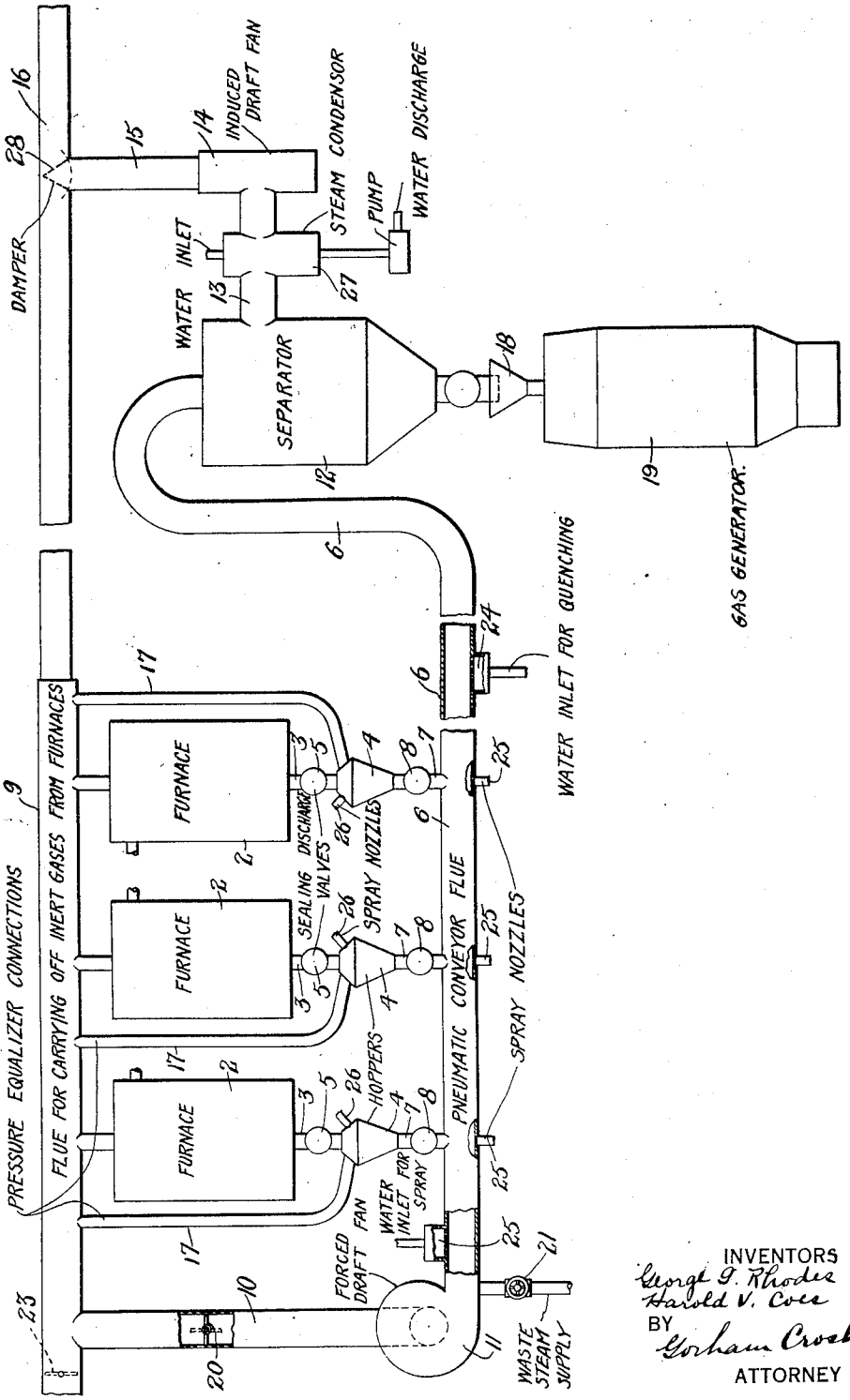
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PROCESS AND APPARATUS FOR CONVEYING AND TREATING MATERIALS.

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PROCESS AND APPARATUS FOR CONVEYING AND TREATING MATERIALS.

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To all whom it may concern:

Be it known that we, GEORGE I. RHODES, a citizen of the United States, and a resident of Glen Ridge, county of Essex, State of New Jersey, and HAROLD V. COES, a citizen of the United States, and a resident of Montclair, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Processes and Apparatus for Conveying and Treating Materials, of which the following is a specification.

The invention relates to processes and apparatus for conveying and treating materials, and while, in its broader aspects, the invention is capable of use in connection with many different classes of materials, it is particularly adapted for the conveying of hot carbon material, such as hot coke and the treatment thereof during conveyance.

The various objects, features and advantages of the invention and improvements will more clearly appear from the detailed description given below, taken in connection with the accompanying drawing, which forms a part of this specification, and which illustrates, purely diagrammatically, a system for carrying out the invention and improvements.

Referring to the drawing, 2, 2, 2 represent furnaces such as coke ovens of the continuous type, in which material, such as bituminous coal, is heated and furnaced, as for example, to produce illuminating gas and other products. Each furnace is provided with a bottom outlet or conduit 3, connecting with a hopper 4. In each conduit 3 is provided a sealing discharge valve 5, which, upon turning the same, will permit the furnaced material, such as hot coke, in pieces suitable for pneumatic transportation, to be deposited within the hopper 4.

It is usually desirable to convey this material to a distant point for further operations, and, for this purpose, a pneumatic conveyer flue 6 is provided, and conduits 7 connect the pneumatic conveyer flue respectively with the hoppers 4. In the conduits 7 are provided sealing discharge valves 8, upon the turning of which the material is allowed to drop from the hoppers 4 through the conduits 7 into the flue 6. 9 represents a flue for carrying off the inert gases from the furnaces.

With many materials, and especially many hot materials, it is impracticable to convey them with air as the conveying medium, because they react with air in a disadvantageous manner. Thus, with hot coke, as discharged from the furnace, if conveyed to any substantial distance in air, it burns, thereby causing a serious loss. Means are, therefore, provided, whereby the material from the furnaces and discharged from the hoppers 4 may be pneumatically conveyed by a current of inert gaseous conveying medium. While any suitable gas or gases may be used for this purpose, it is particularly advantageous to use the inert waste gases from the furnaces themselves, and for this purpose, there is provided a flue 10, connecting with the flue 9, carrying off the inert waste gases from the furnaces, and a forced draft fan 11, which forces the inert flue gases from the flue 10 into the pneumatic conveyer flue 6. As the hot coke, or other material, is deposited in the pneumatic conveyer flue 6, through the sealing discharge valves 8, the current of inert gases coming from a different path through the flue 10 and fan 11 conveys the same through the flue 6 to the desired point, where they enter a separator 12, of any suitable or well known character, which separates the gases from the material, the gases being drawn off through a flue 13 and an induced draft fan or exhauster 14, and allowed to escape through a flue 15 to a flue 16.

The purpose of having sealing discharge valves 5 and 8 is that the valves 8 may be closed when the valves 5 are opened and vice versa, so as to prevent, as far as possible, any difference in pressure between the pneumatic conveyer flue and the furnaces, from causing a flow of gases from the pneumatic conveyer flue to the furnaces, or vice versa. It is, however, very difficult to construct sealing discharge valves for handling certain materials, such that they will positively hermetically seal off the furnaces from the hoppers and the hoppers from the pneumatic conveyer flue. There is, therefore, provided a conduit 17, connecting the hoppers with the flue 9, so that there is no difference of pressure tending to force gases from the hoppers into the furnaces or vice-versa. Any difference of pressure between

the hoppers and the flue 9 is taken care of through the pressure equalizer connections 17.

In the case of hot coke, the material may be deposited from a separator 12 into a hopper 18, from which it falls into a water gas generator 19 and is there converted into gas in a well known manner; the heat retained by the coke being utilized in the gas generator and thus is of economic importance. Before being introduced into the gas generator, the coke may be first deposited in a storage bin and then conveyed from the storage bin to the gas generator or other apparatus in which the coke is to be used.

It is frequently desirable to materially cool the hot coke or material before it enters the separator and goes to other apparatus where it might be subject to contact with air. There is, therefore, provided a quenching chamber 24 filled with water under pressure, the upper side of the quenching chamber 24 being perforated, so that a spray of water is introduced into the conveyer flue and quenches and cools the hot coke. It is preferably to cool the same only to a temperature such that it will not substantially burn or react with air, but otherwise, retaining considerable heat, which will be found useful in the later operations applied thereto.

If it is not desirable to convey the material at such a high temperature from the beginning, the material may be partially or wholly quenched by means of water sprays at 25, 25, 25, which introduce a spray of water onto the material as it comes from the hoppers 4, or the material may be quenched or cooled by water sprays 26, 26, 26, directly in the hoppers 4, or both of these arrangements may be used. If it is desired to cool the gases used for conveying, this may be done by a water spray at 25. Any one or more of the water spraying and quenching devices may be used, coördinately or independently, depending upon conditions.

If the material is sufficiently cool as it enters the conveyer flue or is sufficiently cooled substantially at the point where it enters the pneumatic conveyer flue, so that it will not burn or does not react with air, air may be used as the pneumatic conveying medium.

The steam produced by the use of water sprays for quenching and cooling is preferably condensed by a condenser 27, before the gases enter the induced draft fan 14, so that the volume of gases is very materially reduced before they enter the fan 14, and the fan 14 thus has a much less volume of gases to handle and may be made smaller and less expensive as to first cost and cost of power used. Likewise, since the steam is produced after the waste gases leave the fan 11, the steam does not have to be handled by the fan 11, and so, similarly, this fan may be made smaller and less expensive. Thus, the introduction of water sprays has several functions. It cools the gases to the desired final temperature and increases the volume of conveying gases by converting the water into steam without increasing the volume of gas to be pumped. It also quenches the hot coke or other material, leaving it at such a temperature within the control of the operator that it will not burn or seriously react in air, and yet contain a substantial amount of heat which may be useful in later operations, and in the arrangement shown, the steam does not have to be pumped or exhausted.

In certain manufacturing processes, there is available sufficient waste exhaust steam to furnish the conveying medium, which steam may be further augmented by the quenching or cooling of the hot material to be conveyed by the use of one or more of the water sprays. Under such circumstances, all or a large part of the conveying gases are condensable, and the condenser 27 removes substantially all such vapor or conveying gases, leaving for the exhauster or induced draft fan only the small volume of non-condensable gases that might leak into the system. In the drawing, there is shown a waste steam supply pipe, provided with a valve 21, by which the waste steam may be introduced into the conveyer flue, and a damper valve 20 is provided in the pipe 10 for shutting off or regulating the flow of furnace gases therethrough. A damper 23 is provided in the flue 9 to close this flue at the left of the flue 10, when it is desired that all of the waste furnace gases be used in the pneumatic conveyer flue.

If the waste gases given off by the furnaces 2 are not sufficient to supply the necessary amount of gas for the pneumatic conveyer flue, part or all of the gases leaving the fan 14 through the conduit 15 may be diverted back through the flues 9 and 10 by a damper 28. Also, it may be found necessary to have both of the draft producing fans, and any other suitable device may be used for causing the necessary difference of pressure for the conveyer flue.

The system of conveying hot chemically active materials by means of a current of inert gases, with or without the presence of quenching devices, and with or without the use of condensable vapors in the conveying medium, will find many applications, as in the conveying of hot sublimated zinc dust at zinc smelters, and other hot sublimating materials, as well as hot coke in by-product coke oven plants and in many other industries. Where the material is to be further heated or treated at temperatures above normal, the delivery in a relatively hot condition by means of the method and arrangement described, is of great economic importance.

Likewise, many other modifications, rear-

rangements and changes may be made without departing from the spirit and scope of the invention in its broader aspects.

We claim—

1. The process of conveying solid materials which are likely to be burned or oxidized in air, which consists in introducing such solid material into a current of gaseous conveying medium coming in a different path at such speed as to pneumatically convey the solid material so introduced, said gaseous conveying medium being substantially free of air and substantially inert with respect to said solid material during the conveyance, and collecting the material at the end of the conveyance substantially free of said inert conveying medium.

2. The process of conveying hot solid coke material which chemically reacts with air at the temperature thereof during conveyance which consists in introducing said hot solid coke material into a current of gaseous conveying medium coming in a different path, pneumatically conveying the coke material thereby, said gaseous conveying medium being substantially inert with respect to said coke material at the temperature thereof during conveyance, and collecting the coke material at the end of the conveyance.

3. The process of conveying hot solid material which chemically reacts with air at the temperature thereof during conveyance which consists in introducing the hot solid material which chemically reacts with air at the temperature thereof during conveyance, into a current of gaseous conveying medium coming in a different path, and pneumatically conveying the solid material thereby, said gaseous conveying medium being substantially inert with respect to said solid material during the conveyance thereby, and applying thereto a relatively cool liquid during conveyance to quench the hot material.

4. The process of conveying hot coke material which consists in introducing the hot coke material into a current of gaseous conveying medium coming in a different path, and pneumatically conveying the coke material thereby, and applying thereto a relatively cool liquid during conveyance to quench the hot coke material.

5. The process which consists in introducing hot carbon material which chemically reacts with air to induce combustion at the temperature thereof during conveyance, into a current of gaseous conveying medium, said gaseous conveying medium being substantially inert with respect to said material at the temperature of conveyance, and reducing the temperature of the material during conveyance until the material is substantially inactive in air, and part of the heat in the hot carbon material being retained therein after the reduction in temperature, to aid in the further treatment of the material.

6. The process which consists in introducing hot material at a temperature at which it chemically reacts with air, into a current of gaseous conveying medium, said gaseous conveying medium being substantially inert with respect to said material at the temperature at which it is introduced thereinto, and reducing the temperature of the material during conveyance until the material is substantially inactive in air, part of the heat in the material being retained therein to aid in the further treatment of the material.

7. The process which consists in heating solid material in a furnace and introducing the hot furnaced material at a temperature at which it reacts with air into a current of waste gases coming in a different path from a furnace and pneumatically conveying the furnaced solid material thereby.

8. The process which consists in heating solid material in a furnace and introducing the hot furnaced material at a temperature at which it reacts with air into a current of waste gases coming in a different path from a furnace and pneumatically conveying the furnaced solid material thereby, said waste gases being substantially inert with respect to the material during the conveyance, and reducing the temperature of the material during conveyance until it is substantially inactive in air.

9. The process which consists in heating coal or the like in a furnace to produce hot coke material and introducing the hot coke material into a current of waste gases coming in a different path from the furnace and pneumatically conveying the coke material thereby, and quenching the coke material during conveyance to reduce its temperature until it is substantially inactive in air.

10. The process which consists in heating coal or the like in a furnace to produce hot coke material and introducing the hot coke material into a current of waste gases coming in a different path from the furnace and pneumatically conveying the coke material thereby, and quenching the coke material during conveyance to reduce its temperature until it is substantially inactive in air some of the heat from the furnace being retained in the coke material to aid in further treatment of the coke.

11. The process which consists in introducing solid hot material from a furnace into a current of hot waste gases from the furnace and pneumatically conveying the hot solid material thereby, introducing a liquid into the waste gases to be volatilized therein to form further conveying fluid medium and cool the waste gases, and condensing the volatilized liquid from the cur-

rent of gases after the material has been conveyed thereby to the desired point, to aid in the movement of the conveying gases.

12. The process which consists in introducing hot solid material at a temperature at which it chemically reacts with air, into a current of hot gases coming in a separate path, causing the material to be conveyed thereby, causing condensable gases of a liquid to be mixed with the hot gases to reduce the temperature of the latter and form further conveying medium and condensing the said condensable gases in such a manner as to aid in the movement of the conveying gases.

13. The process of conveying hot material, which consists in introducing the material into a current of hot gaseous conveying medium to be conveyed thereby and introducing a spray of volatile liquid into the conveying medium before it reaches the material to be conveyed, the spray acting to cool the conveying medium and the hot material conveyed and causing the production of additional conveying medium.

14. The process of conveying solid materials which consists in introducing the solid material into a current of gaseous conveying medium containing a substantial amount of condensable vapor, and condensing such vapor after the material has been conveyed to the desired point in such a manner as to assist in promoting the movement of the conveying gases.

15. In the process of pneumatically conveying solid materials by means of a current of gaseous conveying medium, the introduction of a condensable vapor into the conveying medium before the material has been conveyed to the required point, to aid in conveying the material and condensing the condensable vapor after the material has been conveyed the required distance in such a manner as to assist in promoting the movement of the conveying gases.

16. The process of conveying and treating hot materials which consists in introducing the hot material into a current of gaseous conveying medium to be conveyed thereby and introducing a liquid into the current of conveying medium to reduce the temperature of the material, the liquid being volatilized by the hot material to add condensable vapors to the conveying medium, and condensing said condensable vapors after the material has been conveyed to the desired point in such a manner as to assist in promoting the movement of gaseous conveying medium.

17. The process of conveying solid materials which consists in introducing the solid material into a current of hot gaseous conveying medium to be conveyed thereby and introducing a liquid into the current of conveying medium in advance of the introduction of the solid material thereinto to reduce the temperature of the conveying medium before the solid material has been introduced into the conveying medium.

18. The process of conveying hot solid materials which are likely to react with air at the temperature thereof during conveyance, which consists in introducing such hot solid material into a current of gaseous conveying medium coming in a different path at such speed as to pneumatically convey the hot solid material so introduced, said gaseous conveying medium being substantially free of air, and collecting the solid material at the end of the conveyance.

19. The process of conveying hot solid carbonaceous materials which consists in introducing the hot solid carbonaceous material into a current of hot gaseous conveying medium coming in a different path at such speed as to pneumatically convey the solid carbonaceous material so introduced, and introducing moisture into the material during conveyance, the moisture introduced being in such amount as to cause the material to contain a predetermined amount of moisture at the end of the conveyance and collecting the material at the end of the conveyance.

20. An arrangement of the class described having in combination a furnace, a conveying flue, means whereby material from the furnace may be discharged into the conveying flue, means for conveying waste gases from the furnace to the conveying flue independently of said discharge means and forcing the said gases through the conveying flue to convey said material therethrough.

21. An arrangement of the class described having in combination a furnace, a discharge hopper therefor, a conduit from the furnace to the hopper through which material may be discharged from the furnace to the hopper, a sealing discharge valve in said conduit, a conveying flue, a conduit between the hopper and the conveying flue, through which the material may be discharged from the hopper into the conveying flue and a sealing discharge valve in said last mentioned conduit.

22. An arrangement of the class described having in combination a furnace, a discharge hopper therefor, a conduit from the furnace to the hopper through which material may be discharged from the furnace to the hopper, a sealing discharge valve in said conduit, a conveying flue, a conduit between the hopper and the conveying flue, through which the material may be discharged from the hopper into the conveying flue, and a sealing discharge in said last mentioned conduit, and means for causing a current of

gaseous conveying medium to flow through the conveying flue to convey said material along said conveying flue.

23. An arrangement of the class described having in combination a furnace, a discharge hopper therefor, a conduit from the furnace to the hopper through which material may be discharged from the furnace to the hopper, a sealing discharge valve in said conduit, a conveying flue, a conduit between the hopper and the conveying flue, through which the material may be discharged from the hopper into the conveying flue, and a sealing discharge valve in said last mentioned conduit, and means for causing a current of gaseous conveying medium to flow through the conveying flue to convey said material along said conveying flue, and a conduit leading from the hopper to equalize the pressure therein and prevent the transfer of gaseous medium between the furnace and conveying flue.

24. An arrangement of the class described having in combination a furnace, a discharge hopper therefor, a conduit from the furnace to the hopper through which material may be discharged from the furnace to the hopper, a sealing discharge valve in said conduit, a conveying flue, a conduit between the hopper and the conveying flue, through which the material may be discharged from the hopper into the conveying flue, and a sealing discharge valve in said last mentioned conduit, and a conduit connecting the hopper with waste gases from the furnace to equalize the pressure in the hopper and prevent the flow of gases between the conveying flue and the furnace.

25. The combination of a conveying flue, means whereby hot material may be introduced therein, means for causing a gaseous conveying medium to flow through the flue to convey the material along the flue, means for introducing water into the conveying medium and onto said material to cool the material, whereby steam is generated, means separating the steam from the conveyed material, and means for condensing the steam after such separation in such a manner as to aid in the movement of the gaseous conveyed medium.

26. The combination of a conveying flue, means whereby hot material may be introduced into said flue, an induced draft device for inducing a current of gaseous conveying medium to flow through the flue by suction and thereby convey the material along said flue, means whereby vapors of a volatile liquid are mixed with the gaseous conveying medium, and means for condensing said vapors from the conveying medium before the latter reaches the induced draft device.

27. The combination of a conveying flue, means whereby material to be conveyed may be introduced into said flue, and means causing a gaseous conveying medium to flow through the flue to convey the material along the flue, said last mentioned means comprising a forced draft fan acting on the conveying medium before the material has been introduced thereinto, and an induced draft fan acting on the conveying medium after the material has been introduced thereinto.

28. The combination of a furnace, a conveying flue, means whereby hot material from the furnace may be introduced into the flue without access to air, means for causing a current of gaseous conveying medium to flow through the flue to convey the material along the flue, and means whereby the temperature of the material is reduced substantially at the point where it enters the conveying medium in the flue.

29. The combination of a furnace, a conveying flue, means whereby hot material from the furnace may be introduced into the flue without access to air, means for causing a current of gaseous conveying medium to flow through the flue to convey the material along the flue, and means whereby the temperature of the material is reduced substantially at the point where it enters the conveying medium in the flue, said last mentioned means comprising means adapted to spray water into the flue, and means for condensing the steam thereby produced, from the conveying medium.

30. The combination of a pneumatic conveying flue, means whereby the material to be conveyed may be introduced therein and means whereby a spray of volatile liquid may be introduced into the flue ahead of the point where the material is introduced.

31. The combination of a pneumatic conveying flue, means whereby the material to be conveyed may be introduced therein and means whereby a spray of volatile liquid may be introduced into the flue ahead of the point where the material is introduced, and means for condensing the volatilized gases of the liquid after the material has been conveyed to the desired point.

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