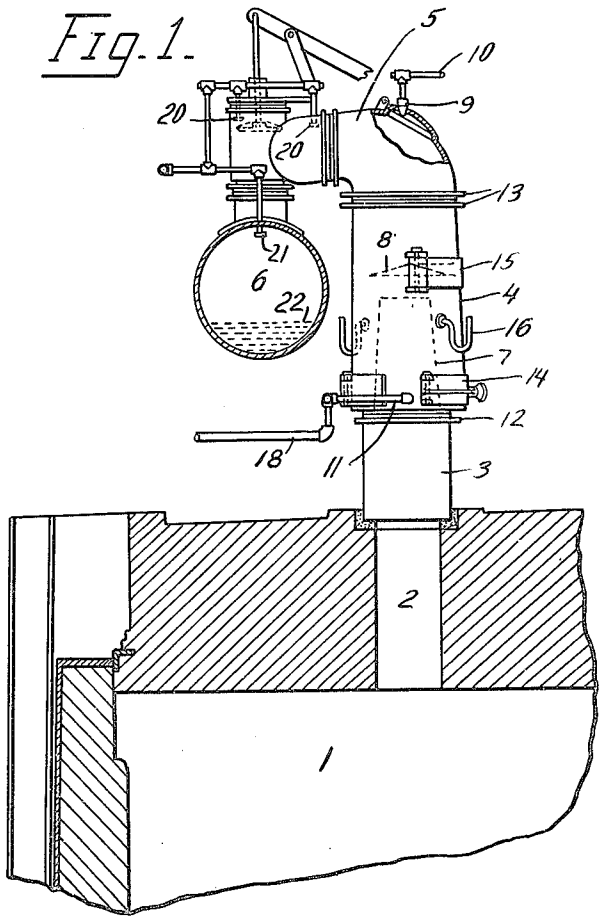
Aug. 1, 1933. S. P. MILLER 1,920,801

DISTILLATION OF TAR, ETC

Original Filed Dec. 31, 1926 5 Sheets-Sheet 1

Fig. 1.



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Aug. 1, 1933. S. P. MILLER 1,920,801

DISTILLATION OF TAR, ETC

Original Filed Dec. 31, 1926 5 Sheets-Sheet 2

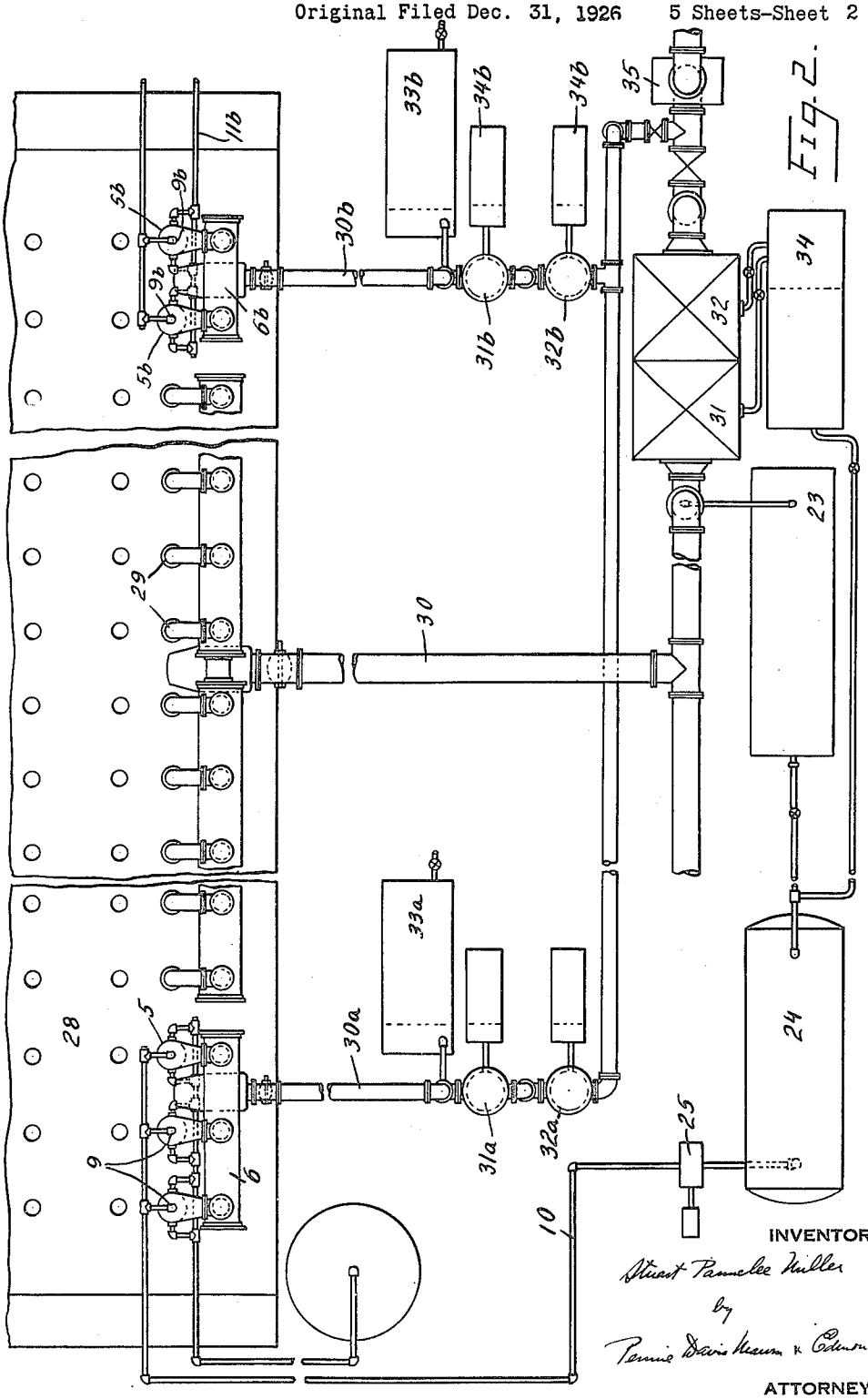


Fig. 2.

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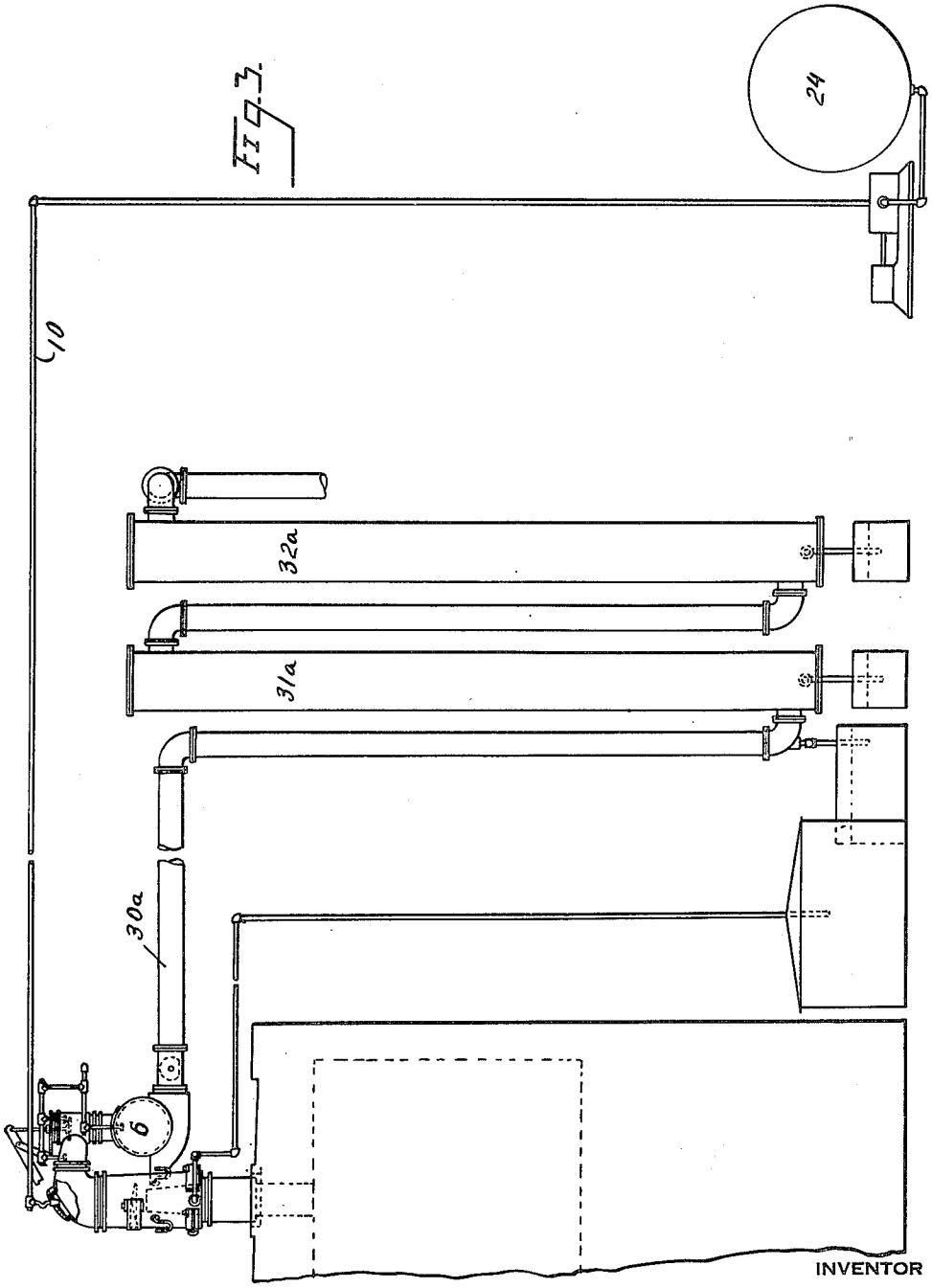
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DISTILLATION OF TAR, ETC

Original Filed Dec. 31, 1926 5 Sheets-Sheet 3



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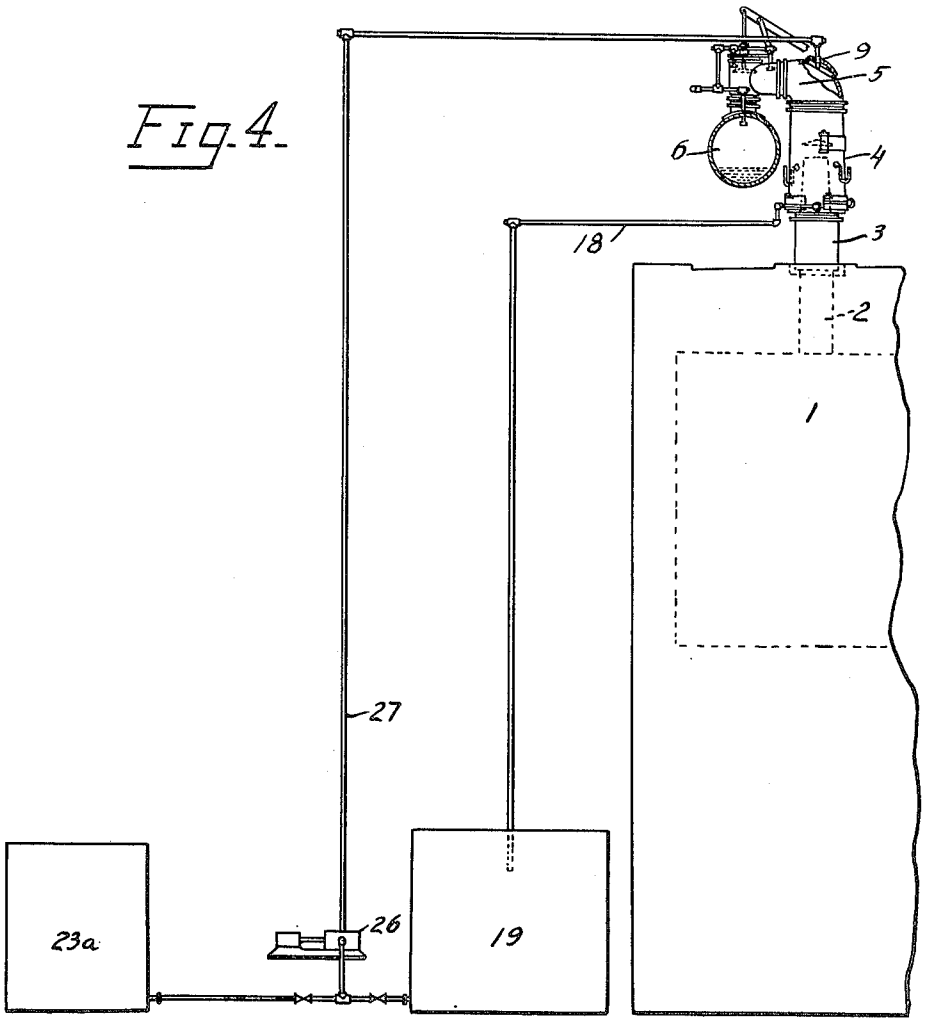
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DISTILLATION OF TAR, ETC

Original Filed Dec. 31, 1926 5 Sheets-Sheet 4

Fig. 4.



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DISTILLATION OF TAR, ETC

Original Filed Dec. 31, 1926 5 Sheets-Sheet 5

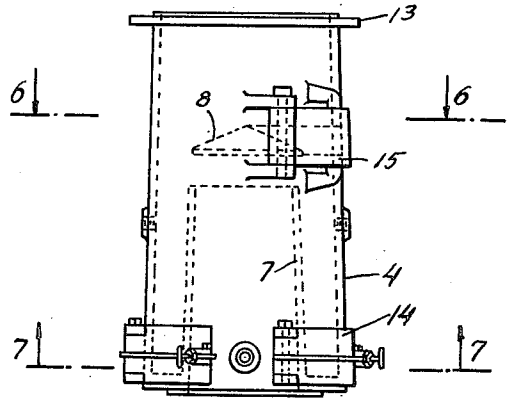


Fig. 5.

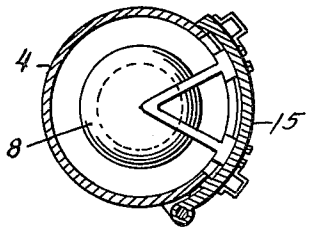


Fig. 6.

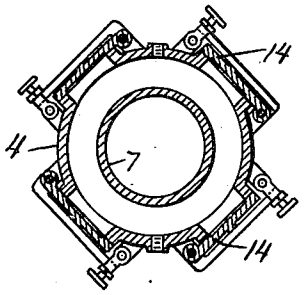


Fig. 7.

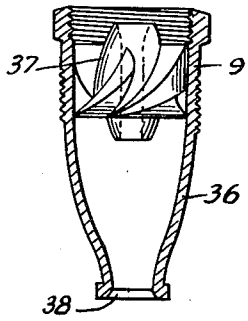


Fig. 8.

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UNITED STATES PATENT OFFICE

1,920,801

DISTILLATION OF TAR, ETC.

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Original application December 31, 1926, Serial No. 158,137. Divided and this application June 7, 1929. Serial No. 369,193

8 Claims. (Cl. 202—84)

This invention relates to improved apparatus for the distillation of tars and the production of pitches and distillate oils therefrom at coal distillation plants, such as by-product coke oven plants.

In the ordinary operation of by-product coke ovens the gases produced by the coking operation pass from the individual ovens through individual uptake pipes and goose-necks to a collector main or mains common to a battery of ovens. The coke oven gases leaving the ovens at a high temperature are cooled to separate tar constituents therefrom, the tar constituents being separated partly in the collector mains and partly in subsequent condensers.

Coal tar produced at by-product coke ovens is commonly shipped or conveyed to tar distillation plants where it is subjected to distillation for the recovery of coal tar distillates and the production of pitches as residues of the distillation.

The present invention provides improved apparatus for tar distillation in which the tar is distilled directly at the by-product coke oven plants without the need of a separate tar distillation plant and without transportation expense, and with the production from the tar of distilled oils and of pitches as residues of the distillation.

According to the present invention, the hot coke oven gases, as they come from one or more of the individual coke ovens, are utilized for the distillation of tar and the separation of vaporizable oils therefrom which are separately recovered, and the production of pitches, by bringing the tar into intimate contact with the hot coke oven gases immediately after they leave such coke ovens, or at least while they are at a temperature high enough to accomplish the desired distillation.

The distillation of the tar is carried out with separate condensation and recovery of the distilled oils, admixed with only such oil and tar constituents as are contained in or remain in the coke oven gas employed for the distillation.

According to the present invention, the tar to be distilled is sprayed or otherwise brought directly into contact with the hot coke oven gases from a limited number of individual ovens, at a sufficiently high temperature so that the tar is effectively distilled thereby, with separation therefrom of a greater or less amount of volatile oils, leaving a heavier tar or pitch as the residuum product of the distillation, and the gases and admixed vapors from the distillation are kept separate from the coke oven gases from the other ovens. The spraying of the tar into the hot coke oven gases results in partial cooling of these gases and separation therefrom of more or less of the heavier tar constituents, a proportion of which are thus thrown down and added to the pitch residue from the tar distillation. This distillation of the tar also results in an increase of condensable vapors in the hot coke oven gases treated as well as in the partial or preliminary removal from the gases of heavier tar constituents, so that these coke oven gases in their partially purified condition and with the increased amount of vapors from the distillation of the tar, differ in composition from the ordinary coke oven gases not so treated.

In the practice of the invention, the tar to be distilled is sprayed or atomized into the hot coke oven gases, or is otherwise brought directly into intimate contact therewith, so that the hot gases can heat and distill the tar and carry off the distillate vapors, and these vapors are then separately condensed, together with vapors which the gases themselves contain.

Certain of the individual coke ovens, according to the present invention, are provided with a gas collecting system or systems of a construction which will enable the tar to be sprayed or otherwise introduced directly into a stream of the hot coke oven gas immediately after it leaves the coke oven, or before the temperature has been greatly reduced. Such gas collecting system or systems may advantageously be "uptake stills" in the form of modified uptake pipes, such as hereinafter described, in which the tar is sprayed or atomized into the stream of the hot coke oven gas while the gas is at substantially its maximum temperature, but the invention in its broader aspects is not limited to the use of such uptake stills. Other apparatus may be employed to utilize the hot gases for the direct distillation of tar.

The distilling capacity of the gases from a single coke oven is greatly in excess of that required for distillation of the amount of tar which a single coke oven produces, so that the tar from a considerable number of coke ovens can be distilled in a single uptake pipe by the hot gases from a single oven.

In the construction of a battery of ovens, for distilling all the tar produced on the battery, it is therefore sufficient to provide a few only of the individual ovens with "uptake pipe stills" for distilling tar with the hot coke oven gases, and the remainder of the coke ovens of the battery may be operated in the ordinary way, the re-

covery of coal tar from their gases being accomplished in the ordinary manner. Such recovered coal tar may then be distilled in the few uptake pipe stills to produce pitches therefrom and to permit recovery of the vaporized oils from the distilled tar, together with tar and oils normally present in the gases.

For the most part, the construction of the coke oven battery and of its by-product recovery system may remain unchanged, so that the greater proportion of the coke ovens may be or remain of usual construction, and the gases therefrom may be collected in the usual collector main, and the tar separated therefrom in the usual way.

A part only of the coke oven battery will be changed by the provision of the uptake stills arranged for the distillation of tar by the hot coke oven gases and for the production of distillate and pitch therefrom. This part of the battery, provided with such modified construction of the gas outlet pipes, has its own collecting, cooling and condensing system so that the coke oven gases employed for and mixed with the vapors produced from the distillation of the tar, can be cooled for the separation of tar and oil constituents therefrom independently of the main gas collecting, cooling and recovery system of the battery.

It is one advantage of the present invention that it can be directly applied to existing or present day coke oven production. Present day coke oven operation so far as the production of coke is concerned, is unaffected, while nevertheless tar may be distilled and pitch produced and oils recovered in the separate gas collecting and condensing system. This special distilling and condensing system does not interfere with the operation of the coke ovens. The by-product recovery system for the coke ovens which are not modified by the provision of the uptake pipe still can be operated in the ordinary way.

Another important advantage of the present invention is that the employment of a separate collector main, with separate cooling and condensing system insures an easier control of the temperature of the distillation process than would be possible with the use of the uptake pipe stills leading to the collector main for the other ovens of the battery. In other words, the volume of tar required to produce a relatively large change in the temperature of the gases in the separate collector main and in the separate uptake stills would have relatively little effect upon the temperature of the total volume of gases evolved by the whole battery. Proper temperature control is important, when tar is introduced into the gases, because maintenance of the apparatus in good condition is attained thereby and in addition products producible at definite temperature ranges may be secured with certainty.

The tar which is distilled according to the present invention may be tar produced at the same coke oven plant at which it is distilled, or it may be tar from another coke oven or other plant. The tar may be a heavy tar, light tar, or heavy or light tar constituents which it is desired to distill in order to separate distillate oils therefrom. Other tar, such as gas house tar, vertical retort tar or water gas tar, etc., can also be distilled. Where blended or composite pitches are desired, or composite or blended distillates, two or more different kinds of tar may be separately distilled at the coke oven plant, or may be admixed in suitable proportions and be distilled together, giving directly a composite pitch product. Where different tars are distilled, the resulting pitches may be blended to give a composite product, and the distillates may likewise be blended when desired.

The amount of condensable oil vapors distilled from the tar in the present process may be in some cases less than the condensable oil vapor content of the coke oven gases employed for the distillation, particularly where the amount of tar distilled is regulated to secure a relatively high melting point pitch as a product of the process, and where only a limited amount of tar is subjected to distillation. In other cases however, the vapors from the tar distillation may be considerably in excess of those normally contained in the coke oven gases, so that these gases may be doubled or more than doubled in their vapor content, giving a high concentration of condensable vapors in the gases. Moreover, the effect of the distillation is proportionately to increase the content of relatively lighter oil vapors and to decrease proportionately the content of heavy pitch constituents, owing to the purifying effect of the tar spray in separating and throwing down some of the heavier constituents of the gases.

Where a few only of the coke ovens of a battery are employed for the distillation of tar and separate collection of oil, in accordance with the present invention, the separate condensing system or systems for the vapors from the coal gases of such ovens can be much smaller than the main condensing system for the remainder of the battery. Such separate condensing system or systems may be of similar construction and operation as the ordinary condensing system, from the standpoint of oil recovery, or of different construction and operation. Owing to the increased condensable oil vapor content of the gases, a proportionately smaller amount of gases require handling, while, from corresponding quantities of the gases, a much greater amount of condensable constituents can be recovered than from ordinary coke oven gases.

The manner in which the tar is brought into direct contact with the hot vapors can be varied. A suitable atomizing or spray nozzle, to which the preheated and thinly fluid tar is supplied under a sufficient pressure to bring about atomizing or spraying and resulting intimate contact of the tar with the hot gases, can be located in the upper part of the modified uptake pipe to bring the tar into intimate contact with the hot gases.

A single tar spray can be used in each of the individual uptake pipes, or a plurality or series of such sprays, and the rate at which the tar is sprayed, as well as its temperature, can be regulated and controlled to obtain a greater or less degree of distillation of the tar and the production of distillates of desired characteristics, and of harder or softer pitches or pitch-like products.

The gases escaping from the top of a coke oven are at a high temperature, e. g., around 600° to 700° C., or in some cases much higher. The temperature of these gases is sufficiently high so that effective distillation of the tar can be accomplished by an intimate and regulated spray of the tar into the hot gases. By employing the gases at practically top-of-oven temperature their maximum heating and distilling effect is utilized. The amount of tar and the intimacy and time of contact of the particles of the tar spray with the gases, and the nature and amount

of oil distilled therefrom, can be varied. Effective distillation can be accomplished with a temperature drop of the gases while passing through the tar spray, of, for example, 100° C., although with increased amount of tar or increased intimacy and time of contact a greater drop in temperature and increased distillation of oil can be obtained.

The tar in turn will be heated by the hot gases and the temperature of the tar will be very considerably raised. Part of the heat of the gases, however, is employed in vaporizing liquid constituents of the tar without corresponding increase in temperature of the tar, so that the maximum temperature of the tar and of the resulting pitch may be considerably below that of the gases.

In carrying out the process, the tar may be brought into contact with the hot gases once only or it may be recirculated and again brought into contact with the hot coke oven gases to bring about further distillation and the production of harder pitches, or even pitches of modified character, such as pitches of increased carbon content. This further distillation may take place by recirculating the tar or pitch through the same distillation system, or through another or other systems, so that distillates and pitch of the same or similar character are produced in the different systems, or distillates and pitches of different character in the different systems. By regulation of the rate and type of tar spray and its temperature of preheating, and by redistillation when necessary, it is possible to regulate the hardness of the pitches produced, and produce softer or harder pitches, as desired, and oils of different characteristics may be formed. The further distillation of the pitch first produced in order to recover additional oil therefrom, can be carried out in the same uptake pipe still, or it may be subjected to further distillation in another uptake pipe still. By operating separate uptake pipe stills as separate systems, it is possible to produce distillates and pitch of different characteristics simultaneously, while by operating separate condensing systems with such separate distillation systems, condensed products of different properties can be simultaneously produced.

In a coke oven plant having a small battery of ovens, for example, a twenty oven battery, one or two uptake stills may be sufficient to distill the tar from the remaining ovens of the battery and such still or stills may have a separate condensing system. In a larger coke oven plant having a large number of ovens in the same or separate batteries, a larger number of the uptake stills will be required to distill the tar produced by the remaining ovens of the battery or batteries. If tar from an outside source is distilled, a larger number of uptake stills may similarly be required. When a coke oven plant has several batteries of ovens, one or more uptake stills may be provided on each battery, or a sufficient number may be provided on a single battery to distill the tar produced by the other batteries and by the other ovens of the same battery, to yield the desired quantities and qualities of distillates or of pitches.

Where several uptake pipe stills are provided for the distillation of a large amount of tar, all of the uptake stills may be connected to the same condensing system, or two or more separate condensing systems may be provided. Where two or more of the uptake stills are combined with the same condensing system, these uptake stills may advantageously have a separate collector main for collecting the gases from the uptake stills so that they may pass through the separate condensing system. Where several uptake stills are provided, they may all be connected to the same collector main and the same condensing system, or different uptake pipes, or different groups of uptake pipes, may be connected to separate collector mains, each having its own independent condensing system, or the condensing systems can be inter-connected.

In the operation of such separate collector main, the gases collecting therein after passing thru the uptake still or stills may be cooled to a relatively low temperature, for example, by spraying with ammonia liquor, and a considerable amount of the condensable constituents can be separated from the gases in the separate collector main or mains. Where it is desirable to throw a larger amount of the condensable constituents over into the condensing system beyond the separate collector mains or main, the temperature in such main or mains is advantageously kept high, for example, by spraying tar in regulated amount into the separate collector main or mains, or by spraying heavy oil such as anthracene oil, etc., into the collector main in regulated amount and with regulation of the temperature so that the gases are not cooled to such an extent that too large an amount of the condensable constituents are separated in the collector main. Tar which is thus sprayed into the collector main may be dehydrated and recovered from the main along with condensed constituents from the gases as a dehydrated and partially distilled tar product. The gases, even after passing through the uptake stills will be at a sufficiently high temperature to effect distillation of tar brought into contact therewith, as by spraying it intimately into the gases in the separate collector main. In such case, the hot coke oven gases will be employed in a two-stage distillation, first in the uptake still and second in the collector main. The tar which is dehydrated, or preheated, or both, in the collector main, may then be conveyed to one of the uptake stills to effect its further distillation and to produce pitch therefrom.

The gases after passing through the separate collector main then pass to the condensing system in which further condensation of condensable constituents takes place. Such condensation may be a fractional condensation in direct or indirect type coolers or condensers of the type now commonly employed for recovering condensable constituents from coke oven gases, or the gases may be subjected to fractional condensation in a stage-by-stage scrubbing system, as, for example, by scrubbing them with oils at progressively lower temperatures.

In systems where different uptake pipe stills, or different groups of uptake pipe stills, are connected to separate condensing systems, each system may, if desired, operate upon a different material; for example, one system may distill tar in the manner described, and another system may distill a mixture of oils for the separation of different oil constituents therefrom.

It is one advantage of the improved apparatus of the present invention that it makes possible the keeping of the distilled oils separate from the main condensing system of the coke oven battery, so that, whatever oils or tar constituents are distilled in the uptake stills, they can be separately

recovered; while by operating different distillation and condensing systems, different products can be simultaneously distilled. A mixture of oils having a wide boiling point range can be subjected to distillation in one of the uptake stills, or in a group of uptake stills, having a separate condensing system, and the mixture thereby fractionated, giving the heaviest fraction as products from the uptake stills, admixed with such tar constituents as are separated from the coke oven gases in the uptake still, while the other oil constituents can be recovered partly in the separate collector main or mains, and partly in the subsequent fractional condensers or coolers.

The present invention is thus of more or less general application to the distillation of tar and oils and the recovery of distillates. It provides for the distillation of tars and oils by means of the heat of the hot coke oven gases, with provision for separately condensing the resulting distillate or distillates fractionally or otherwise. The invention also includes coke oven batteries or coke oven plants equipped for balanced operation in the sense that a part of the coke ovens are provided with uptake stills for the distillation of tar provided by the remainder of the battery or batteries in such cases as it is desired to distill part or all of the tar from the remainder of the battery at the same coke oven plant and produce distillate and pitch therefrom.

The invention will be further illustrated by the following more detailed description taken together with the accompanying drawings, which show apparatus embodying the invention, but it is intended and will be understood that the invention is illustrated thereby but not limited thereto.

In the accompanying drawings—

Fig. 1 is a view in elevation with part in section showing a portion of a coke oven provided with an uptake pipe still and separate collector main;

Fig. 2 shows a plan view of a part of a battery of coke ovens with part of the ovens provided with the uptake pipe stills and with a separate condensing system;

Fig. 3 is an elevation taken at right angles to Fig. 2, showing the separate condensing system and a part of one of the coke ovens with uptake pipe still;

Fig. 4 shows a modification of the apparatus of Fig. 1;

Fig. 5 is an enlarged view of one form of the modified uptake pipe;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 5; and

Fig. 8 is a sectional view showing one form of spray nozzle.

The invention is of more or less general application to different types and constructions of by-product coke ovens such as Semet-Solvay ovens, Koppers ovens, etc., but will be more particularly described and illustrated in connection with by-product coke ovens of the Semet-Solvay type.

In Fig. 1 is illustrated one of the coke ovens of a battery, with gas piping modified to provide for the distillation of tar or oils with the hot coke oven gases which rise from the oven. The coke oven is illustrated conventionally at 1 and has the usual gas outlet 2 for the escape of the hot coke oven gases. The uptake pipe still, viz., the modified uptake pipe, may consist generally of the outlet pipe 3, the casing 4 and the uptake L 5. The outlet pipe 3 is seated in a suitable seal over the gas outlet 2 and connects at its upper end with the lower end of the casing 4. The upper end of the casing 4 connects with the uptake L 5 which leads to a main 6 which may be similar to the ordinary collector main but smaller in size. The casing 4 is enlarged to provide a space around the inner pipe 7 which extends upwardly into the said enlarged casing. The lower ends of the pipe 7 and the casing 4 are preferably integral or threaded one within the other or joined by means of a collar suitable to provide an annular receptacle between the pipe 7 and casing 4.

Located within the casing and above the end of the pipe 7 is a baffle or hood 8 and above this in the upper part of the casing 4, or in the pipe 5 above the casing, is arranged the spray-head 9 connected with a pipe 10 for supplying tar or oil thereto. An outlet 11 for pitch or residue is located at the bottom of the enlarged casing 4 for discharging pitch or residue from the annular space between the pipe 7 and the surrounding casing 4. The casing 4 is attached by means of flanges 12 at the lower end to the outlet pipe 3 which in turn is sealed in the roof structure of the oven to take the gases rising through gas outlet 2 from the oven chamber. At its upper end the casing 4 is connected by flanges 13 with uptake L 5 which in turn connects through the valve box casting with collector main 6.

The casing 4 illustrated in Fig. 5 has a series of doors or openings 14 near the bottom to permit inspection and cleaning and has an upper door 15 carrying the baffle or hood 8, the arrangement being such that when the door 15 is opened the baffle 8 is removed from the casing 4. The casing is also provided with overflow outlets 16 located some distance from the bottom of the annular space therein. The pitch or residue outlet 11 near the bottom of the casing 4 is connected by means of a pipe 18 to a pitch receptacle 19.

The connection from the uptake pipe still to the collector main may be provided with a spray 20 for cooling and assisting in condensing the condensable constituents of the gas and additional spray nozzles 21 may also be provided in the small collector main, although these may be omitted where sudden cooling of the gases is not desired. Ammonia liquor can be used in such sprays or tar or a mixture of liquor and tar. Some heavy tar constituents may be carried along with the gases and separated or condensed after leaving the uptake L 5 although the amount of heavy tar and pitch constituents may be proportionally much less than separated from ordinary coke oven gas, owing to the purifying effect of the tar spray in the uptake pipe still in removing part of the heavier tar and pitch constituents. The condensable oil vapor content of the gases, moreover, will be much higher than in ordinary coke oven gases so that upon cooling the gases for the separation of oils therefrom, a proportionally much greater amount of oils will be obtained than of heavy tar or pitch constituents. By fractionally cooling and condensing the vapors from the gas, different fractions can be obtained, part of which may be relatively clean oil. When substantially all of the oil vapor constituents are condensed together, the product may be a tarry oil but with only a rela-

tively small amount of heavy tar constituents, as mentioned above.

In Fig. 2 part of a battery of coke ovens is indicated at 28 with certain of the coke ovens provided with the modified uptake pipe construction and the others provided with uptake pipes 29 of ordinary construction. The usual collector main connects with the uptake pipes 29 and with the cross-over main 30 leading to the coolers or condensers 31 and 32, connected to decanter 34. The exhauster for drawing the gases through the system is indicated at 35.

This part of the system of Fig. 2 is a common type of by-product coke oven system. The tar collected in the collector main and cross-over main is shown as running to a tar collecting tank or decanter 23 in which the tar separates from the ammonia liquor and this tar in turn is shown as leading to a dehydrator 24 for partly or completely freeing the tar from water and preheating it for distillation. The dehydrator may be of any suitable construction. The dehydrated and preheated tar is then pumped by the pump 25 through the tar supply pipe 10 to the spray nozzles 9.

The condensing and recovery system connected to the uptake pipe stills is shown by way of example as similar to that of the main recovery system but smaller in size. From the small collector main 6 the gases pass through a pipe corresponding to a cross-over main 30*a* to condensers 31*a* and 32*a* and then to the same exhauster 35 which may be common to both condensing systems, or separate exhausters (not shown) may be employed. Any tar or oily tar or tarry oil separating in the small collector main, as where ammonia liquor spray is employed therein, may be run to the receptacle 33*a* for the separation of ammonia liquor from the oil or tar. If this tar is a heavy tar, in case the heavier tar constituents are condensed without any considerable admixture of oils, this heavier condensate may be returned for further redistillation to recover pitch therefrom, and to throw the oils back into the system so that they can be subsequently condensed in a more or less purified state. The tar or oil separated from the small collector main, particularly where it contains a large amount of heavy oil, may be directly utilizable, alone or in admixture with other materials, for example, as creosoting or other material, while the oils separated in the condensers can also be directly utilized, and may be relatively clean oil.

In the apparatus illustrated in Fig. 2, a common tar supply is shown leading to the uptake pipe stills, and all of these uptake pipe stills are shown as connected to the same small collector main so that all of the vapors resulting from the distillation in all of the uptake pipe stills will be collected together.

In some cases, however, it may be advantageous to operate one or more of the uptake pipe stills in a different manner from that in which the others are operated. For example, tar which has been distilled in one uptake pipe can be redistillable in another uptake pipe still to drive off an additional amount of heavier oil vapors therefrom and give a heavier pitch. In such cases, separate collecting and condensing systems can be provided for the individual uptake pipe stills so that heavier oils can be recovered from one than from another. Thus, for example, uptake pipe stills 5*b* may be connected to two of the ovens and to a small collector main 6*b*. Tar or oil to be distilled may be fed to the stills through spray nozzles 9*b* and the distillation may be conducted as in the stills 5. The pitch produced in the stills will be withdrawn through a pipe 11*b* and the gases carrying the distilled vapors will be withdrawn through a cross-over main 30*b* and delivered to condensers 31*b* and 32*b* to which decanters 34*b* are connected. A decanter 33*b* permits separation of the condenser oils from the ammonia liquor which separates in the cross-over main. The condenser 32*b* may be connected to the exhauster 35 to facilitate the flow of gases and vapors through the system.

In Fig. 4 an arrangement is shown for recirculating the pitch produced from one distillation so that it may be redistilled in a second distillation, and the coke oven gases employed in said respective distillation, with different oil vapor content, can be separately collected and condensed in separate condensing systems. In this way, a fractional distillation of the tar can be effected, taking off first the more volatile constituents and giving a soft pitch, then redistilling the soft pitch to take off heavier constituents and give a harder pitch, and the lighter and heavier oils driven off by these successive distillations can be separately condensed along with the vapors of the coke oven gases by which they are carried. In Fig. 4 the pitch receptacle 19 is shown as having a pipe 27 leading therefrom to the spray nozzle and a pump 26 in this line for recirculating the pitch or tar.

One suitable form of spray nozzle is indicated in Fig. 8, this having an outer casing 36 with an inner core 37 having helical passages formed between it and the outer casing 36 and with the nozzle orifice 38. The construction is such that the tar or oil is discharged with a whirling motion in the form of a conical spray. The tar or oil, when it is preheated and thinly fluid, may be pumped to the nozzle under a suitable pressure, for example, 40 pounds per square inch and discharged through the nozzle so as to atomize or spray it into the hot uprising gas.

In the operation of the apparatus illustrated, the hot gases from the distillation of coal in the coke oven pass upwardly through the uptake pipe stills and thence through the connecting piping to the condensing system which in the apparatus illustrated is in part a small collector main. The remainder of the battery of ovens can be operated in the ordinary way to separate tar fractionally or completely from the coke oven gases, as by spraying ammonia liquor or tar or both into the collector main and separating out more or less of the tar in the collector main and then passing the gases through coolers or condensers where the remainder of the tar or oily constituents is for the most part separated. The entire tar or oil, separated both in the collector main and in the subsequent coolers or condensers, may be admixed and employed for redistillation, or only the heavier tar may be so distilled or only the lighter tar or oils may be used or tar or oils from another battery of ovens or from another plant may be employed in the process. The distilling capacity of the hot coke oven gases is so greatly in excess of the amount of tar or oils which is normally produced from the gases that a few only of the ovens, when provided with the new uptake pipe stills, can distill the tar or oils produced by the rest of the battery, and a larger number of ovens can be employed to distill tar or oils from other batteries or from other plants.

The tar or oil to be distilled is supplied in reg-

ulated amounts to the spray nozzle and sprayed into the hot coal distillation gases. The tar or oil may be advantageously preheated before being so sprayed. The hot coal distillation gases are brought into intimate contact with the spray of tar or oil and the tar or oil is heated and distilled by the hot gases, while the hot gases themselves are somewhat cooled. The tar or oil is prevented from falling down into the coke ovens by the baffle 8 and collects in the space outside the pipe 7 and runs out through the pitch or residue outlet 11.

The action of the hot gases upon the particles of tar or oil spray or upon the tar or oil otherwise brought into intimate contact with them and flowing down over the surfaces of the uptake pipe still, is such that the tar or oil is heated and volatile oils distilled therefrom so that a heavier tar or pitch or residual oil collects and runs out through the pitch or residue outlet. The distillation can be regulated in the manner hereinbefore described, as by preheating the tar or oil to a greater or less extent before spraying it into the hot gases, or by regulating the rate or character of spray, etc.

The tar or oil may be subjected to a high temperature for only a short period of time. As a result, a low carbon pitch, as compared with ordinary distillation, can be directly produced without any appreciable increase in carbon content over that normally present in the tar from which the pitch is produced.

The gases after leaving the uptake pipe still and while still at a relatively high temperature may be further cooled, for example, by ammonia liquor or tar sprays in the small collector main, before passing to the condensers, or the gases may be passed to the cross-over main and to the condensers while still at a high temperature. Depending upon the method of cooling and condensation, the oils from the redistillation of the coal tar, together with oil and tar constituents from the normal coal distillation gases employed in the tar distillation, can be obtained in part in the collector main and in part in the subsequent coolers or condensers as relatively clean oils or tarry oils or oily tar containing a greatly decreased content of heavy tar constituents and made up mainly of oils.

When tar or oils are sprayed into the gases in the separate collector main, the heat of the gases will effect partial distillation thereof, and such sprays will further cool and clean the gases, removing some of the heavier tar constituents and increasing their content of oils. In such cases the hot coke oven gases are employed twice, in series, at a higher and then at a somewhat lower temperature, to distill tar or oils, and the gases so employed are twice scrubbed or cleaned by the tar or oil sprays. Where the residue from the second or subsequent treatment or treatments is used in the first treatment, the operation becomes countercurrent, and the tar or oils are preheated (and may be dehydrated) as well as partly distilled, by the gases at the lower temperature before further distillation by the gases at the higher temperature. Nevertheless the heat of the gases is such that effective distillation of a large amount of tar or oil can be so effected, while still leaving the gases at a high temperature such that they carry a large amount of condensable oil constituents recoverable in the separate condensing system, fractionally or otherwise.

In the operation of the battery illustrated in Fig. 2, most of the ovens are provided with uptake pipes of usual construction which may have ammonia liquor or tar sprays in the goose-neck or uptake L and in the collector main to separate a considerable amount of heavy tar in the collector main and to give gases of low tar content going to the coolers or condensers. The entire tar product, or only the heavier tar, or only the lighter tar, can then be employed as the tar to be distilled, for example, by passing the tar to a dehydrator and there dehydrating and preheating it and then bringing the preheated tar into intimate contact with the hot coal distillation gases from the coke ovens so as to utilize the high temperature and heat of these gases to distill the tar and produce distillates and pitch therefrom.

The part of the battery thus employed for tar distillation purposes combines in its function that of a coke oven plant for producing coke and coal distillation gases, and the distillation of tar by the hot coal distillation gases, thus combining a tar distillation plant with the coke oven plant and eliminating expense of transportation of the coal tar from the coke oven plant to the tar distillation plant while also greatly reducing plant cost and fuel cost for the tar distillation by utilizing the hot coal distillation gases, the heat of which is valueless and which must commonly be removed at large expense.

The uptake pipe and the circulating lines, etc., are illustrated in the drawings in a conventional manner and without any insulation around them, but where it is desired to prevent loss of heat by radiation, or to reduce such loss, or to prevent undue cooling of circulating lines, etc., such circulating lines, and the uptake pipes and connecting pipes through which the gases and liquids pass, can be provided with heat insulation.

Furthermore, the hot coal distillation gases from the coke oven can be cooled somewhat before bringing them into contact with the tar provided their temperature is still sufficiently high to bring about the desired distillation of the tar and the production of distillates and pitch therefrom. It is advantageous, however, to utilize the hot gases at their maximum temperature, immediately after they escape from the coke ovens, by employing them in the manner described.

While I have described and illustrated a particular type and construction of uptake pipe still, it will be evident that the invention in its broader aspects can be carried out in apparatus of other construction in which the tar or oils are distilled by the hot gases and the distillates separately condensed in the manner described.

This application is a division of my co-pending application Serial No. 158,137, filed December 31, 1926 which has matured into Patent No. 1,844,889.

I claim:

1. A by-product coke oven battery which comprises means to remove tar from the gases from the ovens of part of the battery thereby producing a cooled vapor-containing gas, means to bring tar into contact with hot gases evolved by ovens of another part of the battery before passing them through cooling means and means to condense vapors obtained from such contact separately from the vapors contained in said cooled gas.

2. A battery of coal distillation ovens or retorts having separate condensing systems for coal tar constituents from ovens in different parts of the battery, and means for bringing tar into direct contact with hot distillation gases from

at least one of the ovens or retorts of one of these parts of the battery before cooling them so as to effect distillation of the tar and the production of pitch therefrom, whereby the gases admixed with the vapors of one condensing system are enriched by the vapors from the distillation.

3. A by-product coke oven plant having one or more condensing systems for condensing coal tar constituents from a number of the ovens of the plant, at least one of the ovens of the plant being provided with means for bringing the tar into direct contact with the hot coke oven gases at a temperature sufficient to distill the tar and produce pitch therefrom, and a separate condensing system for the resulting admixed gases and vapors.

4. A by-product coke oven battery having most of the ovens connected with condensing systems for condensing tar constituents from the gases, a few of the ovens being provided with uptake pipe stills for distilling tar by bringing it into direct contact with the hot coke oven gases, and a separate condensing system for that part of the battery which includes such uptake pipe stills.

5. A by-product coke oven battery having at least one collector main connected with the uptake pipes for most of the ovens of the battery and means for collecting tar from the coke oven gases, means for dehydrating the tar, and means for bringing the dehydrated tar into direct contact with hot coke oven gases from another part of the battery before cooling them to effect distillation of the tar, and a separate condensing system for the gases from that part of the battery where such distillation takes place.

6. A by-product coke oven battery having a collector main connected with the up-take pipes from most of the ovens of the battery, distilling means connected directly with a few of the ovens of the battery and two condensers, one connected with the collector main and the other connected with the distilling means.

7. A by-product coke oven battery, which comprises means to remove tar from the gases from the ovens of part of the battery, means to bring tar into contact with hot gases evolved by ovens of another part of the battery before passing them through cooling means, a condenser, means to pass the gases with which tar has been brought into contact to said condenser and means for passing both the gases from the condenser and the first-mentioned gases after the removal of tar to the same by-product recovery means for the removal of further by-products.

8. A by-product coke oven battery, which comprises means to remove tar from the gases from the ovens of part of the battery, means to collect the tar thus removed, means to convey tar from this collecting means and bring it into contact with hot gases evolved by ovens of another part of the battery before passing them through cooling means, and cooling means to which the resulting gases are passed, said cooling means being separate from the said means for removing tar from the gases.

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