side portions.

It is well known that the effectiveness of the seal made between a self-sealing coke oven door and its frame depends upon the sealing surfaces located between them being initially clean and that, because of the formation of deposits (which are largely of a pitchy nature) on the sealing surfaces, it is necessary periodically to clean these surfaces. This cleaning is at present performed manually and is tedious and arduous work and work which is not easy efficiently to perform because of the prevailing heat conditions in the vicinity of a coke oven door frame.

Various proposals have been made in the past for mechanically effecting the cleaning of the sealing surfaces of coke oven doors and frames for such doors but, as far as we are aware, these proposals have not met with success and have not been generally adopted in the coke oven industry.

An object of this invention is, therefore, to provide a new or improved method of and apparatus for mechanically cleaning the sealing surfaces of coke oven doors and frames for such doors.

We have found that when a coke oven door is removed from its oven end, the pitchy substances that have been deposited upon the sealing surfaces of the door and door frame quickly solidify. Moreover, the deposits on the sealing surfaces of the door itself solidify more quickly than those on the door frame at the end of the oven, and this is particularly true in the case of self-sealing doors where the door sealing surfaces are in the form of resiliently mounted metal sealing strips as above explained, these sealing strips losing the greater part of their heat quite rapidly once the door is removed from its frame and away from the oven.

As a result of considerable research we have discovered that the cleaning of the sealing surfaces of coke oven doors and door frames can be effected mechanically considerably more efficiently than hitherto by applying heat to the surfaces to be cleaned immediately before and/or simultaneously with the exertion of a mechanical scraping action thereon.

Thus according to one aspect of this invention there is provided a method of cleaning the sealing surfaces of the doors of horizontal coke ovens and/or the co-operating sealing surfaces of the door frames, such method comprising heating the deposits on the surfaces to be cleaned and immediately thereafter and/or simultaneously therewith removing the softened deposits by mechanically operated scraper means.

According to a further aspect of this invention there is provided apparatus for cleaning the sealing surfaces of the doors of coke ovens and/or the cooperating sealing surfaces of the door frames, such apparatus comprising mechanically operated scraper means adapted to be traversed over the surfaces to be cleaned, and means for heating the deposits on such surfaces immediately before and/or simultaneously with the scraping operation.

It is also very desirable to avoid the necessity of subsequently cleaning the said mechanically operated scraper means and, according to a further feature of the invention, these devices are themselves heated so that the material removed from the sealing surfaces of the oven door and door frame automatically wholly or largely fall from the said scraper means, leaving the latter substantially clean.

The requisite heat may be applied directly to the surfaces to be cleaned and/or indirectly thereto by heating the scraper blades. Even if heat is applied directly to the surfaces to be cleaned it is also desirable to apply heat to the scraper blades since this aids or reduces as above explained, the necessity for cleaning the scrapers themselves after a sealing surface cleaning operation.

It should be understood that in referring to the application of heat to the surfaces to be cleaned, it is intended to convey that heat extraneous or supplementary to that initially possessed by the surfaces to be cleaned is applied to the latter.

The application of the extraneous heat may be effected by flames directed on to the deposits on the sealing surfaces or on to the scraper blades or by a combination of both these methods. In any case, in order to effect the self-cleaning of the scrapers themselves, these should preferably be maintained at a temperature sufficiently high to ensure that the pitchy deposits removed from the sealing surfaces will not continue to adhere to the scrapers but will be deposited by the latter as they perform their scraping operations.

The heating may conveniently be achieved by means of aerated gas flames and the gas used may be coal gas, propane, butane, or any other appropriate gas.

Although it is preferred to use a gas flame for applying the required extraneous heat, other means may be employed for this purpose. For example jets of hot gases could be used or the scrapers may be electrically heated and/or electrical heat radiating devices may be provided and arranged to travel with or precede the scraper blades, such electric heating means being used either separately or in conjunction with gas flames and/or jets of hot gases.

The invention also resides in the mechanical sealing surface cleaning apparatus itself: thus according to a further aspect of the invention there is provided apparatus for mechanically cleaning the sealing surfaces of the doors of horizontal coke ovens and/or the frames for receiving such doors, such apparatus comprising scraper means for scraping the horizontal and vertical or side portions of the said sealing surfaces, a supporting structure carrying said scraper means and adapted for arrangement adjacent to the sealing surfaces to be cleaned thereby to position said scraper means with respect to said sealing surfaces, and means for mechanically propelling such scraper means over the sealing surfaces to be cleaned thereby in such manner that the scraping is always performed in a direction having no upward component.

According to a further aspect of the invention there is provided apparatus for mechanically cleaning the sealing surfaces of the doors of horizontal coke ovens and/or the frames for receiving such doors, such apparatus compris-

ing scrapers respectively for cleaning the horizontal top, the horizontal bottom and the vertical or side portions of said sealing surfaces, a supporting structure on which said scrapers are mounted and adapted for arrangement adjacent to the said sealing surfaces thereby to position the scrapers with respect to the latter, means for traversing the said scrapers relatively to the said supporting structure and over the said sealing surfaces in such manner that their scraping actions are always exercised in a direction not opposed to that in which gravity acts on the deposits being removed from the sealing surfaces by the scrapers.

According to another aspect of the invention there is provided apparatus for mechanically cleaning the sealing surfaces of self-sealing doors for horizontal coke ovens and of the door frames for receiving such doors, such apparatus comprising a supporting structure adapted for arrangement adjacent to the sealing surfaces to be cleaned, a plurality of scrapers carried by the said supporting structure and movable relatively thereto for cleaning the said sealing surfaces, and means for mechanically moving said scrapers over the surfaces to be cleaned including turning selected scrapers around the corner portions of the said sealing surfaces located between the vertical or side and top and bottom portions respectively of such surfaces, thereby to clean said corner portions.

In accordance with a further aspect of the invention there is provided apparatus for mechanically cleaning the sealing surfaces of a self-sealing door for a horizontal coke oven and of the frame for receiving such door, such apparatus comprising a supporting structure, at least two horizontally reciprocable scrapers carried by said structure, means for reciprocating said scrapers relatively to such structure so that each scraper cleans at least a part of a horizontal portion of said sealing surfaces and for causing such scrapers respectively to sweep, at opposite ends of the travel of the scrapers, around one corner of the said sealing surfaces at a junction between the horizontal and vertical portions of the latter.

According to yet another aspect of the invention there is provided apparatus for mechanically cleaning the sealing surfaces of self-sealing doors for horizontal coke ovens and of the door frames for receiving such doors, such apparatus comprising scrapers for respectively cleaning the horizontal top, the horizontal bottom and the vertical or side portions of the said sealing surfaces, a supporting structure adapted for location adjacent the sealing surfaces to be cleaned and on which structure the said scrapers are all mounted for traversal over their respective top, bottom and vertical or side portions of said sealing surfaces, means for traversing said scrapers over said sealing surfaces and for turning selected scrapers around the corner portions of the said sealing surfaces which lie between the said horizontal and vertical or side portions thereof.

Desirably the scrapers for cleaning the horizontal top, the horizontal bottom and the vertical or side portions of the said sealing surfaces are mounted on individual carriages individually reciprocable on said supporting structure respectively in horizontal and vertical directions, power means being provided for effecting such reciprocation.

In a preferred arrangement each horizontally reciprocable carriage has a pair of laterally spaced horizontal scraper shafts arranged at right angles to the path of travel of their carriage, each of said shafts being provided at its forward part with a scraper blade, and means being provided whereby, at each end of each stroke of said carriage, one of said shafts is adapted to lie in the angle of a corner between a horizontal and a vertical portion of said sealing surfaces and whereby that shaft is automatically rotated through an angle of about 90° to cause its scraper blade to sweep around and clean the said corner of the sealing surfaces.

In accordance with a further feature of the invention each horizontally reciprocable carriage is independently traversed by its own power unit which serves also to rotate said scraper shafts, and means are also provided to arrest the carriage at the end of each of its strokes and to prevent rotation of said scraper shafts while the carriage is travelling but which permit them to be rotated by said power unit when the carriage is stationary at the end of any of its strokes.

Conveniently in the case of the carriage bearing the scrapers for cleaning the upper horizontal portion of the said sealing surfaces a friction clutch is provided to prevent rotation of said scraper shafts whilst their carriage is travelling but which permits such shafts to rotate when the carriage is arrested at the end of any of its strokes.

Advantageously in the case of the carriage bearing the scrapers for cleaning the lower horizontal portion of the said sealing surfaces, a friction brake is provided which is adapted to prevent movement of the carriage from either of its end positions until after that scraper shaft which carries the scraper blade for cleaning around the corner at that end of the horizontal portion of the said sealing surfaces at which the carriage is located, has been rotated to effect the cleaning of said corner but which friction brake is adapted then to release the carriage for horizontal travel.

Each of the scrapers for cleaning the said upper horizontal portion of the said sealing surfaces is adapted to scrape such portion in a horizontal direction outwardly from an intermediate position towards a corner portion of such sealing surfaces and then to sweep outwardly and downwardly around such corner, whilst each of the scrapers for cleaning the said lower horizontal portion of the said sealing surfaces is adapted to scrape first downwardly and then inwardly around a corner at one end of such portion and then horizontally inwardly to an intermediate position in such portion.

In an alternative arrangement, instead of the same scrapers being used for cleaning rectilinear portions of the said sealing surfaces and for traversing around and cleaning the corner portions of these surfaces, a separate scraper may be provided for cleaning each corner portion of said sealing surfaces.

According to a further feature of the invention at least two vertically traversable scrapers may be provided for cleaning each of the said vertical or side sealing surfaces, said two scrapers being arranged one above the other and one being adapted to commence downward scraping at the top of the vertical or side sealing surface and the other to commence scraping at an intermediate position down said sealing surface and to continue to the bottom of the latter, such scrapers being presented obliquely to the surface being cleaned and so as to propel the deposits encountered thereby in a downward direction.

Conveniently the said vertically traversable scrapers may be carried by at least one vertically reciprocal side scraper carriage mounted on said supporting structure, means being provided for selectively propelling the said carriage alternately downwardly and upwardly on said supporting structure, for yieldingly holding said scrapers in their scraping positions during their respective scraping operations, and for retracting such scrapers before any upward movement of said carriage occurs.

Desirably the paths scraped by the said side scrapers overlap the paths scraped by the scrapers serving to clean the said corner portions of the sealing surfaces.

Further features of the invention will become apparent from the following description and the appended claims.

In order that this invention may be more readily understood and carried into practice and further features of the same appreciated, certain embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a vertical section through an apparatus

constructed in accordance with this invention for cleaning the sealing and adjoining surfaces (hereinafter referred to as the "sealing surfaces") of a self-sealing coke oven door, the figure showing a door supported in a door rack with the sealing surface cleaning apparatus in position to clean the sealing surfaces of the door;

FIGURE 2 is a section on line II—II, FIGURE 1, the door and door rack being omitted from this figure for the sake of clarity;

FIGURE 3 is a section on line III—III, FIGURE 1, drawn to a larger scale than FIGURE 1;

FIGURE 4 is a section on line IV—IV, FIGURE 3;

FIGURE 5 is a horizontal sectional plan view of the scraper mechanism for cleaning the top horizontally disposed sealing surfaces of the door and the corners of the latter surfaces at the upper end of the door;

FIGURE 6 is a section on line VI—VI, FIGURE 5;

FIGURE 7 is a section on line VII—VII, FIGURE 6;

FIGURE 8 is a sectional plan view of the scraper mechanism for cleaning the bottom horizontally disposed sealing surfaces of the door and the corners of the latter surfaces at the lower end of the door;

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

FIGURE 10 is a section on line X—X, FIGURE 9;

FIGURES 11 and 12 are diagrammatic perspective views illustrating the method of operation of the scraper mechanism for the top sealing surfaces of the door and the adjoining arcuate corners of such sealing surfaces;

FIGURES 13 and 14 are diagrammatic perspective views illustrating the method of operation of the scraper mechanism for the bottom sealing surfaces of the door and the adjoining corners of such sealing surfaces;

FIGURE 15 is a diagrammatic view illustrating how, with apparatus illustrated in FIGURES 1 to 14, the deposits removed from the door sealing surfaces are removed from the latter in directions never opposed to, but mainly assisted by, the force of gravity;

FIGURE 16 is a diagrammatic view of the hydraulic circuit of the apparatus shown in FIGURES 1 to 14;

FIGURE 17 is a rear elevation of a scraper blade furnished with electric heating means;

FIGURE 18 is a side elevation of the same;

FIGURE 19 is a sectional plan view of an apparatus for mechanically cleaning the sealing surfaces of a door frame of a coke oven battery;

FIGURE 20 is a section on line XX—XX, FIGURE 19;

FIGURE 21 is an enlarged fragmentary horizontal sectional plan of the scrapers of the apparatus shown in FIGURES 19 and 20;

FIGURE 22 is a section on line XXII—XXII, FIGURE 21;

FIGURE 23 is a fragmentary side elevation showing the drive for the scraper carriage of the apparatus illustrated in FIGURES 19 to 22.

FIGURE 24 is a part vertical sectional and part fragmentary side elevation of a modified form of apparatus constructed in accordance with this invention for cleaning the sealing surfaces of a self-sealing door for a horizontal coke oven;

FIGURE 25 is a section on line XXV—XXV, FIGURE 24, drawn to an enlarged scale;

FIGURE 26 is a front elevation, drawn to the same scale as FIGURE 25, of the upper part of the apparatus shown in FIGURE 24 showing in particular the means for scraping the upper horizontal portions and radiused corners of the sealing surfaces of the door;

FIGURE 27 is a section on line XXVII—XXVII, FIGURE 26;

FIGURE 28 is a section on line XXVIII—XXVIII, FIGURE 26;

FIGURE 29 is a section on line XXIX—XXIX, FIGURE 28;

FIGURE 30 is a section on line XXX—XXX, FIGURE 26; and

FIGURE 31 is a section on line XXXI—XXXI, FIGURE 30.

The oven door sealing surface cleaning apparatus hereinafter described with reference to FIGURES 1 to 16 is designed first to clean the upper horizontal and corner sealing surfaces of the door from approximately the centre of the upper horizontal surface outwardly, then to clean the side or vertical sealing surfaces in a downward direction and finally to clean the lower corner and horizontal sealing surfaces commencing at the corners and working inwardly.

The apparatus shown in FIGURES 19 to 24 inclusive is intended for cleaning the sealing surfaces of the door frame at the end of a coke oven and into which a self-sealing door is intended to fit, whilst the arrangement described with reference to FIGURES 24 to 31 for cleaning the sealing surfaces of a self-sealing door differs in some respects from that shown in FIGURES 1 to 16; nevertheless in each case means are preferably provided for applying extraneous or supplementary heat to the surfaces to be heated and to the scrapers themselves.

Referring to FIGURE 1 of the drawings it will be seen that apparatus of the invention is there shown in use in conjunction with a door holding rack **1** such as is provided at the present time in horizontal coke oven batteries, usually at one end of the battery, the door being carried by a door handling machine to the end of the battery and mounted in this rack for subsequent cleaning.

The door sealing surface cleaning apparatus according to this invention may, however, alternatively be mounted upon a door extracting machine or on a coke guide machine or pusher machine including a door extracting mechanism as described in our application Serial No. 780,799, executed of even date, now Patent 2,986,758.

As will be seen from FIGURE 1, a coke oven door **2** is supported in the rack **1** by engaging the usual lip **3** of the door upon a transverse member **4** of the rack, the door being secured to the rack by engaging the latch bars **6** of the door with latch hooks **5** on the rack.

The door sealing surface cleaning apparatus is, in the embodiment being described, included in a machine **7** movable to and from the rack **1** in a direction at right angles to the vertical plane containing this rack, the machine comprising a carriage **8** mounted on rails **9** projecting perpendicularly from the rack **1** and suitably supported on cross bearers **10**.

At the front thereof the carriage **8** supports, in a vertical plane, an oblong frame **11** (see FIGURES 1 and 2 in particular). Upon this oblong frame are fixed at vertically spaced intervals four horizontally disposed door-locating yokes **12**, the front end portions **13** (see FIGURE 3) of whose arms are cranked inwardly to receive the door **2** between them and centralise it in the frame **11**. The yokes **12** are additionally supported by vertical members **14** and **15** forming part of the framework of the machine **7** and mounted on the carriage **8**. Conveniently the frame **11** and the other parts of the framework of the machine **7** is fabricated from profiled section metal and is furnished with appropriate reinforcing members and struts which need not be described in detail.

The machine **7** is adjustable as a whole along its rails **9** by a double acting hydraulic ram and cylinder assembly **16** of which the ram is secured to an outrigger **17** of the machine framework whilst the cylinder is connected to any suitable rigid structure **18** (FIGURE 1) relative to which the machine **7** may move, hydraulic pressure fluid being supplied from a suitable source under the control of an operator to advance or retract the carriage **8** towards or away from the door rack **1** as will hereinafter be described. It will, of course, be clear that alternative mechanism may be used for advancing and retracting the carriage **8** with respect to the rack **1** as, for example, a screw and nut arrangement. It will also be appreciated that it would be possible to have the machine **7** stationary

and to arrange for the rack 1 to be moved towards or away from the machine or for both the machine and the rack to be mutually adjusted towards or away from one another.

In the oven door 2 illustrated in the drawings the sealing strip 19 (see FIGURES 3, 4, 5 and 15, for example) is of angular cross-section and is rigidly carried by a slightly resilient carrier member 20 of U-shaped cross-section so that the sealing strip 19 is capable of a slight degree of yielding when applied to the frame of the end of a coke oven designed to receive the door. The sealing strip 19 and carrier member 20 are together in the form of an elongated oblong frame as is very clearly seen in FIGURE 15, comprising vertical parallel side portions 21 and top and bottom horizontal portions 22 and 23, the latter being united with the side portions by corner portions 24, 25, 26 and 27 hereinafter generally referred to as "corners" or "arcuate corners."

The mechanism for cleaning the top horizontal and corner sealing surfaces 22, 24 and 25 in the manner above referred to is shown in FIGURES 5, 6 and 7 of the drawings and comprises a pair of similar scraper blades 28 and 29 having their forward edges contoured as seen in FIGURE 5 and respectively fixed replaceably upon the front ends of horizontally arranged scraper shafts marked 30 and 31 respectively.

The scraper blades 28 and 29 extend radially from the front ends of their shafts 30 and 31 and these shafts are journalled respectively in bearings 32 and 33 depending from the underside of a top scraper carriage 34 reciprocable on a pair of parallel horizontally disposed rails 35 suspended from a superstructure 36 at the top of the framework of the machine 7 and arranged immediately behind the oblong frame 11.

The shafts 30 and 31 are arranged with their axes in the same horizontal plane but are spaced apart along the carriage 34 which comprises a substantially rectangular plate 37 furnished with a pair of longitudinally extending parallel upstanding webs 38 located between the guide rails 35 and carrying at each end thereof a pair of superposed rollers 39 rotatable on horizontal axes and between the rollers of each pair of which inwardly directed flanges of the rails 35 are received. Movement of the carriage 34 transversely of the rails 10 is avoided by the provision on the carriage of rollers 40 which bear on the inner edges of the inwardly extending flanges of the rail 35.

The shafts 30 and 31 are capable of a limited degree of sliding axial movement in their journals 32, 33 and are urged forwardly to press the scrapers 28 and 29 into engagement with the sealing surfaces to be scraped, by means of helical springs 41 and 42 respectively arranged around the said shafts and engaging, at their front ends, against collars 43 and 44 fixed upon the shafts and, at their rear ends, against sleeves 45 and 46 respectively keyed to the shafts 30 and 31 so that the latter must rotate with the sleeves although the shafts are capable of sliding movement through the sleeves.

On the sleeve 45 on the horizontal scraper shaft 30 are fixed or formed three similar chain sprocket wheels 47, 48 and 49 arranged at axially spaced intervals along the sleeve.

The sleeve 46 on the other scraper shaft 31 is provided with a single sprocket wheel 50 which is aligned with the rear sprocket 49 on the sleeve 45 on the scraper shaft 30 and an endless chain 51 passes over these two aligned sprocket wheels so that the two shafts 30 and 31 may not rotate independently but always turn in unison.

Between the said top scraper carriage guide rails 35, and at one end thereof, is provided a bracket 52 in which a guide sprocket wheel 53 is mounted for free rotation about a horizontal axis perpendicular to the guide rails, this sprocket wheel being aligned with the central sprocket wheel 48 on the sleeve 45. A further driving, sprocket wheel 54, aligned with the front sprocket wheel 47 on the sleeve 45, is fixed upon the driving shaft 55 of a hydraulic torque motor 56 carried in a bracket 57 rigidly mounted on the outside of the superstructure 36, the motor 56 being located to the right-hand side of the said oblong frame 11 viewing machine 7 from the rear.

To the centre sprocket 48 on the sleeve 45 on the scraper shaft 30 is fixed one end of a roller chain 58 which passes partially round this sprocket (as will be clearly seen from FIGURE 11) in an anti-clockwise direction (as seen from the rear) and over the top of the same and then extends substantially centrally below the guide rails 35, over the freely rotatable guide sprocket 53 and then slightly diagonally over the top of the top scraper carriage and then around the driving sprocket 54 on the driving shaft 55 on the torque motor 56 after which the chain 58 again passes below the top scraper carriage and then in an anti-clockwise direction (seen from the rear) over and partially around the front sprocket 47 on the scraper shaft 30, this end of the chain being secured to this sprocket. Thus any rotation of the driving sprocket 54 tends to rotate the front and centre sprockets 47 and 48 on the scraper shaft 30 in the same direction and to rotate the scraper 28 carried by said shaft in that direction.

As the scraper shaft 30 rotates the other scraper shaft 31 must rotate similarly because of the chain drive 51 between the rear sprocket 49 on the scraper shaft 30 and the aligned sprocket 50 on the scraper shaft 31.

However provision is made whereby the scraper shafts 30 and 31 are only rotated at the opposite ends of the reciprocating movement of the scraper carriage 34 and then only through about 90°. Thus the scraper shaft 31 is extended rearwardly beyond its rearmost journal 33 on the top scraper carriage and into a friction clutch assembly comprising a housing 59 secured to the rear of the carriage 34. On the rear end of this scraper shaft 31 is slidably keyed a sleeve 60 which carries at least one friction disc 61 adapted to engage a friction ring 62 coaxially fixed to the rear surface of the front end of the housing 59. About the rear end of the sleeve 60 is concentrically and slidably mounted a further sleeve bearing a further friction disc 63 and adapted to engage a friction ring 64 located between the discs 61 and 63. The disc 63 is prevented from rotating in the housing 59 by lugs 65 on the disc engaging in radial stops 66 within the housing 59. The slidable friction disc 63 is urged by a spring 67 towards the front end of the housing 59. The adjustment of the frictional resistance to the rotation of the shaft 31 with respect to the housing 59 is effected by means of a cap 68 engaging the pressure spring 67 and adjustable with respect to the housing 59 by means of a screw and nut arrangement 69.

The frictional resistance between the friction discs 61 and 63 and the static friction surfaces is adjusted to such a value that the tension in the driving chain 58 connected to the front and centre sprockets 47 and 48 on the sleeve 45 of the scraper shaft 30, cannot rotate this scraper shaft until such time as the endwise movement of the top scraper carriage, under the action of the torque motor and the said driving chain, is arrested by engagement with stops on the guide rails 35, there being a pair of stops 70 near one end of the guide and a further pair of stops 71 at the other end of such rails. The said stops 70 and 71 may be adjustable on the guide rails 35, these stops being so located that they arrest the carriage 34 in such end positions that either the scraper shaft 30 or the scraper shaft 31 is positioned approximately respectively at the centre of curvature of the corresponding arcuate corner 25 or 24 of the sealing surfaces of the door being cleaned.

At the commencement of a cleaning operation the left-hand (seen from the rear of the machine) scraper blade 29 will be somewhat to the left of the vertical medial plane of the door with the scraper blade in a horizontal plane as shown in FIGURE 12. The right-hand scraper blade 28 will, at this stage, extend vertically from its shaft 30.

If the torque motor 56 is now energised so as to rotate the driving sprocket 54 in an anti-clockwise direction as seen in FIGURE 11, the carriage 35 will be moved to the right as indicated by the arrow in FIGURE 12 since the friction exercised by the friction clutch assembly in the housing 59 is such as to prevent at this stage the rotation of the scraper shafts 30 and 31. Thus as the carriage 34 travels to the right, the right-hand scraper 28 will scrape the adjoining horizontal sealing surfaces of the oven door.

When the scraper carriage reaches and engages the right-hand stops 70 on the guide rails 35 these arrest its further movement to the right, and at this stage the pull in the driving chain 58 overcomes the friction exerted by the clutch assembly so that clutch slip occurs and the scraper shafts 30 and 31 are caused to rotate about their own axes in a clockwise direction through about a right angle whilst the carriage remains stationary, the scraper 28 on the right-hand shaft 30 turning in a clockwise direction from a vertical position to a horizontal position or just beyond such position during which movement this scraper blade effects the scraping and cleaning in an outward and downward direction of the right-hand arcuate corner 23 of the sealing surfaces at the top corner of the door. Simultaneously with this movement of the right-hand scraper into a horizontal position, the left-hand scraper moves to a vertical position and at this stage this scraper has passed to the right of the said medial plane of the door, this final position being illustrated in full lines in FIGURE 11.

At this stage the rotation of the torque motor 56 is reversed so that the carriage 34 commences to move to the left with the right-hand scraper blade 28 in a horizontal position and the left-hand scraper blade 29 in a vertical position so that the latter blade scrapes the sealing surfaces from somewhat to the right of the centre thereof, this scraping continuing until the carriage is arrested at the left-hand end of its movement when the left-hand scraper will turn in a clockwise direction through 90° or rather more to scrape the left-hand arcuate upper corner 24 of the sealing surfaces of the door in an outward and downward direction whilst the right-hand scraper 28 turns from its horizontal position in an anti-clockwise direction to a vertical position ready for the return of the carriage to its starting position shown in FIGURE 12. Thus the deposits on the upper horizontal sealing surfaces 22 and the arcuate corners 24 and 25 of this upper part of the sealing surfaces are scraped away from approximately the centre of the door outwardly and downwardly, some of the deposits being pushed to the right and downwardly by the scraper 28 and the remainder of the deposits being pushed to the left and downwardly by the scraper 29.

The shaft 55 of the torque motor 56 rotates in each direction through about 270° but provision is preferably made for adjusting the degree of angular rotation of this shaft, the angular rotation of the blades 28 and 29 depending upon the angular movement of the torque motor shaft.

The scraping unit for cleaning the bottom part 23 and arcuate corners 26 and 27 of the sealing surfaces of the door is similar in construction and function to the top scraping unit but the arrangement is such that the scrapers are arranged to start their scraping at the top of the arcuate lower corners 26 and 27 of the door sealing surfaces and to propel the removed deposits inwardly to the centre of the door, the paths of movement of the scrapers overlapping one another as in the case of the scrapers of the top scraping unit of the machine.

Thus the bottom scraping unit (which is shown in FIGURES 8, 9, 10 13 and 14 in particular) comprises, like the upper scraping unit, a pair of scraper blades 72 and 73 respectively fixed in a radial position (preferably replaceably) to the front end of scraper shafts 74 and 75 so as to project forwardly therefrom along the diametrical plane of the shaft. The said two scraper shafts 74 and 75 are arranged in parallelism in the same horizontal plane and are spaced laterally from one another, being journalled at spaced positions along their lengths in bearings respectively marked 76, 76 and 77, 77 in the drawings, the said bearings are provided on a carriage 78, hereinafter referred to as the bottom scraper carriage, which is reciprocable along a pair of guide rails 79 fixed horizontally across the lower portion of the framework of the machine 7 and behind the said oblong frame at a level such that the scraper shafts 74 and 75 are, when in use, substantially opposite the horizontal bottom sealing surface 23 of the door.

The said guide rails are conveniently in the form of a pair of angle section members arranged in opposition each with one flange directed horizontally inwardly. The carriage 78 comprises a horizontal plate 80 having a pair of webs 81 depending therefrom between the guide rails 79, these webs each carrying, on the outsides thereof, two pairs of upper and lower rollers 82, these pairs of rollers being spaced longitudinally of the carriage and the upper rollers engaging the upper surfaces of the inwardly directed flange of the adjoining guide rail 79 and the lower rollers engaging the under surfaces of such flange, the carriage thus being located against up and down movement but free for horizontal endwise movement along the guide rails.

Lateral movement of the carriage 78 with respect to the guide rails 79 is precluded by providing rollers 83 which rotate on vertical spindles located on the insides of the said dependent webs 81 of the carriage, the rollers passing through slots in the dependent webs and bearing upon the inner edges of the horizontal inwardly directed flanges of the adjoining guide rails.

To regulate the freedom of movement of the carriage 78 along the guide rails 79 and to hold the carriage against movement along the guide rails 79 in certain circumstances as hereinafter explained, there is provided a friction brake comprising an adjustable friction shoe 84 resiliently mounted (see FIGURES 9 and 13) on the carriage 78, this shoe bearing upon a friction strip or pad 85 secured to the upstanding flange of the rear guide rail 79 for the bottom scraper carriage 78.

The friction shoe 84 is carried at the front ends of a pair of horizontal rods 86 (FIGURE 9) slidable in horizontal externally screw threaded sleeves 87 mounted in a dependent arm of a bracket 88 fixed to the plate 80 of the carriage 78, the sleeves 87 being adjustable in the bracket 88 and securable in any of their adjusted positions by lock nuts 89, and a compression spring 90 being arranged between each of the front end sleeves 87 and the friction shoe 84 and around the corresponding shoe carrying rod 86.

The scraper shafts 74 and 75 are capable of limited endwise sliding movement in their bearings 76 and 77 and are urged forwardly respectively by helical springs 91 and 92 engaging at their front ends collars 93 and 94 fixed upon the shafts 74 and 75, said springs engaging at the rear ends against the front ends of sleeves 95 and 96 respectively keyed on to the shafts 74 and 75 so as to rotate with these shafts but to permit the latter the said limited axial movement through the sleeves.

The sleeve 95 on the right-hand scraper shaft 74 has three axially spaced similar sprocket wheels formed integrally thereon or rigidly secured thereto, these sprocket wheels being respectively marked 97, 98 and 99 in the drawings.

Similarly the sleeve 96 on the left-hand scraper shaft 75 has a single sprocket wheel 100 integrally formed or fixed thereon, this sprocket wheel being aligned with the rearmost sprocket wheel 99 on the sleeve 95 of the right-hand scraper shaft 74.

To the centre sprocket wheel 98 on the sleeve 95 is fixed one end of a roller chain 101 which passes partially around this sprocket in a downward and clock-

wise direction (as seen from the rear as in FIGURE 13) and thence rectilinearly to the left of the carriage 78 and centrally over the guide rails 79 as will be seen from FIGURE 10 which, of course, is also a view looking from the rear of the mechanism. The chain 101 then passes downwardly over a freely rotatable sprocket wheel 102 mounted in a bracket 103 between the left-hand ends of the guide rails 79 and from this sprocket the chain 101 extends approximately centrally between the two guide rails 79 and under the scraper carriage 78 to a driving sprocket wheel 104 located beyond the right-hand end of the guide rails and fixed upon the shaft 105 of a reversible hydraulic torque motor 106 carried by a bracket 107 secured to the right-hand side of the frame-work of the machine 7 by which the said rectangular frame is carried. After passing upwardly over the driving sprocket 104 the chain 101 extends inwardly towards the bottom scraper carriage 78 and has its second end secured to the front sprocket 97 of the series of three sprockets on the sleeve 95 on the right-hand scraper shaft 74, the chain passing under and partially around this sprocket in a clockwise direction before being fixed thereto.

The rear sprocket 99 of the said series of three sprockets and the aligned sprocket 100 on the sleeve 96 of the scraper shaft 75 carry an endless chain 108 that extends around both of the sprockets so that both scraper shafts must rotate in synchronism with one another at the same rotational speed.

As in the case of the top scraper unit, the scraper shafts 74 and 75 of the bottom scraper unit are limited to a rotational movement of 90° or slightly more. In the case of the bottom scraper unit positive stop means are provided for limiting the rotational movement in one direction of each of the shafts 74 and 75, these stop means comprising radial arms 109 and 110 respectively fixed to the rear ends of the shafts 74 and 75 and adapted for co-operation respectively with the opposite ends of the bracket 88 on the rear of the carriage 78.

As previously explained, it is preferred that one of the scraper blades 72, 73 of the bottom horizontal sealing surface scraper unit should commence its action at the upper end of one of the arcuate lower corners 26, 27 of the sealing surfaces and move downwardly and then inwardly, after which the other scraper of the unit will scrape the opposite lower arcuate corner of the sealing surfaces and scrape downwardly and then inwardly.

Assuming that the bottom scraper carriage 78 is at the right-hand limit of its movement as seen from the rear, as shown in FIGURE 13 and that the right-hand scraper blade 72 is in a substantially horizontal position, on the torque motor 106 being operated in the appropriate direction, the scraper blade 72 will be rotated in a clockwise direction and will scrape the lower right-hand radiused corner 26 of the sealing surface with which it is registered and not until the scraper 72 has reached a substantially vertical dependent position and has been arrested from further rotation by the arm 109 engaging the bracket 88 will the carriage 78 commence to move along its guide rails 79, the carriage having been so far restrained from longitudinal movement by the engagement of the friction shoe 84 with the friction pad 85 on the adjoining carriage guide rail 79. However, when the rotational movement of the right-hand scraper shaft is arrested, the carriage 78 is compelled to move to the left under the pull of the chain 101, the right-hand scraper blade 72 thus being caused to travel along the lower horizontal sealing surface 23 of the door and cleaning the latter and continuing to do so to a position somewhat to the left of the vertical medial plane of the door.

At the commencement of the scraping operation just described the scraper blade 73 on the left-hand scraper shaft 75 occupies the dependent vertical position in which it was at the end of the previous left-to-right scraping stroke of the carriage. However, as the right-hand scraper 72 turns from its horizontal to its vertical position, the left-hand scraper blade 73 moves from its vertical to a horizontal position in which it is directed to the left from its shaft 75.

Thus, when the scraper carriage 78 has moved fully to the left, the left-hand scraper blade 73 is approximately horizontally positioned ready for effecting a downward and inward scraping of the left-hand arcuate corner 27 of the sealing surfaces of the door so that, on the reversal of the torque motor 106, this corner is first scraped downwardly and inwardly while the carriage 78 is stationary and then, on the left-hand scraper blade 73 reaching its vertical position, the carriage moves to the right so that the blade 73 continues its inward scraping movement and overlaps the path previously scraped by the right-hand scraper blade 72, the deposits removed from the sealing surfaces thus being drawn to the centre of the door and deposited in a trough or other collecting vessel (not shown) placed below the door. FIGURE 14 illustrates the last mentioned phase in the scraping operation.

Referring to FIG. 3, behind the oblong frame 11, and within the yokes 12, are arranged a pair of parallel laterally spaced guide rails 111 which extend vertically from the lower to the upper of the yokes and which are arranged symmetrically with respect to the frame 11 and in a plane parallel thereto, the rails 111 conveniently being secured to the side arms of the yokes 12 and being of right-angled form so that one flange of each rail projects inwardly at right angles to the corresponding sides of the yokes 12 as shown clearly in FIGURES 2 and 3.

On these guide rails 111 is mounted a vertically reciprocable carriage 112. This carriage comprises a pair of vertical laterally spaced side plates 113 rigidly secured together by a horizontal cross beam 114.

Each of the said side plates 113 is furnished with two pairs of horizontally spaced guide rollers, an upper pair 115 and a lower pair 116, the rollers of these several pairs rotating on axes perpendicular to the side plates 113 and engaging between them the inwardly directed flanges of the guide rails 111 so that the carriage is free to reciprocate up and down these rails.

To locate the carriage 112 against lateral displacement relatively to the guide rails 111, the carriage is also furnished at each side thereof with a roller 117 rotatable on an axis parallel to the adjoining side plate 113 and bearing on a runner 118 extending vertically between the upper and lower yokes 12.

The carriage 112 is furnished with means for cleaning the vertically arranged or side sealing surfaces 21, 21 of the door and for this purpose it is necessary that the carriage 112 should be reciprocated up and down the guide rails 111. Whilst any suitable mechanism may be used to effect this reciprocation, such as screw and nut mechanism, it is preferred to employ the mechanism shown in the drawings (particularly in FIGURES 1, 2 and 3) which comprises a pair of endless chains 118 arranged in spaced parallel planes and each attached at a point 119 to the carriage 112 at one position in the length of the chain, the latter then passing from the carriage vertically upwardly and vertically downwardly and respectively over and under upper and lower pairs of freely rotating spaced sprocket wheels respectively marked 120 and 121 and mounted on the framework of the machine 7, the upper and lower portions of each chain then extending respectively downwardly and upwardly from the said pairs of sprocket wheel and respectively over freely rotating sprocket wheels 122 and 123 and around a driving sprocket 124 fixed upon the output shaft 125 of a reduction gear box 126, the input shaft 127 of which is driven by a reversible motor 128 which, in this case, is a reversible hydraulic motor.

In order automatically to retard the movement of the carriage 112 and to bring it to rest as it reaches the upper and lower ends respectively of its travel, appropriate trip units 129 and 130 are respectively provided near the upper and lower ends of the guide rails 111,

these trip devices being included in a hydraulic control circuit for the apparatus and hereinafter more fully described.

The length of travel of the carriage **112** is rather less than the distance between the sealing strips **19** of the top and bottom horizontally extending sealing surfaces **22** and **23** of the door to be dealt with.

On the carriage **112** are mounted scrapers for cleaning the vertical or side sealing surfaces **21** of the door, these scrapers hereinafter being referred to as "side scrapers."

There are an upper scraper assembly **131** and a lower scraper assembly **132** at each end of the carriage **112** as will be clearly seen from FIGURES 2, 3 and 4 for example. These scraper assemblies include scraper blades **133** and **134** respectively formed of alloy steel of an air hardening kind, the scraping edges of the blades that are offered to the sealing surfaces to be scraped being of a substantially matching and complementary contour to such surfaces as will be clearly apparent from FIGURE 3.

The several scraper assemblies are all of a very similar character and for the purposes of simplicity similar parts of all these assemblies will, in describing them, be given the same references although where any of these parts need subsequently to be referred to separately similar parts will be referred to respectively by the same, but primed and unprimed, references.

Each of the scraper assemblies **131**, **132** comprises an arm, the arms of the upper and lower assemblies being respectively marked **135** and **135'**. The scraper blades **133** and **134** are replaceably secured, if desired adjustably, to the front ends of these arms by screws **136**. The rear rear end of each scraper arm is clamped in one end of a lug **137** pivoted at its other end on a pivot pin **138** carried by a boss **139** which is itself pivoted on a fulcrum stud **140** secured in the corresponding side plate **113** of the carriage **112** so as to be perpendicular to such plate, the axis of the pivot pin **138** being swingable in a plane parallel to said side plate and perpendicular to the fulcrum pin **140**. Thus each scraper arm may oscillate in a plane parallel to the adjacent side plate **113** and may also swing in planes perpendicular to such side plate. The said scraper arms are longitudinally adjustable in the lugs **137** to enable the scraper blades **133** and **134** to be preliminarily advanced or retracted, as required (whilst setting up the apparatus), with respect to the carriage **112**.

The arm **135** of each upper side scraper assembly **131** is arranged so as to extend upwardly and forwardly from the carriage **112** at all times and the arm is furnished, between its ends, with a lug **141** connected by a tension spring **142** to an upstanding rear corner bracket **143** on the corresponding side plate **113** of the carriage **112**, the arm **135** thus always being biased in a rearward direction away from the sealing surfaces to be cleaned.

A hydraulic jack **144** is provided for urging each upper scraper arm **135** into its sealing surface-cleaning position, this jack being pivotally connected at its forward end to the arm and at its rear end to the bracket **143** on the corresponding side plate **113** of the carriage. The application of hydraulic pressure (as hereinafter explained) to the jack **144** causes this to extend and yieldingly to urge the side scraper arm **135** forwardly towards the surfaces to be cleaned, whilst the release of the hydraulic pressure supply to the jack enables the tension spring **142** to withdraw the scraper arm from its scraping position.

The scraper blade **133** of each upper scraper arm **135** is arranged transversely with respect to the arm as clearly seen from FIGURE 4, the blade projecting downwardly and forwardly from the arm at an angle of rather less than 90°, this scraper blade **133** thus being adapted to engage on the surfaces to be cleaned thereby with a raking or claw-like action as the side scraper carriage **112** descends from its upper to its lower position on the guide rails **111**.

The scraper arm **135'** of each lower scraper assembly **132** is mounted on the corresponding side plate **113** of the carriage **112** in the same manner as the scraper arms **135** of the upper scraper assemblies **131** with the exception that the lower scraper arms are always directed downwardly and forwardly as clearly seen in FIGURE 4. The scraper arms **135'** of the lower assemblies are, moreover, biased rearwardly by tension springs **142'** anchored at their opposite ends to the arms and to dependent brackets **145** at the lower rear corners of the corresponding side plates **113** of the carriage **112**. Furthermore, each of the lower scraper arms **135'** is adapted to be urged forwardly into its scraping position by means of a hydraulic jack **144'** connected at one end to the arm and at the other end to the corresponding bracket **145**.

The four jacks **144** and **144**, and **144'** and **144'** are included in the hydraulic circuit hereinbefore referred to and subsequently to be described.

The scraper blade **134** of each lower scraper arm **135'** is substantially colinear with the said arm, being secured to the underside of the front end of the arm so as to project forwardly and downwardly therefrom.

The pressure with which the scraper arms **135** and **135'** are urged towards the surfaces to be cleaned may be varied as required by means of the hydraulic jacks **144** and **144'** and provision is made whereby this pressure may be of a yielding character as hereinafter described.

A stop bracket **146** is provided for each of the scraper arms **144**, **144'**, these brackets being mounted on the side plates **113** adjoining the respective scraper arms and the brackets serving to limit the rearward swinging movements of the scraper arms which, when in their fully retracted positions, are wholly received in V-shaped notches **147** (see FIGURE 3) in the brackets. The oblique edges of the said brackets adjoining the notches **147** serve to limit the lateral movements of the scraper arms **135** and **135'** and also to centralise these arms as they return to their rearward positions.

By mounting the scraper arms so that they can, at their rear ends, swing about two axes at right angles, the scraper blades **133** and **134** are permitted, as they are scraping the knife-edge-like portions of the sealing strip **19** of the door, to move laterally, as well as up or down, and thus to follow any lateral changes in the contour of such knife-edge-like portions of the sealing strip.

The scraping of the side sealing surfaces **21** is effected wholly by downward scraping so that the deposits are always removed from the sealing surfaces in the direction in which gravity acts and the paths scraped by the upper and lower scraper blades **133** and **134** respectively are arranged to overlap one another and also the ends of the paths scraped by the top scrapers **28**, **29** and the bottom scrapers **72** and **73**. Thus, as diagrammatically illustrated in FIGURE 15, the upper scraper blades **133** are advanced into their scraping positions with the carriage **112** at the top of its stroke and with the lower scraper blades **134** retracted as shown in FIGURE 4, after which the carriage is caused to descend so that the upper scraper blades **133** effect, as indicated diagrammatically in FIGURE 15, the downward scraping of the upper portions of the side sealing surfaces **21** from positions just above the lower ends of the arcuate corners **24** and **25** of the door sealing surfaces to any suitable predetermined positions intermediate the upper and lower ends of the side sealing surfaces. The downward movement of the carriage **112** is then arrested and the carriage is raised again for a distance at least sufficient to bring the lower scraper blades **134** above the position last scraped by the upper scraper blades **133** whereafter the lower scraper blades are advanced into scraping position and the descent of the carriage **112** recommenced,

the upper scraper blades 133 being, however, retracted from their scraping positions before the partial re-ascent of the carriage. Thus the downward scraping of the side sealing surfaces 21 is continued by the lower scraper blades 134 down to and just below the upper ends of the lower arcuate corners 26 and 27 of the sealing surfaces. It will be appreciated that as the paths scraped by the lower scraper blades 134 overlap the paths scraped by the upper scraper blades 133, the lower scraper blades continue to propel smoothly downwardly the deposits removed from the sealing surfaces by the upper scraper blades.

At the end of the downward travel of the carriage 112 the hydraulic jacks 144' are operated to retract the lower scraper arms 135' so that during the upward or return movement of the carriage 112 (e.g. preparatory to cleaning a further door) the scraper blades 133 and 134 are all out of contact with the sealing surfaces 21, 21.

It will be appreciated that the scraping of the sealing surfaces 22, 21 and 23 is effected sequentially, always in a direction not opposed by the force of gravity, the top scrapers 28 and 29 scraping the horizontal top sealing surfaces 22 from an intermediate position outwardly and then around the arcuate corners 24 and 25 in an outward and downward direction, the side scrapers 133 collecting the deposits pushed sideways and downwards into their paths by the scrapers 28 and 29 and then continuing to scrape downwardly the sealing surfaces 21, the completion of the scraping of these surfaces being effected by the scraper blades 134 from which the lower scraper blades 72 and 73 take over to scrape the deposits downwardly and inwardly to the centre of the bottom of part of the sealing surfaces 23 where the deposits are discharged. The hydraulic motor 128 is stopped, started, and reversed as and when required and its speed controlled from an appropriate hydraulic control unit hereinafter referred to in describing the aforementioned hydraulic circuit of the apparatus.

A deflector shield 148 is provided near the upper end of each of the upper scraper arms 135 to deflect downwardly any deposits scraped from the sealing surfaces by the scraper blades 133 and thrown rearwardly by these blades.

Although the two pairs of upper and lower scraper assemblies 131 and 132 are described above as being both carried by the same carriage 112, they could be mounted on separate carriages if desired.

In FIGURE 16 the aforementioned hydraulic circuit of the apparatus is diagrammatically illustrated. In this arrangement the controls are for the main part manually operated but, as hereinafter mentioned, they could, to a large extent, be automatically operated, if desired.

The hydraulic fluid employed is preferably oil and the hydraulic system illustrated comprises an oil reservoir 149 from which oil is drawn through a filter 150 by a vane pump 151 driven by an electric motor 152. The oil passes from the pump 151 to an adjustable pressure relief valve 153 which is conveniently pre-set to a pressure of 500 lbs., the valve 153 being connected to a return line 154 by which excess oil may return to the reservoir 149.

From the valve 153 oil passes to a counterbalancing and sequence valve 155 connected by a line 156 to the pressure inlet of a distributor valve 157 one of the outlets of which is connected by line 158 to the pressure inlet of a control valve 159 from an outlet of which a return line 160 leads back to the reservoir 149.

The valve 159 is a combination of three plunger-type valves 161, 162 and 163 which control respectively the operation of the top and bottom scraper torque motors 56 and 106 and the hydraulic ram and cylinder assembly 16 by which the carriage 7 is adjusted towards and away from the rack 1. The centre valve 161 controls the torque motor 56, the end valve 162 controls the torque motor 106 and the other end valve 163 controls the ram and cylinder assembly 16. Movement of operating levers 164, 165 and 166 of these valves from their midpositions starts the said motors and the operation of the ram and cylinder assembly whilst the direction of rotation of the motors or travel of the ram of the piston and cylinder assembly is determined by the end positions to which said levers are moved. When levers 164, 165 and 166 of these valves are in their midpositions the valve 159 connects the line 158 to the line 160.

Thus by manipulating the lever 166 in one direction the carriage 7 can be advanced towards the door to be cleaned whilst appropriate subsequent operations of the control lever 164 will bring about the scraping of the top sealing surfaces 22 of the door and later appropriate manipulation of the control lever 165 will bring about the cleaning of the bottom horizontal sealing surfaces 23.

As will be well understood from what has gone before, the side sealing surfaces 21, 21 require to be scraped between the operations of the top scrapers 28 and 29 and the bottom scrapers 72, 73.

The side scraper carriage motor 128 is controlled by the distributor valve 157. A line 167 leads from one of the outlets of this valve through a non-return valve 168 to one side of the motor 128 and a further line 169 leads from the other side of this motor through a non-return valve 170, a flow control and motor speed regulating valve 171, and a non-return valve 172 to one port of the bottom trip unit 130. A further port of the valve 130 is connected by a line 174 and line 175 to another outlet of the distributor valve 157. The line 175 is also connected through a non-return valve 176 to the line 169 on the trip unit side of the non-return valve 172, whilst this part of line 169 is connected through a further non-return valve 177 to the non-return valve 170-side of the flow control and speed regulating valve 171.

The top trip unit 129 is in parallel with the non-return valve 168 in line 167, having two ports thereof connected to the line 167 on opposite sides of the non-return valve 168 by lines 178 and 179.

The trip units 129 and 130 are in the form of three-way plunger-type valves in which the plunger is urged outwardly by spring means and pushed inwardly by levers 181 and 182 respectively operated by an adjustable abutment 183 provided on the carriage 112 at a suitable position thereon. When their plungers are in their outer positions, i.e., when the abutment 183 is clear of the levers 181 and 182, the units provide by-passes for the non-return valves 168 and 176 respectively, movement of the plungers inwardly closing such by-passes.

The plunger of the distributor valve 157 has a control lever 180 adjustable from a mid-position to either of two alternative end positions in which it causes rotation of the side scraper motor 128 in one or the other direction to traverse the carriage 112 up or down the guide rails 111 as required, the speed of travel being controlled by the valve 171 and the carriage being first slowed down and then stopped at the upper and lower ends of its stroke respectively through the medium of the trip units 129 and 130 when actuated by levers 181 and 182.

When the lever 180 is in its mid-position, oil flows from line 156 directly to line 158 and thence to the control valve 159. However, when the lever 180 of the valve 157 is in either of its two alternative end positions the direct flow of oil from line 156 to the control valve 159 is interrupted and the oil is directed from line 156 to one of lines 167 and 175, according to the position of lever 180, whilst the other of lines 167 and 175 is connected to line 158.

When the control lever 180 is in an end position permitting flow of oil from the line 156 through the valve 157 to the line 167, the oil passes along the line 167 through the non-return valve 168 to one side of the motor 128, through the motor 128 which is thereby operated to traverse carriage 112 down the guide rails 111, the oil then passing successively through the non-return valve

170, speed-regulating valve 171, non-return valve 172, the trip unit 130, line 175, valve 157, line 158, valve 159, line 160 and so back to the oil reservoir 149. This flow of oil can, however, only occur when levers 164, 165 and 166 are in their mid-positions and the carriage 112 is in a position other than in its lower limit position.

On the other hand, when the control lever 180 is in its other end position so that oil from line 156 is directed to line 175, oil flows through the line 175 past the non-return valves 176 and 177, through the flow control and speed-regulating valve 171 and thence through a further non-return valve 185 to the motor 128, thereby operating the latter to traverse the carriage 112 up the guide rails 111, and then back through line 178, the top trip unit 129, line 179, line 167, valve 157, line 158, valve 159 and line 160 to the reservoir 149. For this flow to occur, levers 164, 165 and 166 must be in their mid-positions and the carriage 112 must be in a position other than its upper limit position.

It will be clear from the foregoing that the carriage 112 may be traversed up or down the guide rails 111 as desired by setting the control lever 180 into one or other of its end positions as appropriate, only when the motors 56 and 106 are stationary and the hydraulic ram and cylinder assembly 16 is at rest. Also the carriage cannot be traversed beyond either of its limit positions, owing to the presence of the trip units 129, 130 which control the flow of oil in the circuit of motor 128.

The trip units 129, 130, as mentioned above, provide by-passes for the non-return valves 168 and 176 respectively to enable the oil which has passed through motor 128 to return, via valves 157 and 159, to the reservoir 149. As the carriage 112 approaches either of its limit positions, the abutment 183 engages the lever 181 or 182 as the case may be and causes inward movement of the appropriate trip unit plunger to restrict and ultimately close the by-pass constituted by the trip unit, thereby to slow and ultimately stop the flow of oil through motor 128.

Movement of the control lever 180 to its mid-position automatically cuts off the supply of oil to either side of the motor 128.

Assuming that all the scraper arms 135 and 135' are in their retracted positions, as they should be, at the top of the stroke of the carriage 112, then before the carriage commences to descend the upper scraper arms 135 require to be advanced by their jacks 144. This is effected by applying fluid pressure to the jacks from the counterbalance and sequence valve 155. This is achieved by passing the oil through line 186 and a pressure reducing valve 187 (which conveniently reduces the oil pressure from an operative pressure at the valve 155 of 500 lbs. to a pressure in the region of 25 lbs. per square inch). From the valve 187 a line 188 extends to the inlet of a combination valve assembly similar to the combination valve 159 and having an outlet connected by a line 190 to the reservoir 149. This combination valve 189 comprises two separately operable valves 191 and 192. They are both plunger type valves operated by control levers 193 and 194. The inlets of both these valves are connected to the line 188 and the outlets of the two valves are respectively connected to lines 195 and branch lines 196, and line 197 and branch lines 198 to the upper scraper arm jacks 144 and the lower scraper arm jacks 144'. Thus by setting the lever 193 in one end position thereof the jacks 144 may be extended to advance the scraper blades 133 into their scraping positions whilst setting the control lever 193 in its other end position places the jacks 144 in direct communication with the reservoir 149 so that the tension springs 142 may withdraw the scraper blades 133 from their scraping positions. Similarly operation of the control lever 194 into one or the other of its alternative positions can cause the jacks 144' of the lower scraper arms 135' to advance the scraper blades 134 into their operative positions, or permit withdrawal of the scraper blades from their operative positions by the tension springs 142'.

It is very desirable that the pressure that the jacks 144 and 144' exert on their respective scraper arms should be of a yielding character, and for this purpose an adjustable relief valve 199 is placed across the lines 195 and 197, being connected to these lines through non-return valves 200 and 201 and lines 202 and 203. The relief valve 199 has its outlet communicating with the reservoir 149. If the back pressure in any of the jacks 144 or 144' becomes for any reason excessive, fluid flows through the non-return valves 200 and 201 to the relief valve 199 and the excess oil is discharged to the reservoir 149.

In the hydraulic system above described all the operations are effected under manual control except the slowing up and stopping of the carriage 112 respectively at the ends of its upward and downward strokes.

However, subject to an over-riding control all the mechanisms may be automatically controlled. Thus trip means may be provided for automatically reversing the direction of rotation of the top and bottom scraper motors 56 and 106 respectively. Similarly, automatically controlled sequence devices may control the bringing into and putting out of action of the upper scrapers 133 and the lower scrapers 134 respectively and for initiating the sequential operation of the scraper motors 56, the side scraper motor 128 and the bottom scraper motor 106 to effect the cleaning of the sealing surfaces in the proper order from the top sequentially downwards. The said automatic control means would, of course, preferably also include means for arresting the downward movement of the carriage 112 at the aforementioned intermediate position in its travel, reversing the motor 128 to cause the carriage to travel upwardly again for a short distance, and then for again automatically reversing the direction of the motor 128 so that the latter will cause the carriage once again to descend.

For the purpose of heating immediately in advance of the scraper blades those sealing surfaces to be cleaned by the scraper blades, and/or for heating the scraper blades themselves, means are provided for applying extraneous or supplementary heat to these parts and, as will be seen from the appended drawings and in particular FIGURES 4, 5, 6, 8 and 9, aerated gas flame burners providing fan shaped flames are mounted adjacent the several scrapers of the apparatus so as to heat the surfaces to be scraped in advance of the scrapers and also simultaneously to heat the scrapers themselves thereby to avoid the adherence to the scrapers of the pitchy deposits removed by the scrapers from the sealing surfaces being cleaned. It would, of course, be possible either to heat the scrapers alone or to heat only the sealing surfaces to be cleaned, such heating being effected immediately before the surfaces are scraped. It is, however, preferred to heat the scrapers and simultaneously the surfaces to be cleaned, as above described.

FIGURE 4 illustrates how a gas burner 204 is mounted below each scraper arm 144 and 144' so as to play respectively on to the sealing surfaces in advance of the scraper blades 133 and 134 and on to these blades themselves.

FIGURES 5 and 6 illustrate how similar gas burners 205 and 206 may be associated with the scraper blades 28 and 29 of the top sealing surface scraping mechanism whilst FIGURES 8 and 9 show how gas burners 207 and 208 may similarly be associated with the scraper blades 72 and 73 of the lower scraper unit. It will be seen that the burners 205, 206, 207 and 208 are mounted on the adjoining scraper shafts so as to turn with the latter and the scrapers carried thereby.

The deflectors or shields 148 hereinbefore described as being applied to the upper scraper arms 135 also serve as shields for the burners 204 and assist in preventing the flames from these burners being accidentally blown

out. Similar shields may be provided for the same purpose in the vicinity of any or all of the gas burners of the apparatus. Moreover, pilot jets (not shown) may be provided for igniting these burners.

FIGURES 17 and 18 illustrate diagrammatically, in front and side elevation respectively, an alternative means of heating scraper blades, this alternative means comprising an electric heating element 209. These figures illustrates this alternative applied to the scraper blades 134 of the lower scraper arms 144' but it will be obvious that similar arrangements may be made in connection with any or all of the scrapers.

The burners 204, 205, 206, 207 and 208 or the electric heating elements 209 will, of course, be supplied with the necessary gas or electrical energy through appropriate flexible hoses or connections. Similarly the moving hydraulically operated parts of the apparatus will also be connected to the pressure supply sources by flexible hoses.

Mechanism similar to that above described could be used for cleaning the sealing surfaces of the oven end frame into which the door is adapted to fit and herein referred to as the "door frame." However, as the sealing surfaces of the door frame are flat, without knife edges as in the case of the door sealing strip 19, an alternative scraping arrangement can be used for cleaning the sealing surfaces of the door frame and such an alternative mechanism is shown in FIGURES 19, 20, 21, 22 and 23. The mechanism there illustrated effects scraping downwardly from the top of the frame to the bottom so that the removal of the deposits is always assisted and not opposed by gravity.

Referring to FIGURES 19 to 23 of the drawings, it will be seen that the machine there illustrated comprises a carriage 212 which may be a separate carriage running on rails 213 alongside the battery or a carriage forming a part of, or mounted on, the pusher machine or the coke guide machine of the battery or a door extracting machine of the latter. On the carriage 212 is mounted a superstructure generally indicated by the reference 214 bearing horizontal rails 215 on which an auxiliary carriage 216 is mounted so that it can be moved transversely to the rails 213 to and from the door or end frame 217 of an oven of the battery. The carriage may be adjusted on the rails 215 in any suitable manner as, for example, by a screw 218 and a nut assembly 219 shown in the drawings, or by electrical or hydraulic means. Preferably, in an installation such as above described in which the power provided is hydraulic power, a hydraulic ram and cylinder assembly would be used in place of the screw and nut arrangement shown in FIGURES 19 and 20.

An oblong frame 220 carried by transverse members 221 is mounted on guide brackets 222 on the auxiliary carriage 216 so as to be capable of slight movement to and from this carriage against the pressure of spring devices diagrammatically illustrated at 223. In the frame 220 is vertically reciprocable a scraper carriage 224 carried by rollers 225 operating in the vertical sides of the frame 220 which act as guide rails for the carriage.

The scraper carriage has a transverse beam 226 to the upper side of which is fixed one end of each of two laterally spaced roller chains 227 having their other ends secured to the underside of the beam 226 and between its ends passing upwardly and over chain sprockets 228 and downwardlly and under chain sprockets 229, the sprockets 228 being fixed upon a horizontal shaft 230 journalled in bearings at the top of the frame 220 and the sprockets 229 being fixed upon a shaft 231 journalled in bearings at the bottom of the frame 220. The shaft 231 is driven by an electric hydraulic or other appropriate motor 232 fixed to the lower part of the frame 220 as seen in FIGURES 22 and 23, the driving being transmitted from the motor through an endless chain 233 and chain sprockets 234 and 235 respectively on the motor shaft and the shaft 231.

The scraper carriage 224 carries a scraper assembly generally indicated by the reference 236. This assembly comprises a pair of U-shaped brackets 237 arranged one near each end of the beam 226 of the scraper carriage 224 and furnished on its rear surface with a boss 238 and coaxial spigot 239, the boss 238 being received within a horizontal socket 240 fixed in the web of the beam 226 and the boss 238 being free to slide axially in said socket against the restraint of a compression spring 241 surrounding the spigot 239. Thus the brackets 237 are yieldingly urged forwardy from the carriage 224. Each of the brackets 237 is furnished with a central lug 242 to which is fixed a forwardy projecting limb 243 (see FIGURES 21 and 22) constituting a profiling or limit scraper which is adapted to enter the door opening in the door frame 217 and to remove hard deposits on the frame and to prevent such deposits building up sufficently to interfere with the proper entry of the oven door into the frame.

Between the upper ends of the two brackets 237 at opposite ends of the beam 226 extends a scraper bar 244 having at its front edge and at each end a downwardly and forwardly directed knife edged scraper blade 245 primarily intended to effect the scraping of the vertical or side portions 247 of the sealing surface of the door frame 217. A similar scraper bar 248 is carried by the lower ends of the brackets 237 and has a downwardlly and forwardly directed knife edged scraper blade 249.

Between each pair of end scraper blades 245, 245 and 249, 249 is secured a further downwardly and forwardly directed knife edged scraper blade 246, 246' bolted to the scraper bars 244 and 248 respectively in a forwardly and rearwardly adjustable manner. The blades 246, 246' could be made integrally with the blades 245 and 249 respectively but are preferably made separately because the blades 245 and 249 receive more wear than the blades 246, 246' as the former have to scrape the long side surfaces of the side sealing surfaces of the door frame whereas the blades 246, 246' only respectively scrape downwardly the top and bottom horizontal faces of the door frame.

As will be seen from the drawing means are provided for heating the scraper blades, such means being in the example illustrated, in the form of aerated flame gas burners 250.

The operation of the door frame scraping mechanism will be clear from the drawings and the above description the carriage 224 being taken to the top of the frame 220 and then caused to descend to the bottom of the door frame when the scrapers effect the scraping of the top horizontal sealing surfaces and the side sealing surfaces of the frame and finally the bottom horizontal sealing surfaces of the door frame, the scraping always being downwardlly and uni-directional without an upward component and never opposed to the force of gravity.

It will be appreciated that the lower horizontally extending sealing surface of the door frame is scraped solely by the lower scraper blades 249 and 246', whilst the upper horizontally extending sealing surface of the door frame is scraped solely by the upper scraper blades 245 and 246.

In the modified apparatus illustrated in FIGURES 24 to 31 for cleaning the sealing surfaces of a self-sealing coke oven door, a carriage 8' runs on rails 9' mounted on a coke guide machine or a pusher machiine 251 as described in the specification of our aforesaid co-pending application Serial No. 780,799. The carriage 8' supports a vertical oblong frame 11' which is advanceable to and from a coke oven door 2 carried by a door extracting machine 252, the frame being furnished with horizontally disposed yokes 12' between the inset front ends of which a door 2 is centralised as previously described. The frame 11' carries the scrapers for cleaning the seal-

ing surfaces of the door and the frame is advanced and retracted with respect to the door by means of a screw shaft **253** actuated by a reversible electric motor or other power unit **254** and operating in a nut **255**, this nut being carried by an auxiliary frame **256** yieldingly associated with the frame **11'** through spring devices **257** in order that the frame will be urged forwardly with a yielding pressure.

In this case the scrapers for cleaning each of the side portions of the sealing surfaces of the door comprise an upper and a lower scraper assembly respectively marked **131'** and **132'** mounted on a carriage **112'** which can be traversed vertically with respect to the frame **11'** by means of a vertical screw **258** journalled at its lower end in the sub-structure **259** of the carriage **8'** and at its upper end in the super-structure of such carriage, the scraper carriage **112'** being furnished with a nut **260** through which the screw **258** passes so that as the screw rotates the carriage **112'** must either rise or fall. Suitable limit switches (not shown) may be provided to arrest the movement of the carriage **112'** at the upper and lower ends of its travel respectively. The screw **258** is driven through bevel gearing **261** from a power unit **262** suitably controlled from a remote position, and preferably, the arrangement is such that, as the carriage **112'** ascends, the scrapers of the upper assemblies **131'** commence to scrape the corresponding vertical or side portions of the sealing surfaces upwardlly from approximately the positions shown in FIGURE 24 and continue this scraping action until the carriage reaches the top of its stroke. The scrapers of the upper assemblies are then retracted. As the upper scraper assemblies are ascending as above described, the scrapers of the lower scraper assemblies **132'** are retained in their retracted positions but are brought into their scraping positions when the carriage commences its descent, and the arrangement is such that the paths scraped by the scraper assemblies **131'** and **132'** overlap.

Hydraulic means are provided for bringing the scraper assemblies **131'** and **132'** into operation and tension springs (not shown) are provided to retract the assemblies all as hereinbefore described with reference to the assemblies **131** and **132**.

Like the latter the upper and lower scraper assemblies **131'** and **132'** are provided with means for applying extraneous heat to the scrapers and/or the surfaces to be cleaned by such scrapers.

The primary difference between this mechanism and that previously described with reference to FIGURES 1 to 16, resides, apart from the method of advancing and retracting the frame **11'** and the nature of the scraping action of the assemblies **131'** and **132'**, in the nature of the scraper mechanisms for the upper and lower horizontal portions and radiused corners of the door sealing surfaces. These scraper mechanisms are similar for the upper and lower horizontal portions of the sealing surfaces and only the upper mechanism is described in detail below.

This mechanism is shown particularly in FIGURES 24 and 31 and, as will be seen from the drawings, the horizontal upper (and likewise the lower) portion of the frame **11'** carries a horizontal guideway which comprises a pair of parallel, horizontally disposed angle section members **263** between which rides a carriage **264** comprising a length of channel section metal arranged with its longitudinal flanges horizontal and having its vertical web furnished towards the ends thereof with centrally located trunnions **265** on which are mounted rollers **266** engaging in the said guideway whilst the top and bottom edges of the said carriage-forming channel are furnished with rollers **267** near their ends to bear against the front surfaces of the guideway and to take the reaction resulting from the scraping operation.

The carriage **264** is adapted to be reciprocated along the said guideway by any suitable means, but conveniently by a hydraulic or pneumatic double acting piston and cylinder assembly **268**.

The carriage **264** is provided with several longitudinally spaced, vertically fixed, scraper blades **269** which are adapted, as the said carriage is reciprocated in the guideway, to scrape the front edge and adjacent surfaces of the parts of the sealing strip which extend horizontally across the top (or bottom) of the door.

Heating means are provided adjacent to the scrapers for operation in the manner of the heating means previously described, the heating means shown being in the form of aerated flame gas burners **270** directed towards the scraper blades **269** and the sealing surfaces of the door to be cleaned. The burners **270** are all connected to a supply pipe **271**, see FIGURE 26 in particular, connected by flexible hose **272** to a suitable gas supply (not shown).

Each of the scrapers **269** is resiliently mounted on the carriage so as to be urged yieldingly into engagemnt with the surface being cleaned thereby.

For scraping around the arcuate corners of the door sealing surfaces special scraping devices are provided. These consist of radial scrapers **273**, see FIGURES 26, 28 and 29 in particular, carried diametrically at the front ends of rotatable shafts **274**, journalled in the lower angle section members **263** at such positions as to be approximately opposite to the centres of curvature of the arcuate corners of the door sealing surfaces when the frame **11'** is brought into register with the door, and the arrangement is such that the said rotatable shafts **274** are oscillated by the scraper carriage **264**. This oscillation of the shafts **274** is achieved by furnishing those shafts each with a radial arm **275** which engages in an aperture or slot **276** in the adjoining flange of the carriage **264** so that each time the carriage moves in one direction the rotary scrapers **273** operated thereby move in one rotational direction and as the carriage returns to its original position the said scrapers move in the opposite rotational direction.

The shafts **274** are yieldingly urged forwardly by springs **276** (see FIGURES 28 and 29).

Aerated flame gas burners **270** are also provided for heating the rotatable scraper blades **273**.

We claim:

1. A method of cleaning the self-sealing metal surfaces between the doors of horizontal coke ovens and their co-operating door frames while hot from the heat of the oven structure, comprising: horizontally moving a carriage containing two sets of mechanically reciprocated scrapers with extraneous heating means therefor individually into position with self-sealing surfaces aforesaid between individual ones of doors and their frames for cleaning self-sealing surfaces aforesaid, applying extraneous heat to the deposits of pitchy constituents of the gas from the ovens on the aforesaid surfaces to be cleaned, and thereupon scraping off the softened deposits by said mechanically reciprocated scrapers.

2. A method according to claim 1, wherein the heating of the said deposits is effected by the application of extraneous heat to the said scrapers.

3. A method according to claim 1, wherein the heating of the said deposits is effected by simultaneously applying heat directly to both the said scrapers and the deposits themselves.

4. A method according to claim 1, wherein the heating of the said deposits is effected by directing thereupon aerated gas flames.

5. A method according to claim 1, and which includes the steps of: effecting the reciprocation of the two sets of the heated scrapers along the sealing surfaces with one set along respectively the upper and lower horizontally extending sealing surfaces, and the other set along the vertical side sealing surfaces to be cleaned, so that their reciprocation scraping paths intersect.

6. Apparatus for cleaning the self-sealing metal surfaces located between the doors of horizontal coke ovens

and their co-operating door frames, comprising: a carriage movable horizontally individually into position with sealing surfaces aforesaid of individual ones of said doors for cleaning of said surfaces; scrapers on said carriage for cleaning the sealing surfaces on the doors of coke ovens, which sealing surfaces seal by engagement with door frames, reciprocable mechanically operated means for reciprocating the scrapers back and forth along the sealing surfaces to be cleaned on the doors; and heating means on said mechanically operated means for heating the scrapers for thereupon heating the deposits on such surfaces simultaneously with the scraping operation.

7. Apparatus for mechanically cleaning self-sealing metal surfaces on self-sealing doors for horizontal coke ovens, comprising: two sets of scrapers with one of the two sets comprising heated scraper blades associated with an upper and a lower horizontally reciprocable carriage for respectively cleaning sealing surfaces aforesaid at the horizontal top and the horizontal bottom area of the oven doors, and with the other of the two sets of scrapers constituted of pairs of an upper and a lower vertically reciprocable heated blade for cleaning sealing surfaces aforesaid along the area at the two vertical side portions of said doors; a supporting structure for said two sets of scrapers adapted for locating the scrapers adjacent said sealing surfaces for cleaning them; means on said structure for normally urging the upper and lower vertically reciprocable blades out of contact with said sealing surfaces; actuating means for urging the vertically reciprocable blades into cleaning relation with the sealing surfaces; operating means for operating the actuating means for the upper and lower vertically reciprocable blades in alternation with each other, whereby the cleaning is done by only the upper or lower blades at a time; and co-operating means on said structure and on said upper and lower carriages for turning certain scraper blades of said one set around the corner portions of said sealing surfaces which lie between said horizontal and vertical side portions of the oven doors.

8. Apparatus according to claim 7, wherein each horizontally reciprocable carriage has a pair of laterally spaced horizontal scraper shafts arranged at right angles to the path of travel of their carriage, each of said shafts being provided at its forward part with a scraper blade, and wherein said means for turning includes parts whereby, at each end of each stroke of said carriage, one of said shafts is adapted to lie in the angle of a corner between a horizontal and a vertical portion of said sealing surfaces and whereby that shaft is automatically rotated through an angle of about 90° to cause its scraper blade to sweep around and clean the said corner of the sealing surfaces, said means for turning also including parts for rotating both the said scraper shafts in unison but with their scraper blades about 90° out of phase.

9. Apparatus according to claim 8, wherein each horizontally reciprocable carriage is independently traversed by its own power unit which serves also to rotate said scraper shafts, and wherein are also provided means to arrest the carriage at the end of each of its strokes and means to prevent rotation of said scraper shafts while the carriage is travelling but which permit them to be rotated by said power unit when the carriage is stationary at the end of any of its strokes.

10. Apparatus according to claim 9, wherein the carriage bearing the scrapers for cleaning the upper horizontal portion of said sealing surfaces includes a friction clutch to prevent rotation of said scraper shafts whilst their carriage is travelling but which permits such shafts to rotate when the carriage is arrested at the end of any of its strokes.

11. Apparatus according to claim 9, wherein the carriage bearing the scrapers for cleaning the lower horizontal portion of said sealing surfaces includes a friction brake to prevent movement of the carriage from either of its end positions until after that scraper shaft which carries the scraper blade for cleaning around the corner at that end of the horizontal portion of the said sealing surfaces at which the carriage is located, has been rotated to effect the cleaning of said corner but which friction brake is adapted then to release the carriage for horizontal travel.

12. Apparatus according to claim 10, wherein each of the blades for said upper horizontal portion of the said sealing surface is adapted to scrape in a horizontal direction outwardly from an intermediate position towards a corner position of such sealing surfaces and then to sweep outwardly and downwardly around such corner.

13. Apparatus according to claim 11, wherein each of the blades for said lower horizontal portion of the said sealing surfaces is adapted to scrape first downwardly and inwardly around a corner at one end of such portion and then horizontally inwardly to an intermediate position in such portion.

14. Apparatus according to claim 7, wherein the scraper blades of said one set, that are turned around corner portions, are carried by said supporting structure so as to be capable of rotation about a fixed axis lying, when the supporting structure is in such a position with respect to said sealing surfaces as to permit cleaning of such surfaces to be effected, within the angle of the corner portion of the sealing surfaces to be cleaned by the scraper, and wherein such separate scraper blades are oscillated about their axis of rotation, for cleaning said corner portions, by the horizontal reciprocation of one of the horizontally reciprocable carriages.

15. Apparatus according to claim 7, wherein one of the upper and lower blades of the pairs for the side portions of said doors is adapted to commence downward scraping at the top of the vertical side sealing surface and the other to commence scraping at an intermediate position down said sealing surface and to continue to the bottom of the latter, such scraper blades being presented obliquely to the surface being cleaned and so as to propel the deposits encountered thereby in a downward direction.

16. Apparatus according to claim 15, wherein the said vertically traversable scraper blades are carried by a vertically reciprocable carriage mounted on said supporting structure, and wherein means are provided for selectively propelling the said carriage alternately downwardly and upwardly on said supporting structure, and means are provided for yieldingly holding said scrapers in their scraping positions during their respective scraping operations, and means are provided for retracting both upper and lower scraper blades before any upward movement of said vertically reciprocable carriage occurs.

17. Apparatus according to claim 16, wherein are provided means for holding said lower scraper blades out of engagement with said vertical side portions of the sealing surfaces during the first part of the downward transverse of said vertically reciprocable carriage, for retaining at this time said upper scraper blades in their scraping positions, for arresting the downward travel of said carriage at an intermediate position in its descent, for retracting the upper scraper blades from their scraping positions, for raising said carriage to lift the lower scraper blades to positions above those reached by the upper scraper blades before the arrest of the downward travel of said carriage, and for then moving the said lower scraper blades into scraping relation and recommencing the downward movement of the vertically reciprocable carriage.

18. Apparatus according to claim 16, wherein hydraulic jacks are provided for urging said vertical side sealing surface-cleaning scraper blades yieldingly into their scraping positions.

19. Apparatus according to claim 16, wherein the vertical side scraper blade carriage is moved downwardly and upwardly by means of a reversible hydraulic motor, and hydraulic trip valve means are provided for auto-

matically arresting the carriage at the lower and upper ends respectively of its downward and upward movements.

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