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2 Sheets-Sheet 1

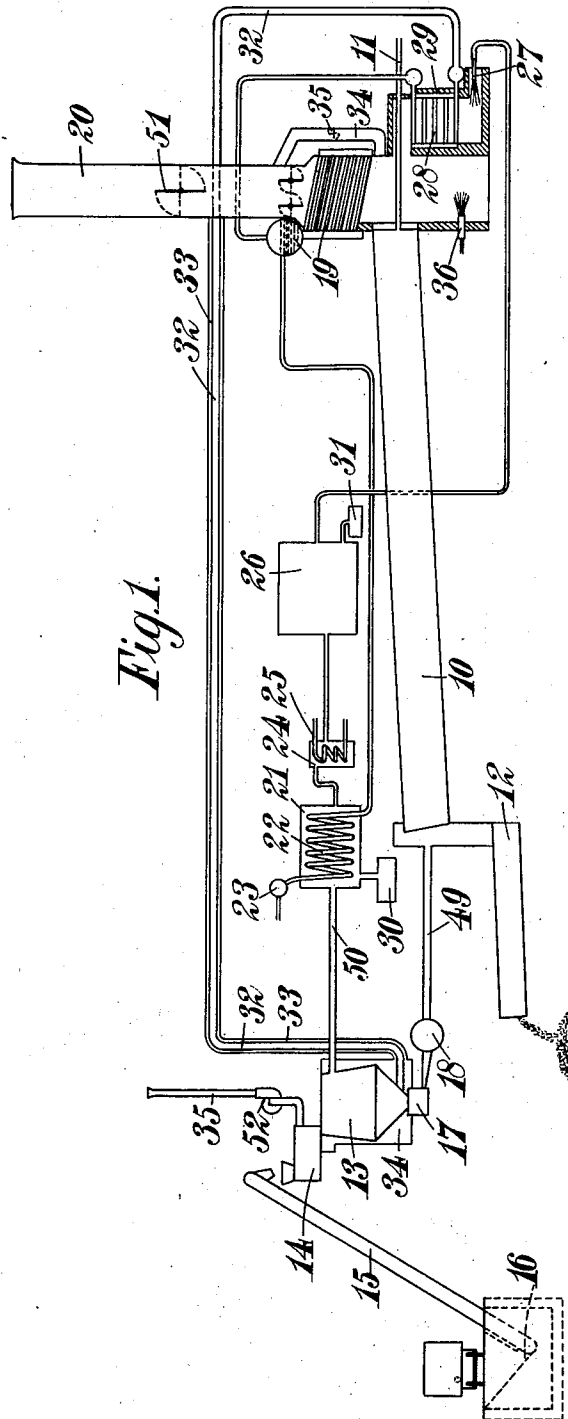


Fig. 1.

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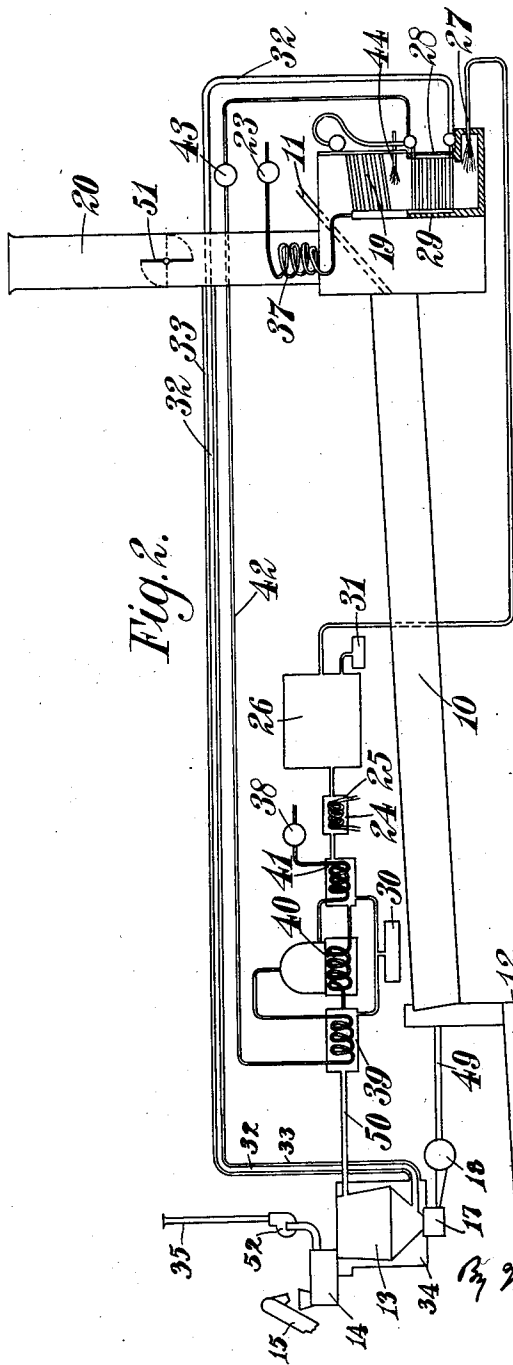
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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CEMENT MANUFACTURE AND PROCESS FOR OPERATING THE SAME.

Application filed February 7, 1922, Serial No. 534,731, and in Great Britain March 17, 1921.

This invention consists in improvements in or relating to cement manufacture and has for its object to provide a process for operating a cement kiln and a plant to be used in connection therewith whereby decreased cost of manufacture is effected in comparison with processes and plant hitherto employed.

According to the present invention a process for operating a cement kiln consists in firing the kiln with coke residue from a fuel carbonization plant, preferably a low-temperature carbonization plant, with or without the addition of other fuel (such for example as powdered raw coal or residual oils obtained from the carbonization process or both) and utilizing the heat of the exhaust gases from the kiln for heating the said carbonization plant.

According to a feature of the invention, if additional heat is required for the kiln, it is supplied by burning the gas obtained from the aforesaid carbonization plant.

Conveniently, the coke residue, with or without raw powdered fuel, such as coal, is admixed with residual oils produced by the carbonization of the fuel to form a "colloid fuel" which is fed to the kiln as such.

The term "colloid fuel" is intended to include a substantially homogeneous mass in which the solid particles are held in suspension in the oils.

To effect a further fuel economy the coke residue from the carbonization plant may be fed to the kiln in a heated condition.

Apparatus according to the invention may comprise broadly in combination a low-temperature fuel-carbonization plant, a cement kiln, a steam-plant comprising steam-generating or superheating apparatus or feed-water heater or all of them, means to convey hot gases from the kiln to the said steam-plant and means to pass steam therefrom to the fuel-carbonization plant to supply heat thereto.

The invention also includes the combination of a fuel distillation retort operating substantially continuously, a cement kiln, and means communicating between the retort and the kiln to transfer coke residue from the retort in a heated or partially cooled condition to the combustion zone of the kiln, whereby the sensible heat in the coke is utilized and the necessity of quench-

ing, among other disadvantages, is obviated.

An advantage of the present invention is that although the weight of fuel used per ton of cement may be, and probably will be, larger than that hitherto required, economy in cost of manufacture is nevertheless effected in that valuable oils and other by-products are recovered from the fuel whereby the cost of fuel per ton of cement is virtually reduced on account of the value of the oils and other by-products so obtained.

Two preferred arrangements of apparatus according to the present invention will now be described by way of example with reference to the accompanying drawings which are to be taken as purely diagrammatic illustrations in which—

Figure 1 shows in outline one general arrangement of combined coal-carbonization plant and cement kiln;

Figure 2 shows a modified arrangement in which the steam generating plant derives the major portion of its heat from the retort gases.

Like reference numerals indicate like parts in the two figures of the drawings.

Referring in the first instance to Figure 1, there is provided a cement kiln 10 of the inclined rotary cylinder type to which slurry is introduced at the higher or upper end in the usual manner through a feed-conduit 11. The partly finished cement or "clinker" is discharged from the lower end of the kiln into a cooler 12 through which the air supporting combustion is conveniently passed, the air becoming preheated in travelling through the cooler.

In proximity to the discharge end of the cement kiln is a low-temperature fuel-carbonization plant, conveniently operating with a distilling temperature not exceeding 550 to 600° C. and comprising a retort 13 and a preheater 14 for the fuel supplied thereto with an elevator 15 for raising the fuel from a pit 16 (into which it is discharged from trucks) to the preheater chamber. The general features of this part of the apparatus are preferably similar to those described, for example in the specifications of prior British Letters Patent Nos. 117,290; 136,868; and 149,733.

Connected with, or immediately below, the lower end of the retort is a pulverizer 17 into which coke from the retort is de-

livered and is pulverized in a hot or partially cooled condition. The pulverized coke is passed, by means of a fan 18, through a delivery conduit 49 and thence into the lower
 5 end of the cement kiln. With the fuel, if desired, there may be fed into the kiln powdered raw coal and/or residual oils obtained from the carbonization process.

For generating steam required for heating the retort, and thereby distilling the fuel therein, a boiler 19 working at low pressure is installed at or near the base of the chimney 20 (provided with a damper 51) through which the waste hot flue-gases escape from
 15 the cement kiln.

The distilled gases leave the upper end of the retort by way of a pipe 50 and are passed first through a condenser 21 within which there is a coil 22 for the passage of feed-
 20 water from a pump 23 to the boiler 19. From the condenser the uncondensed gases pass to an additional gas-cooler 24 through which cooling water circulates in a coil 25 disposed therein. The cooled gas is led to
 25 a by-product recovery plant 26 where motor-spirit and other products are recovered from the gas, the stripped or treated gas passing therefrom to a burner 27 employed for heating a superheater 28 for the steam as
 30 it leaves the boiler. The waste gases leave the superheater 28 through the upper end of a casing 29, pass up beneath the boiler and eventually escape through the main chimney 20, imparting their heat to the
 35 boiler in so doing. The condensed oils extracted from the stripped or treated gas in the condenser 21 and plant 26 are collected in sumps 30 and 31 respectively.

Steam from the superheater passes
 40 through a pipe 32 leading to the lower end of the retort. The major portion of this pipe is jacketed by a second pipe 33 through which is drawn by means of a fan 52 a portion of the exhaust gases passing up the
 45 main chimney 20. The pipe 33 delivers into a jacket 34 surrounding the retort 13 and from thence the exhaust gases are led to the preheater 14 from which they finally escape through the chimney 35. The exhaust gases
 50 thus serve, not only to prevent heat-radiation from the steam-pipe 32, and from the retort, but also to heat the preheater.

In the event of the heat in the waste gases from the kiln and from the superheater being in excess of the requirements for the boiler, the whole or part of the waste gases may be by-passed round the boiler through
 55 a by-pass conduit 34 wherein a damper 35 is provided to regulate the amount of gases thus by-passed.

If, on the other hand, the heat in the waste gases is insufficient for the requirements of the boiler, additional heat may be provided
 60 therefor, in the form of gas, powdered fuel or oil burned in auxiliary burners such as

36, disposed beneath the boiler. The materials thus burned may be products from the carbonization plant.

The second form of apparatus diagrammatically illustrated in Figure 2 is applied
 70 to cases where the heat in the waste gases from the kiln is known to be insufficient for generating the steam required for the retort. In this case the cement kiln and coal-carbonization plant, (with the exception of the by-
 75 product recovery portion thereof) and the means for feeding the kiln and the carbonization plant are the same as in the arrangement shown in Figure 1. Part of the steam for the retort is generated in the
 80 boiler 19 which in this case is situated in the same casing 29 as a superheater 28 below it, the upper end of the casing being in communication with the main chimney or exhaust stack 20 from the kiln. Feed-water
 85 for the boiler 19 is supplied from any convenient source and is circulated by means of the pump 23 through an economizer 37 disposed in the chimney and thence to the boiler, from which steam is thereafter passed
 90 into the superheater 28 and through the jacketed steam-conduit 32, as before, to the retort. The retort gases enter the pipe 50 and are passed in succession through three
 95 heat-interchangers 39, 40 and 41 arranged in series, the first unit 39 constituting a superheater, the second an evaporator, and the third a feed-water heater. Water for cooling the retort gases and supplying the
 100 evaporator is circulated by a pump 38 on the contra-flow principle, entering first the unit 41 and then passing to the unit 40. Steam generated in the latter is slightly superheated in the unit 39 and from thence
 105 passes by way of a pipe 42 and pressure-booster 43 to the superheater 28, where it joins steam from the boiler 19, and passes in company therewith to the retort. The distillate from the retort which is condensed in the heat-interchangers is collected
 110 in a sump 30. Gas from the unit 41 is passed through a cooler 24 and by-product plant 26 as before, the stripped or treated gas being burned at 27 to supply heat to the main superheater 28. If additional heat
 115 is required for the boiler 19 to augment the heat in the gases leaving the superheater, a burner 44 may be provided in which fuel of any preferred form is consumed.

It will be understood that the two arrangements of apparatus described above are
 120 given by way of illustration only and are capable of many modifications without departing from the spirit of the invention. For example, the superheater may be fired
 125 by any means other than that described above, and for this purpose producer-gas or pulverized fuel, for example, may be employed. It is also within the invention to
 130 supply, as fuel for the kiln, a colloid fuel

composed of powdered coke residue and residual oils obtained from the coal-carbonization plant. Moreover, gas from the latter can also be burned within the cement kiln and other raw solid fuel may be added if desired, separate burners being provided to feed the different fuels to the combustion zone of the kiln.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A process of operating a cement kiln in conjunction with a low-temperature fuel-carbonization plant the still of which is heated by steam, which consists in firing the kiln with coke residue from the fuel-carbonization plant, and utilizing the heat of the exhaust gases from the kiln for generating the steam to be supplied to the still of the fuel carbonization plant, substantially as described.

2. The combination of a steam-heated low-temperature fuel-carbonization still or retort, a cement kiln, a steam-generating plant, means to convey exhaust gases from the cement kiln to the steam-generating plant for heating the same, means to pass steam thus generated to the still or retort to supply heat thereto, and means for feeding into the kiln pulverized coke residue from the still or retort for firing the kiln therewith, substantially as described.

3. The combination of a steam-heated low-temperature fuel-carbonization still or retort, a cement kiln, a steam-generating plant, means to convey exhaust gases from the cement kiln to the steam plant, means to pass steam therefrom to the still or retort to supply heat thereto, means for feeding into the kiln pulverized coke residue from the still or retort for firing the kiln therewith, and means associated with the steam-plant for burning gas obtained from the still or retort thereby to assist in the heating of said steam-plant, substantially as described.

4. The combination of a steam-heated low-temperature fuel-carbonization still or retort, a cement kiln, a steam-generating plant, means to convey exhaust gases from the cement kiln to the steam-plant for heating the same, means to pass steam therefrom to the still or retort to supply heat thereto,

means for feeding into the kiln pulverized coke residue from the still or retort for firing the kiln therewith, means associated with the steam-plant for burning gas obtained from the still or retort to assist in the heat of said steam-plant, and apparatus for treating said gas and recovering the by-products obtained from the carbonization of the fuel in the still or retort before gas is supplied to the steam-plant substantially as described.

5. The combination of a steam-heated low-temperature fuel-carbonization still or retort, a cement kiln, a steam-generating plant, means to convey exhaust gases from the cement kiln to the steam-plant for heating the same, a heater, an evaporator and superheater acting in the dual capacity of a condenser for the gases from the still or retort and of a steam-generating plant to provide additional steam for heating the still or retort, and means for injecting pulverized coke residue from the still or retort into the cement kiln.

6. The combination of a steam-heated low-temperature fuel-carbonization still or retort operated substantially continuously, a cement kiln, a steam-plant comprising steam-generating and superheating apparatus, means to transfer pulverized coke residue in a heated condition from the still or retort to the kiln, means to convey exhaust gases from the kiln to said steam-plant for heating the same, and means to pass steam from the latter to the still or retort to supply heat thereto.

7. The combination of a steam-heated low-temperature fuel-carbonization retort, a cement kiln, means for injecting coke residue from the retort into the kiln, a steam-generating plant, means to convey exhaust gases from the cement kiln to the steam-plant, means to pass steam therefrom to the carbonization plant to supply heat thereto, a jacket for the carbonization retort, a jacket for the steam-pipe leading from the steam-plant to the retort, and means to pass flue gases from the cement kiln through the aforesaid jackets, substantially as described.

In testimony whereof I affix my signature.

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