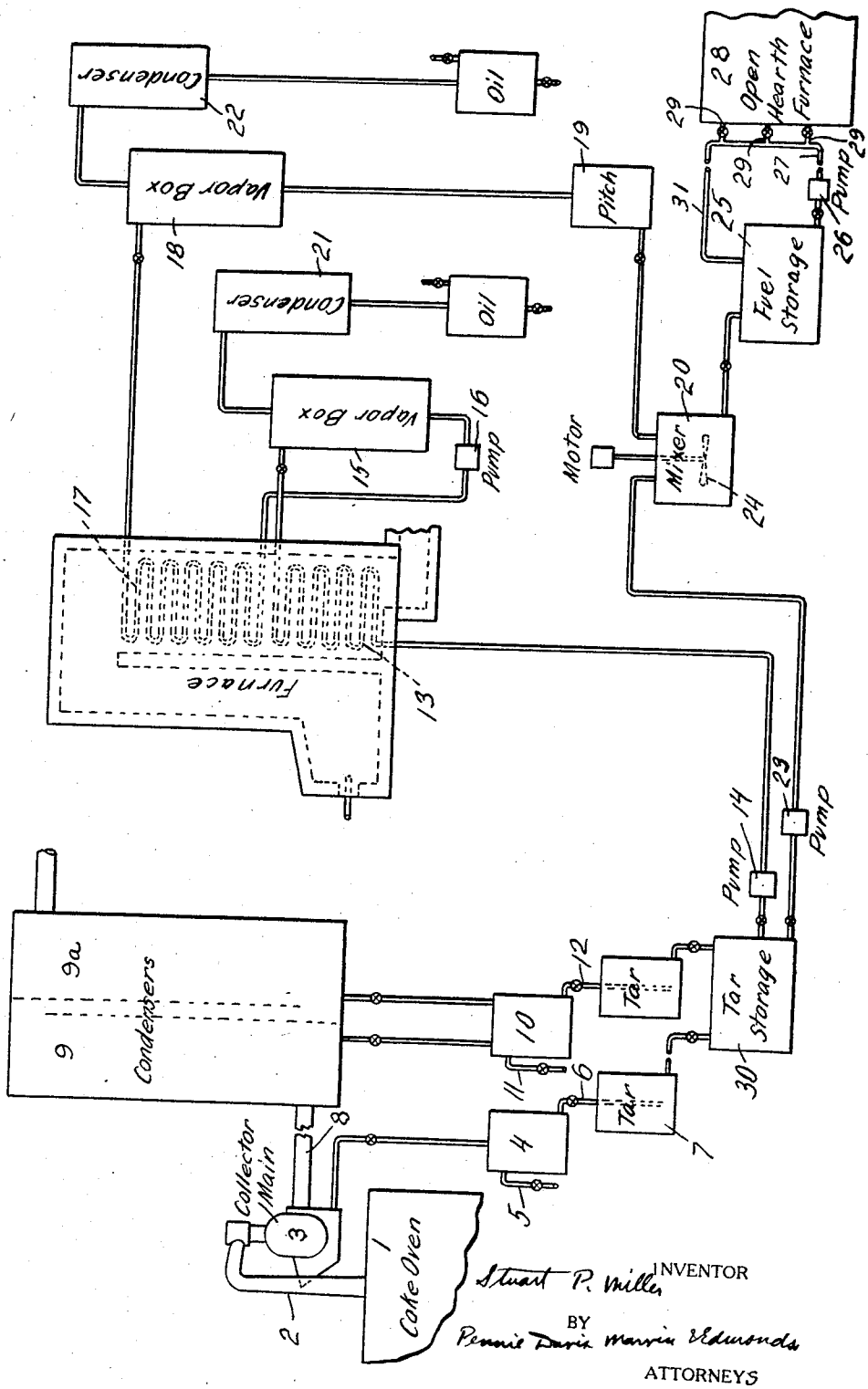
June 30, 1931. S. P. MILLER 1,812,829

PRODUCTION OF FUEL, ETC

Filed April 17, 1928 3 Sheets-Sheet 1

Fig. 1.



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June 30, 1931. S. P. MILLER 1,812,829

PRODUCTION OF FUEL, ETC

Filed April 17, 1928 3 Sheets-Sheet 2

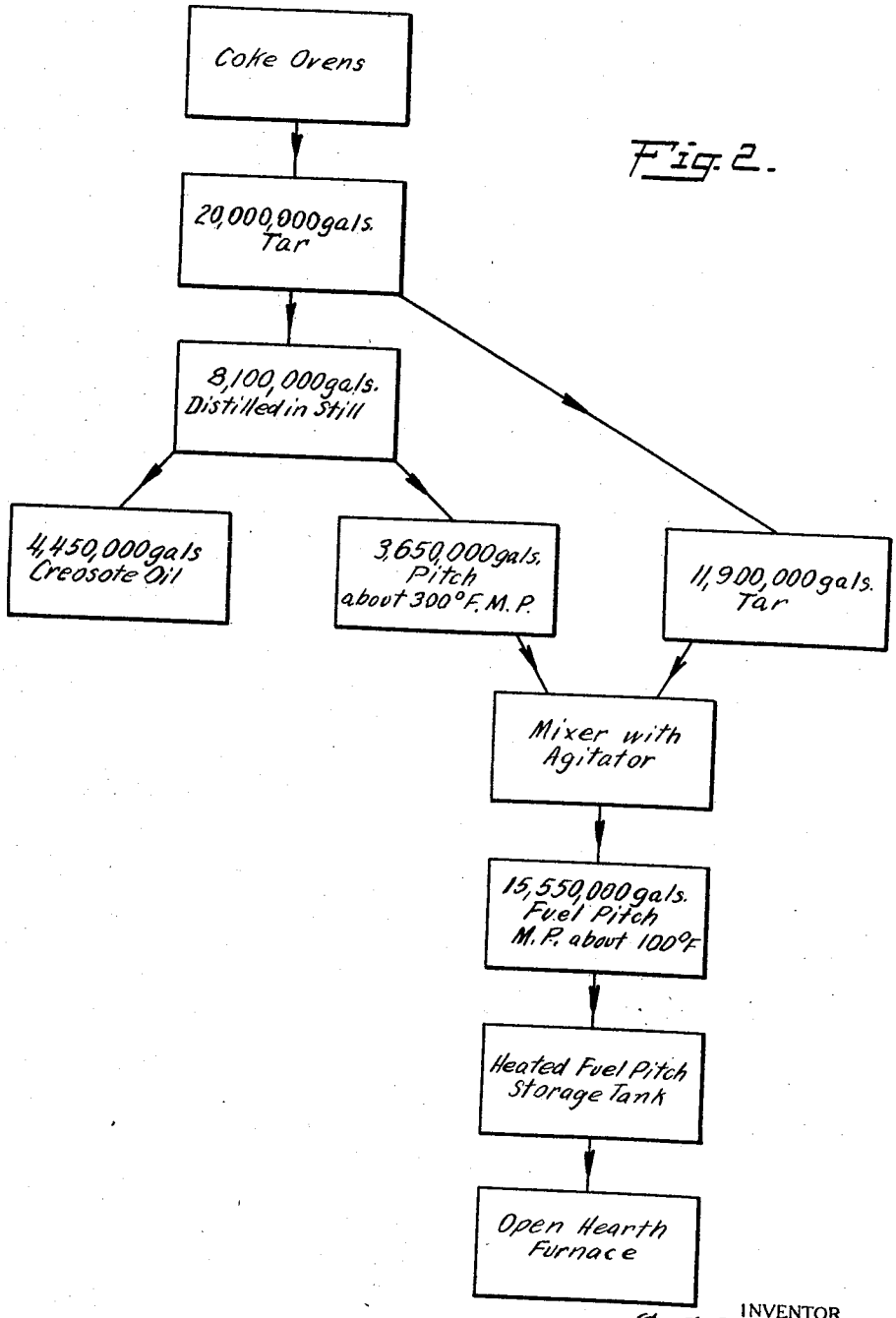


Fig. 2.

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June 30, 1931. S. P. MILLER 1,812,829

PRODUCTION OF FUEL, ETC

Filed April 17, 1928 3 Sheets-Sheet 3

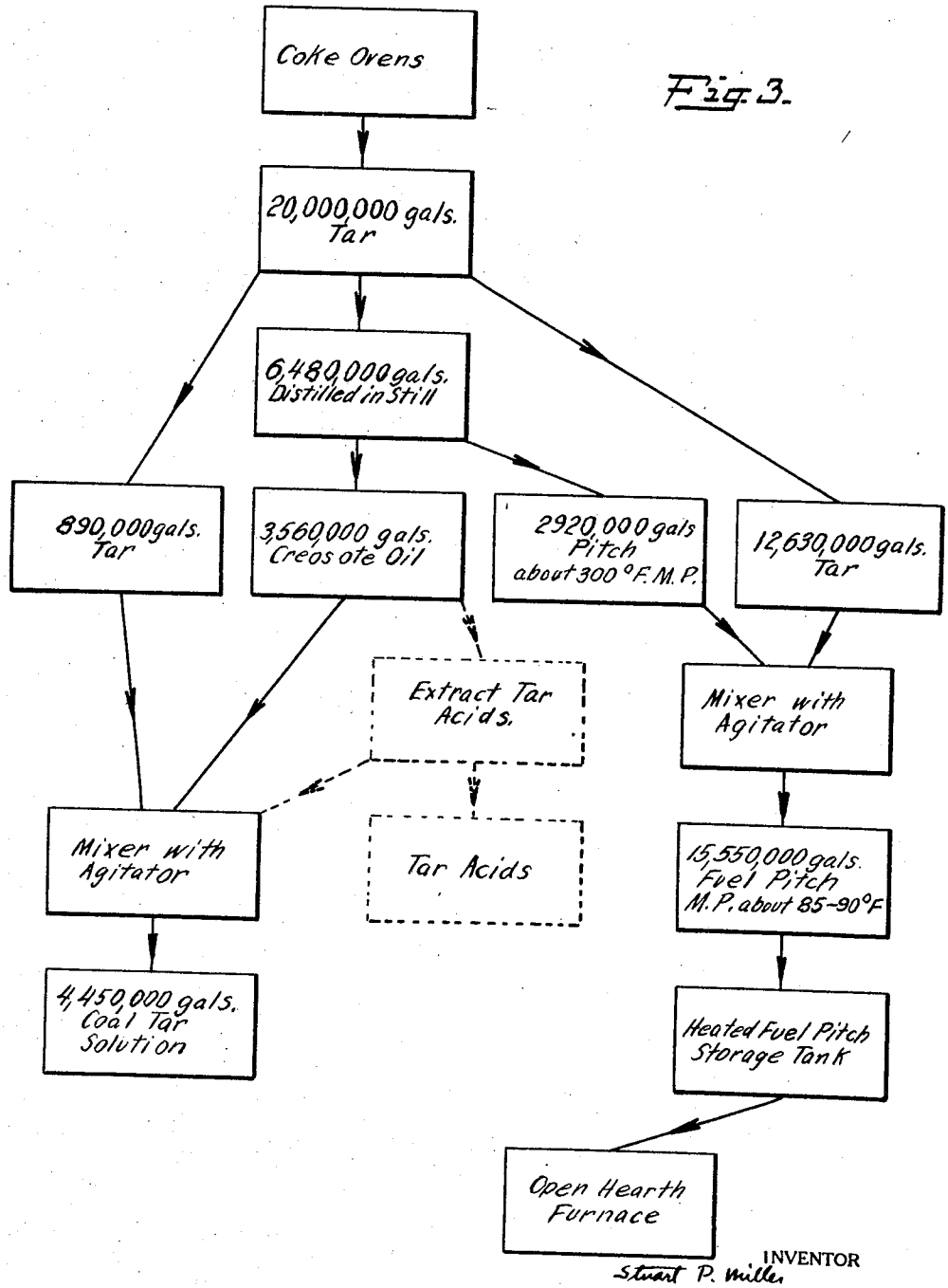


Fig. 3.

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Patented June 30, 1931 1,812,829

UNITED STATES PATENT OFFICE

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PRODUCTION OF FUEL, ETC.

Application filed April 17, 1928. Serial No. 270,625.

This invention relates to the production of fuel from coke oven tar for use in steel mills, together with the production of creosote oil or creosoting compositions from such coke oven tar.

Where coke oven plants are operated by steel companies, the coke produced at the coke oven plant is commonly used in the blast furnaces of the steel company and the tar produced at the coke oven plant is commonly used as fuel in the steel mill, particularly as fuel in open hearth or other furnaces. When a surplus of tar is produced by the coke oven plant, in excess of that required as fuel in the steel mills, the excess is commonly sold as tar and is shipped to tar distillation plants and there distilled for the production of distillate oils and pitch. The distillate oils have considerably greater value than the tar itself, but the pitch has relatively much less value and in some cases presents a problem in its disposal.

The present invention provides an improved process in which surplus tar produced at the coke oven plant is employed for giving distillate oils, and particularly creosote oils, of considerably greater value than the tar, without producing a separate pitch product presenting any problems for its disposition, and in which the pitch produced by the distillation, is blended with tar to give an improved fuel for use in open hearth and other furnaces. The improved process of the present invention enables the entire surplus production of tar to be converted into valuable distillate oils, such as creosote oil, or coal tar solutions, while providing an improved fuel for use in the operation of the open hearth and other furnaces of the steel mill.

According to the present invention, I subject an amount of tar which is in excess of the surplus tar production of the coke oven plant to distillation, and I produce therefrom valuable distillate oils, particularly cresote oil, which may be sold as merchantable oils, or which may be blended with additional tar to form commercial coal tar solutions; and I combine the pitch residue from such distillation with the tar which is not subjected to distillation, thereby producing an improved fuel in the form of a pitch of relatively low melting point which is employed instead of tar as the fuel in the open hearth or other furnaces. By combining these operations at the coke oven plant, the surplus tar production is converted into products of considerably greater value, while the tar ordinarily employed as fuel is replaced in whole or in part by an improved fuel made up of the undistilled tar, or a suitable portion of it, blended with the pitch residue from the distillation to form a homogeneous fuel.

The tar which is subjected to distillation, according to the present invention, is the coke oven tar which is available as surplus production at coke oven and steel plants where only part of the tar is employed as fuel at the steel plants, but instead of distilling only the surplus tar production, I distill a larger amount of tar to give an amount of distillate therefrom which is approximately equal to the surplus tar production volume, and I make up for the part of the tar which would ordinarily be employed as fuel by the pitch residue from the distillation which is approximately equal in volume to that part of the tar distilled which would ordinarily be employed as fuel. It will be understood, however, that these approximate volumes can be varied somewhat, as where only part of the excess tar, not desired as fuel, is subjected to distillation according to the invention.

The distillation of the tar to produce distillate oils and pitch therefrom, can be carried out in ordinary externally heated tar stills, operating either upon successive batches of tar, or continuously. I consider continuous distillation of the tar particularly advantageous since it gives a continuous production of distillate oils and of pitch residue, which pitch residue can advantageously be blended in a continuous manner with tar to produce an improved fuel that can be supplied directly to the open hearth or other furnaces as fuel. A valuable method of carrying out this continuous distillation is in a pipe still in which the tar is heated to a high temperature while being

forced at high velocity through a long continuous heating coil and in which the heated tar is discharged into a vapor box or vaporizing chamber to permit separation of vaporized oils from the pitch residue. Such a continuous method of distillation can be carried out in stages to give first a distillate of lower boiling point, and with further distillation of the pitch residue from the first distillation to give pitch of higher melting point and a distillate of higher boiling point. In this way, the distillation can be made a fractional distillation to give directly two or more distillates differing from each other. The distillates can also be fractionally condensed to give fractions of different composition and boiling point.

The extent to which the distillation is carried can be varied, but in general the distillation should be carried sufficiently to produce a distillate oil which can be employed in whole or in part as creosote oil, or for blending with tar to make coal tar solutions or creosoting compositions. If the distillation is carried only to the extent of producing pitch of around 165° F. melting point, the total distillates produced may be too light for certain creosoting purposes, and may require fractionation or fractional condensation to give a heavier creosote oil and a lighter oil. When, however, the distillation is carried further to produce a pitch of melting point around 200° F. or higher, and particularly where it is carried to the point of producing pitch of melting point around 250° F. or around 300° F. melting point, the total distillate oil is a valuable creosote oil, and as much as half or more of the tar distilled can be recovered as valuable creosote oil, leaving a pitch residue representing around half or somewhat less of the tar subjected to distillation.

The total distillates produced as above described can be employed directly as creosote oils, and can be marketed as such. Where phenols or tar acids are desired, the total distillates can be extracted with caustic soda to recover tar acids therefrom, leaving a tar acid free oil which is a valuable creosote oil. Instead of extracting the entire distillate, the distillate can be fractionally condensed or separated and only the lighter carbolic oil subjected to extraction for the production of tar acids therefrom. In such case, the extracted oil can be returned for blending with the heavier portion of the distillate for use as creosote oil, or can be returned and blended with pitch or with tar for use as fuel.

Creosote oils are employed to a large extent in admixture with tar as so-called coal tar solutions, commonly made of about 20% of tar and 80% of creosote oils. When the distillate produced by the present process is employed in making such coal tar solutions, an additional amount of tar is required for blending therewith, thus further reducing the amount of tar which is used directly as fuel or with which the pitch residue from the distillation is blended for use as fuel.

When the distillation of the tar is carried out by direct contact with hot coke oven gases, an increased yield of oils can be obtained and a pitch produced of relatively low carbon content.

The pitch residue produced by the distillation is blended, while still hot, with tar to produce an improved fuel to be used in place of tar in the open hearth or other furnaces. With pitch of melting points around 250 or 300° F. it is important to carry out the admixture with tar under properly regulated conditions. Unless these are observed, there is danger of formation of a livery mass. To insure an intimate and uniform admixture and blending of the hot pitch with the tar, I carry out the admixture with sufficient agitation to insure uniform and thorough admixture. This can be accomplished by running streams of the tar and hot pitch together in a suitable mixing chamber or tank with sufficient agitation of the mixture to insure thorough blending and homogeneity. The mixing can thus be carried out by flowing the tar and pitch into a body of the resulting admixture, so that the gradually and progressively added tar and pitch blend with the accumulated body of admixed material instead of directly with each other. The bulk of previously admixed materials, to which the tar and pitch are added need not be large but it should be maintained at a proper temperature to insure that the added tar and pitch will blend therewith continuously to form a homogeneous blend. Agitation during the blending operation is important, and particularly so where the tar and pitch are run together directly without having a body of previously admixed material to which the pitch and tar are added.

The high temperature of the hot pitch blended with the cold tar will give a blended product which has a temperature considerably above that of the tar and considerably above atmospheric. This is important, because the resulting product is itself a pitch which may have a melting point considerably above atmospheric temperature and which would solidify if permitted to cool to atmospheric temperature. In order to prevent such cooling and solidification, I maintain the blended product at a temperature which insures that it is thinly fluid so that it can be pumped and handled and used as fuel in the same equipment in which tar is ordinarily handled for that purpose.

The fuel storage tanks in which the fuel composition of the present invention is stored should be provided with heating means, such as steam coils in the bottoms of the storage

tanks, to insure that the fuel product will be maintained thinly fluid. This fuel can then be pumped from the storage tanks to the open hearth or other furnace and there employed in the burners as fuel. It is a more valuable fuel than ordinary coal tar, containing a considerably higher proportion of heavier constituents supplied by the pitch, and being free from a corresponding amount of lighter oil constituents which have been distilled from the pitch before it is blended with the tar to make the new composite fuel product. Should it be necessary to store the fuel composition before use, or to discontinue its use temporarily, it can be maintained in a warm or hot thinly fluid condition by supplying heat to the storage tanks, and it can be kept from solidifying in the pipe lines leading to the burners by maintaining a continuous circulation of the fuel through these lines and back to the storage tanks so that the circulating fuel will be kept at a temperaure above that of solidification.

The excess tar which is available for distillation, according to the present invention, will vary with different coke oven and steel plants. It may be only a small proportion of the total tar produced, or it may be a major proportion. All of the excess tar may be subjected to distillation, or only part of the excess tar. In case only a minor portion of the total tar production is subjected to distillation, the pitch produced may be blended with only part of the undistilled tar.

The excess tar which is subjected to distillation according to the present invention may be considerably in excess of that which would ordinarily be considered excess tar. The greater value of the distillate oils produced from the tar distilled, and the equal or greater value of the fuel composition produced by blending the pitch residue from the distillation with the undistilled tar make it profitable to distill the greater part of the tar produced at the coke oven plant, leaving only enough tar undistilled to blend with the pitch residue from the distillation to produce fuel pitch; and if the amount of fuel pitch so produced does not meet the requirements of the steel mill, additional fuel oil can be supplied to make up the fuel requirements of the steel mill. For example, as much as two-thirds or more of the total tar produced can be subjected to distillation to give a yield of 50% or more of the tar distilled as valuable distillate oils, and the pitch residue from the distillation can then be blended with the undistilled tar to give a quantity of fuel pitch which may represent only two-thirds or one half or less of the volume of tar produced, in which case the yield of valuable distillate oils may amount to a third or a half or more of the total tar production.

The distillation of the excess tar may in some cases be carried out at a tar distillation plant to which the tar is shipped and from which the pitch is returned. In such case, the pitch, if returned in a cold solidified state, will require reheating to make it hot and thinly fluid before it is blended with the undistilled tar to produce the fuel composition. In such case, the fuel composition when produced should be kept hot, or, if permitted to cool and solidify, should be reheated, before it is supplied as fuel at the steel plant, so that it will be supplied to the burners in a hot and thinly fluid condition.

The process of the present invention can be carried out much more advantageously by distilling the excess tar at the place of production or use so that the still hot and thinly fluid pitch residue from the distillation can be blended directly with the undistilled tar to give a hot and thinly fluid fuel composition. If this fuel is permitted to cool and solidify, it must be reheated and rendered thinly fluid before being used as fuel at the steel plant. This need of reheating is eliminated where the distillation and production of the fuel pitch is carried out at the steel plant so that the hot fuel can be produced and used while in a still hot condition and maintained hot and thinly fluid from the time it is produced until it is employed as fuel at the steel plant.

In all cases it is important that the fuel composition be maintained hot and thinly fluid while it is being used as fuel, and, with fuel compositions that solidify when permitted to cool, it is important to supply the fuel compositions in insulated lines to the burners and to maintain a circulation of the fuel continually, as by circulating it past the burners and back to the supply tank and keeping it hot and thinly fluid during circulation, thereby insuring against solidification and "freezing" of the fuel in the supply pipes, and enabling the fuel composition to be available at all times in a hot and thinly fluid state for use in the fuel burners.

The invention will be further illustrated by the following more detailed description of certain examples thereof, in connection with the accompanying drawings which show illustrative flow sheets and a diagrammatic arrangement of apparatus for the carrying out of the process of the invention and the production of the new fuel composition.

In the accompanying drawings,

Fig. 1 shows a diagrammatic arrangement of apparatus for carrying out the process of the invention; and

Figs. 2 and 3 show illustrative flow sheets.

In the apparatus of Fig. 1 a coke oven block is shown conventionally at 1, having the usual uptake pipes 2 leading from the individual coke ovens to a collector main 3 common to a number of the ovens of the block. In the collector main the coke oven gases are cooled, as by the introduction of ammonia

liquor, or ammonia liquor and tar, and a considerable part, usually the greater part, of the tar contained in the gases is separated or condensed. The tar and ammonia liquor flow from the collector main to the separators or decanters 4 from which the ammonia liquor is separately drawn off at 5, and the tar separately drawn off at 6 to the tar storage tanks 7.

The gases from the collector main pass through the cross-over main 8 to the condensers, of which two are shown as 9 and 9*a*, and the gases then go to the gas handling system (not shown). The tarry oils from the condensers may be collected together in the separator or decanter 10, the ammonia liquor drawn off at 11 and the tarry oil or light tar drawn off at 12 to the tar storage tanks 30.

The still shown is a pipe coil still 13 through which the tar is pumped from a tar storage tank by means of the pump 14. A vapor box or vapor separating chamber 15 is located at the end of the first heating coil. The pitch collecting in the bottom of the vapor separating chamber is pumped by pump 16 through a second heating coil 17 and further heated and discharged into the vapor separating chamber 18 from which the pitch residue is drawn off through the line 19 to the mixing chamber 20. The heating coils are enclosed in a suitable furnace, heated by any suitable fuel.

The still illustrated subjects the tar to distillation in two stages, with separation of the distillate oil vapors from the first stage and further heating of the pitch residue from the first stage to a higher temperature to produce therefrom a pitch residue of higher melting point and a heavier distillate. Separate condensers 21 and 22 are provided for condensing the distillates from the two stages of distillation, and, if desired, the condensers may be fractional condensers, to give heavier and lighter oil distillates. The total distillate can be blended together to give creosote oil, or part of the oil, particularly the lower boiling fraction, may be extracted for tar acids and the neutral oil returned for admixture with the unextracted oil to give creosote oil, or employed for other purposes.

Part of the tar from the tar storage tank is pumped by pump 23 to the mixing chamber 20 and is there intimately admixed with the hot pitch. A suitable agitating device 24 is provided in the mixing chamber for insuring thorough and uniform intermixture. The mixing chamber shown is one in which a small body of the mixed material is maintained so that the tar and pitch can blend therewith instead of directly with each other, although, with sufficient agitation, they may be blended directly with each other without interposition of a body of the previously blended material. From the mixing chamber the resulting homogeneous mixture flows while still warm or hot to the storage tank 25 from which it is drawn off by means of pump 26 through the line 27 to the open hearth or other furnace 28 where it is employed as fuel.

Figs. 2 and 3 show illustrative flow sheets giving typical operations of the process where the excess tar production, not desired as fuel, is only around a quarter or a fifth of the total tar production. Assuming, for example, a total tar production of twenty million gallons a year of which only around three-quarters is required as fuel and around a quarter is excess production to be used for other purposes, this excess production would ordinarily be sold as tar, and, on distillation, according to common methods of distillation, would give around half or somewhat more of its volume of creosote oil and around half or somewhat less its volume of pitch, and this pitch, being a product of relatively little value, much less than the value of the tar itself as fuel, would limit the return to the tar distiller of the products of the distillation. Taking the amount of tar illustrated in the flow sheets, namely, twenty million gallons production with around four and a half million gallons excess over and above that required for fuel, this excess tar, on distillation, would give around two and a quarter million gallons of creosote oil, or something more, and a somewhat smaller amount of pitch having a much less value than the tar itself as fuel.

According to the present invention, a much larger amount of tar is subjected to distillation than the excess tar not desired as fuel, so that the amount of creosote oil obtainable therefrom is approximately equal to what would otherwise be the total tar production. When, instead of creosote oil, coal tar solution is to be made, the amount of tar to be distilled will be somewhat less than when creosote oil alone is to be the sole product, but the amount of tar distilled will nevertheless be considerably in excess of what would ordinarily be the excess tar production; and, in addition, a considerable amount of the tar is employed directly in making coal tar solution without requiring distillation, thus giving a total of around four and a half million gallons of valuable coal tar solution.

The pitch produced in the present process is blended with the tar which is not subjected to distillation and not used for making coal tar solutions to give a total blended product approximately equal in volume to the normal fuel requirements of tar in the steel plant.

When it is appreciated that the value of creosote oil or of coal tar solution is ordinarily considerably more than twice that of the tar itself, and that pitch has a value which represents only a small fraction of the value of the tar for equal volume, and when it is considered that the present invention makes

possible the production of creosote oil or coal tar solution equal to the entire excess tar production and at the same time gives a superior fuel in place of tar for use in open hearth furnaces, it will be appreciated that the present invention is a radical improvement over present methods of handling excess tar production at coke oven and steel plants. The pitch, which would ordinarily be a product of little value, is retained as a product having as great or greater a value than the tar itself as fuel, and is blended with tar to give an improved fuel for open hearth furnaces. The carrying out of the process at the coke oven and steel plants eliminates cost of transportation to the tar distillation plant and reduces losses of tar through handling and transportation.

It will be understood that the specific examples of the process hereinbefore given, and the specific illustrations of the process given in the drawings and in the flow sheet are illustrative of the invention, and that variations can be made in the proportion of tar distilled and employed without distillation, in the particular method of distillation employed, in the melting point of pitch produced and the yield of distillate oils, and in the proportions in which the pitch and undistilled tar are blended, as well as variations in the character of cresote oil or other distillates produced, etc.

The specific examples above described and illustrated on the drawings indicate the advantages of the invention when only a relatively small part of the tar produced is subjected to distillation and when the greater part of the tar is undistilled. Even in such cases pronounced advantages are obtained. Even greater advantages are obtained when larger proportions of the tar are distilled and greater yields of distillate oils are produced and relatively smaller amounts of the new fuel composition are produced and used as fuel at the steel plant. The maximum advantages are obtained when the maximum amount of tar is distilled and only sufficient tar remains undistilled to blend with the pitch residue from the distillation to make the new fuel composition.

I claim:

1. The improvement in the utilization of coke oven tar as fuel in steel plants which comprises subjecting part of the tar to distillation to give a distillate suitable for use for creosote oil and a pitch residue, blending the pitch residue while hot and thinly fluid from such distillation with coke oven tar with agitation to promote the formation of a uniform product, and supplying the resulting product in a hot and thinly fluid condition as fuel to the open hearth or other furnaces of the steel plant.

2. The improvement in the utilization of coke oven tar as fuel in steel plants which comprises subjecting part of the tar to distillation to give a distillate suitable for use for creosote oil and a pitch residue, blending the pitch residue while hot and thinly fluid from such distillation with coke oven tar by adding the tar and pitch to a previously blended and thinly fluid mixture thereof with agitation to promote the blending operation and supplying the resulting product in a hot and thinly fluid condition as fuel to the open hearth or other furnaces of the steel plant.

3. The improvement in the utilization of coke oven tar as fuel in steel plants which comprises subjecting part of the tar to distillation in a continuous manner to give continuously a distillate suitable for use for creosote oil and a pitch residue, blending the pitch residue produced by such continuous distillation with coke oven tar in a continuous manner by bringing the still hot and thinly fluid pitch and tar together with agitation to promote the formation of a uniform product and supplying the resulting mixture in a hot and thinly fluid condition as fuel to the open hearth or other furnaces of the steel plant.

4. The further improvement in the process of claim 3 in which the continuous blending of the tar and pitch with each other is promoted by adding the still hot pitch and the tar continuously to a hot and thinly fluid previously blended mixture with continuous drawing off of the blended product and maintenance of a body thereof with which the continuously added tar and pitch are blended.

5. The improvement in the utilization of coke oven tar as fuel in steel plants which comprises subjecting part of the tar to distillation to give a distillate suitable for use for creosote oil and a pitch residue having a melting point in excess of about 250° F., blending the pitch residue while still hot and thinly fluid with coke oven tar with agitation to promote the formation of a uniform product, keeping the resulting mixture hot and thinly fluid and supplying it in a hot and thinly fluid condition as fuel to the open hearth or other furnaces of the steel plant.

6. The improvement in the utilization of coke oven tar as fuel in steel plants which comprises subjecting part of the tar to distillation to give a distillate suitable for use for creosote oil and a pitch residue having a melting point of about 300° F., blending the pitch residue while still hot and thinly fluid with coke oven tar with agitation to promote the formation of a uniform product, keeping the resulting mixture hot and thinly fluid and supplying it in a hot and thinly fluid condition as fuel to the furnaces of the steel plant.

7. The improvement in the utilization of excess coke oven tar at coke oven and steel plants where a part only of the tar is required as fuel in the steel plants which comprises subjecting the excess tar and part of the tar

normally required as fuel to distillation to produce therefrom distillate oil suitable for use for creosote oil and a pitch residue, blending the pitch residue while still hot and thinly fluid with tar to be used as fuel in the steel plant to form a homogeneous blended fuel product and supplying such fuel product in a hot and thinly fluid condition to supply the fuel needs of the furnaces of the steel plant.

8. The improvement in the utilization of coke oven tar as fuel in steel plants where the coke oven tar is available in excess of the fuel requirements which comprises dividing the tar into two parts, the first of which is less than the fuel requirements, distilling the second part of the tar to give a distillate oil suitable for use as creosote oil and a pitch residue, blending the pitch residue while still hot and thinly fluid with the first part of the tar to give a homogeneous and thinly fluid hot fuel mixture, and supplying such fuel mixture in a hot and thinly fluid condition to the furnaces of the steel plant.

9. The improvement in the utilization of coke oven tar as fuel in steel plants where the coke oven tar is available in excess of the fuel requirements which comprises dividing the tar into three parts, the first of which is less than the fuel requirements, distilling a second part of such tar to give a distillate suitable for use for creosote oil and a pitch residue in amount sufficient when blended with the first part of the tar to meet the fuel requirements, blending such pitch while still hot and thinly fluid with the tar to form a thinly fluid mixture, and supplying such mixture in a hot and thinly fluid condition as fuel to the furnaces of the steel plant.

10. The method of producing a composite product from coal tar, which comprises subjecting tar to distillation in a continuous manner to produce therefrom distillate oils and a pitch residue, drawing off the pitch residue while it is hot and thinly fluid from the distillation and continuously blending it with coal tar in an unheated condition, with agitation of the mixture to promote the formation of a uniform and thinly fluid blended product.

11. The method of producing a composite product from coal tar, which comprises subjecting a portion of the tar to distillation in a continuous manner to produce therefrom distillate oils and a pitch residue, withdrawing the pitch residue while in a hot and thinly fluid state from the distillation and continuously adding the same to a body of previously admixed hot pitch and tar, continuously adding unheated tar to said body, and agitating said body to cause blending of the added hot pitch and unheated tar therewith.

12. The method of producing a composite product from coal tar, which comprises subjecting part of the tar to distillation in a continuous manner and carrying the distillation to a sufficient extent to produce an oil suitable for creosoting purposes and a high melting point pitch which would solidify if cooled to ordinary temperatures, drawing off the hot and thinly fluid pitch produced by the distillation and continuously blending it, while still in such a hot and thinly fluid condition from such distillation, with unheated tar, with agitation of the mixture, to produce a homogeneous and thinly fluid blended product.

13. The method of producing a composite blended product from coal tar, which comprises subjecting part of the coal tar to distillation in a continuous manner and carrying the distillation to a sufficient extent to produce a creosote oil distillate and a high melting point pitch residue, withdrawing the hot pitch residue from such distillation and continually supplying it, while in a still hot and thinly fluid state from such distillation, to a body of previously admixed tar and pitch, continuously and simultaneously supplying to said body unheated tar, and agitating said body to promote blending therewith of the hot high melting point pitch and of the unheated tar to promote the formation of a uniformly blended product.

In testimony whereof I affix my signature.

STUART PARMELEE MILLER.