

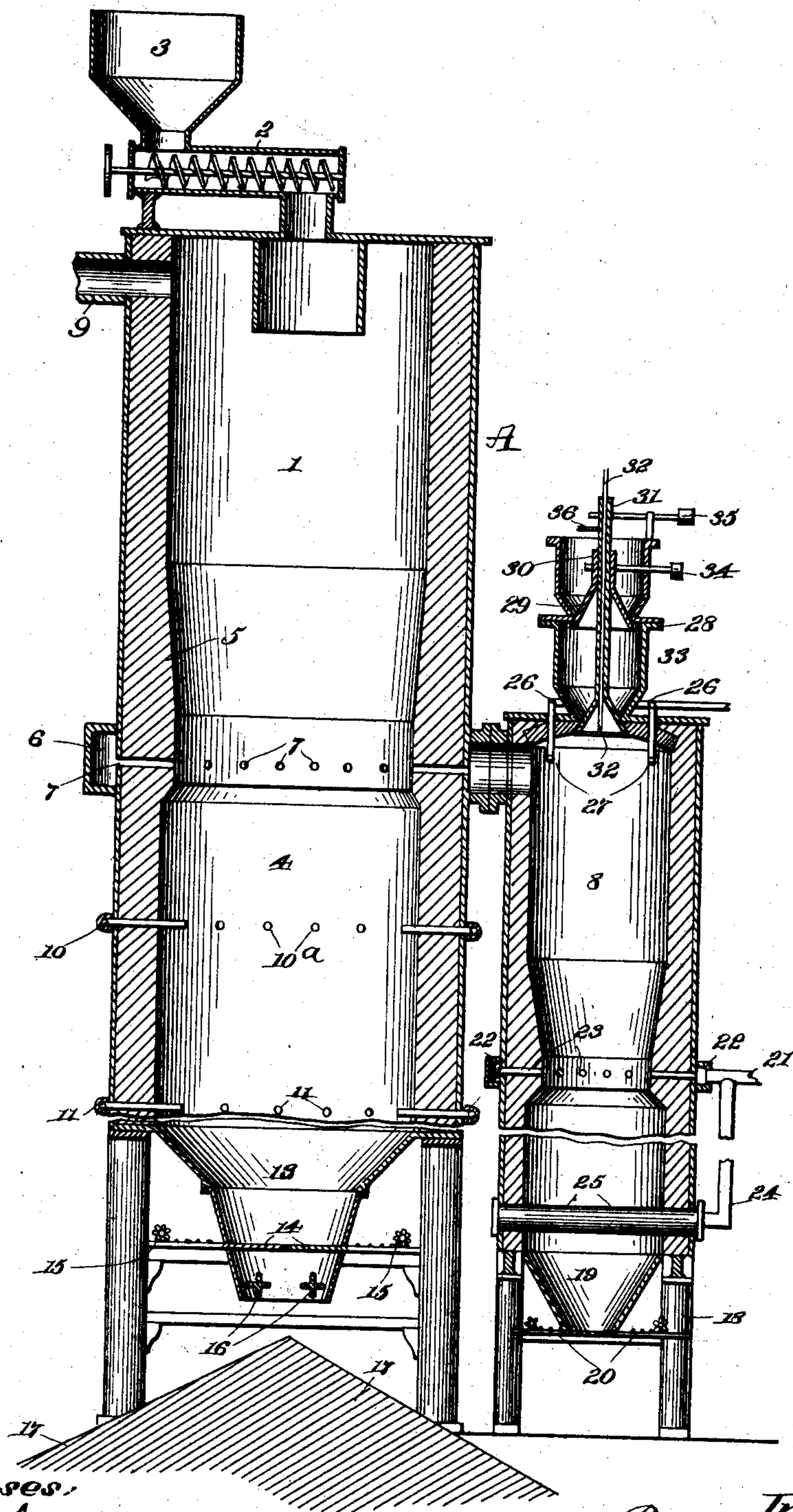
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P. NAEF.  
PROCESS OF MAKING COKE.

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(No Model.)



Witnesses:

G. F. Downing  
S. G. Nottingham

Inventor

Paul Naef  
By H. A. Seymour,  
Attorney.



# UNITED STATES PATENT OFFICE.

PAUL NAEF, OF NEW BRIGHTON, NEW YORK.

## PROCESS OF MAKING COKE.

SPECIFICATION forming part of Letters Patent No. 706,443, dated August 5, 1902.

Application filed September 7, 1897. Serial No. 650,761. (No specimens.)

*To all whom it may concern:*

Be it known that I, PAUL NAEF, Ph. D., a citizen of Switzerland, and a resident of New Brighton, county of Richmond, State of New York, have invented certain new and useful Improvements in Processes of Making Coke, of which the following is a specification.

My invention relates to an improved process of making coke, the object of the invention being to overcome the objections, disadvantages, and excessive expense incident to coking processes heretofore employed of which I am aware and to provide a process which will result in the production of a very large quantity of coke in a given time.

A further object is to provide a coking process by which a superior quality, as well as a large quantity, of coke will be insured.

A further object is to coke coal in such manner as not only to insure a large output of superior coke in a short space of time, but also to increase the maximum recovery of the most valuable by-products.

With these objects in view the invention consists in certain novel steps in the process of making coke, as hereinafter set forth, and pointed out in the claims.

The accompanying drawing illustrates one form of apparatus by means of which my improved process can be carried into effect, and to the end that said process may be more readily understood I will now describe the apparatus shown in detail.

A represents a furnace, shaft, or tower which in practice will be made of considerable height and large capacity. The shaft or tower is supported on columns 12, and the bottom of the shaft is provided with a conical funnel 13, through which coke is discharged. This funnel is provided with sliding doors or gates 14, which can be manipulated by rack-and-pinion operating mechanism 15 or other suitable means. Crushing-rollers 16 are located in the lower part of the funnel-base below the doors, so that the coke can be broken up and discharged on the bottom slopes 17 in a suitable condition. The portion 1 of this shaft or tower may be termed the "coking-chamber," and on the top of the shaft or tower a mechanical feed mechanism 2 is located and adapted to discharge carbonaceous fuel (coal) in a finely-divided condition into the coking-

chamber. The feed mechanism may receive the coal from a hopper 3, to which said coal may be elevated by any suitable means. The lower portion 4 of the shaft or tower may for convenience be termed the "cooling-chamber," although certain steps of the process other than mere cooling of the coke take place in this chamber. At the juncture of the coking and cooling chambers the internal diameter of the shaft or tower is contracted to compensate for the shrinkage of the body of fine fuel in the upper portion of the coking-chamber, and thus cause the material to hug the wall of the shaft closely where the heated fluid for the coking of the fuel is introduced, so as to prevent the too free passage of the heating fluid between the body or mass of fuel and the wall of the shaft rather than through it, which result would likely occur were some means not provided to compensate for the shrinkage of the body or mass of fuel. The inner wall of the coking-chamber at the contracted portion is made tapering, as at 5, and the lower end of this tapering portion 5 discharges into the cooling-chamber 4.

A channel or annular flue 6 surrounds the apparatus at or near the lower end of the contracted portion thereof and is connected with the coking-chamber a considerable distance from the respective ends of the shaft, preferably at or near the lower end of the conical or tapering portion 5, by means of an annular series of ducts 7, which extend radially through the wall of the shaft. Hot gas from a gas-producer 8 enters the annular channel or flue 6, and as considerable pressure is developed in the generation of this gas the latter will flow from the annular channel or flue 6 through the radial ducts 7 with considerable force. As the fuel completely fills the contracted portion of the coking-chamber, the hot gas thus introduced into the lower end thereof will penetrate the mass of fine fuel and will supply sufficient heat to coke it, this coking of the fuel extending some distance above the lower end of the coking-chamber, where the heated gaseous fluid enters. In its passage through the carbonaceous material the gas will absorb more or less of the volatile constituents of the fuel and after passing through the uncoked fuel in the upper portion of the cok-



ing-chamber will leave the upper end thereof through a suitable pipe 9 considerably cooled and charged with such by-products as tar and ammonia, which may be afterward separated 5 and washed by means of any apparatus suitable for the purpose.

To produce a superior coke rapidly, it is a matter of importance that certain constituents of the carbonaceous fuel be removed, 10 and I propose to remove these rapidly and in a manner to effect their ultimate recovery as by-products in paying quantities. To effect these results, the treatment of the material will proceed in a manner which will now be 15 explained.

After the coke has passed through the contracted portion of the apparatus it enters the chamber 4, where it is treated with steam, and subsequently in the lower portion of the 20 chamber 4 it is treated with water. For the introduction of steam an annular flue 10 surrounds the shaft some distance below the lower end of the coking-chamber and a considerable distance above the lower end of the 25 shaft or tower. The flue 10 may be supplied with steam from any convenient source and discharges the steam into the chamber 4 through an annular series of radial ducts 10<sup>a</sup>. It is important that both the heated gas and 30 the steam should be introduced at such heights that coke can be withdrawn without the escape of gas. Now when the coke discharged through the contracted lower end of the chamber 1 reaches the steam-inlet flues it is 35 further heated by the steam entering through said inlets 10<sup>a</sup>, and the union of the coke and steam will result in the setting free of more ammonia and in the formation of water-gas, which will rise through the mass, unite with 40 the other by-products evolved in the chamber 1, as well as assist in the more thorough setting free of said by-products in the upper chamber, and will finally leave the apparatus through the pipe 9, by which they may be conducted to 45 suitable washing and rectifying apparatus, as before explained. The use of steam in the manner above stated not only results in the rapid production of valuable by-products in large quantities, but it also greatly improves 50 the coke by depriving it of certain constituent elements of the fuel which it is desirable should not be present in a good quality of coke, especially when it is desired to use the coke for metallurgical purposes. In other 55 words, by treating the material with steam in the manner before explained it is freed to a considerable extent of certain nitrogenous compounds and, still more important, the sulfur is driven off. By being deprived of 60 sulfur the coke is very materially improved. When the descending coke reaches the lower portion of chamber 4, it is subjected to the action of water entering through an annular series of ducts or twyers 11. The coke is still 65 hot when it reaches the water-inlets, and its union with the water will result in the generation of steam, which will rise through the

mass, and thus further facilitate the results above explained. The water entering through the ducts or twyers 11 will also serve to cool 70 the coke as it leaves the apparatus. The results above explained may also be enhanced by introducing steam with the heated gaseous fluid, by means of which the coal is coked.

While the hot gaseous fluid for carrying out 75 my process may be generated in any preferred way, still I have shown means whereby this hot gas and an admixture therewith of steam can be readily accomplished. The gas-producer 8 is here shown in the form of 80 a shaft or tower mounted on iron columns 18 and provided at its lower end with an outlet-hopper 19, the discharge of ashes and cinders from which is controlled by sliding doors 20. Air under pressure is supplied by any 85 suitable means through a pipe 21 to an annular channel 22, having ducts 23 leading into the producer. A pipe 24 depends from the pipe 21 and is connected with one or more 90 perforated pipes 25, extending through the bottom of the producer. Some blast is thus conducted to the lower part of the producer to prevent loss of fuel. Water-pipes 20 and nozzles 27 are arranged at the top to spray 95 water into the producer. The means for charging the gas-producer comprise a double hopper 28, having a cone-bottom 29 suspended from a pipe 30 and a cone-bottom for the 100 lower hopper suspended at the end of a pipe 31, inclosing a water-pipe 32, which discharges in the lower cone 33. The pipe 30 is attached to a lever 34, and the pipe 31 is secured to a similar lever 35. The bottom cone is hollow and has a bottom head and is cooled 105 by water flowing into it through the inner pipe 32 and then up between the said pipe and the supporting-pipe 31 and out by the eduction-pipe 36.

I have merely described the details of construction to explain one convenient means of 110 supplying the hot gas (mixed with steam) for supplying heat for coking, the construction of said producer forming the subject-matter of a separate application for patent.

While I have shown and described one construction of apparatus by means of which my 115 improved process can be carried into effect, I would have it understood that differently-constructed apparatus might be employed without in any way departing from the spirit 120 of my invention or limiting its scope, the apparatus shown and described being intended simply to demonstrate and explain the process which constitutes the subject of this case.

Having fully described my invention, what 125 I claim as new, and desire to secure by Letters Patent, is—

1. In a process for producing coke, passing a mass of finely-divided carbonaceous material through a furnace or shaft and simulta- 130 neously forcing heated fluid and steam into said mass a considerable distance from both ends of said furnace or shaft, whereby successive portions of the mass will be coked, the



coke desulfurized and the by-products absorbed by the heated fluid as it ascends through the mass and permitted to pass from the upper end of the furnace or shaft.

5 2. In a process for producing coke, passing a mass of finely-divided carbonaceous material through a shaft or furnace, generating a gas under pressure and heating said gas and coking said carbonaceous material by injecting  
10 said heated gas under pressure into the mass as it passes through the furnace or shaft, at a point between and a considerable distance from the ends of the furnace or shaft through which said mass passes, whereby portions of  
15 the mass will be coked successively and the hot gas with by-products absorbed thereby will ascend through the uncoked portion of the mass and be permitted to pass from the upper end of the shaft or furnace.

20 3. In a process of producing coke, passing a mass of finely-divided coking material through a furnace or shaft, introducing hot gas into said mass a considerable distance from the ends of said furnace or shaft and  
25 introducing steam into the descending coke at a point below the ingress of hot gas and a considerable distance above the outlet of coke at the lower end of the furnace or shaft.

30 4. A coking process consisting in passing a mass of finely-divided carbonaceous material continuously through a furnace or shaft, and subjecting the moving mass to the action of hot gas at a point a considerable distance from the top of the furnace or shaft and sub-  
35 jecting the descending coke at a lower point and a distance above the lower end of the furnace or shaft to the action of steam, whereby the mass will be gradually and rapidly coked and the by-products made to ascend through  
40 the descending mass and be permitted to pass from the furnace.

45 5. In a continuous process of producing coke, introducing into a body of finely-divided coking material, heated gas, at a distance from the upper end of the mass, introducing steam at a lower level and introducing water at a still lower level.

50 6. In a process of producing coke, subjecting a body of coking material to the action of heated gas and simultaneously injecting steam and water into the heated material at points below that at which the body of material is subjected to the action of heated gas.

7. In a continuous process for producing coke, coking coal by introducing a series of  
55 jets of heated gas into a body of fine coking material at the juncture of the coking and cooling chambers and a considerable distance from the other ends of said chambers at the respective ends of the apparatus. 60

8. The process of producing coke, gas and by-products which consists in passing heated gas through a body of coking material where-  
by the volatile matter is removed; injecting steam at a lower level whereby ammonia is  
65 formed by decomposition of the nitrogenous compounds contained in the coke and finally injecting water at a still lower level chiefly for the purpose of cooling the coke.

9. In a coking process passing a mass of  
70 carbonaceous material through a furnace or shaft, generating a heated gas mixed with steam in a separate apparatus and coking the carbonaceous material by injecting the mixed gas and steam into the mass thereof, where-  
75 by the latter is coked and desulfurized and the gas and by-products absorbed and permitted to pass from the top of the furnace or shaft.

10. The herein-described process of making  
80 coke which consists in taking hot gas from a shaft furnace or producer at such height that said gas will be under considerable pressure, and coking coal by passing said hot gas under pressure through a mass of coal. 85

11. The method which consists in subjecting a progressing column of bituminous fuel in one part to the action of coking and treat-  
ing another part of the column of coke while  
90 said part is still highly heated for the elimination of impurities, without interfering with the structure of the coke.

12. The method, which consists in conduct-  
ing gaseous fluid through a body of coking  
95 material in one part for the purpose of coking, and conducting a different gaseous fluid for the removal of impurities through another part.

In testimony that I claim the foregoing as my invention I have signed my name, in pres-  
100 ence of two witnesses, this 27th day of August, 1897.

PAUL NAEF.

Witnesses:

G. W. VANRUP,  
J. C. SPRINGSTEEN.