

July 25, 1939.

L. P. J. M. BÉNÉZECH

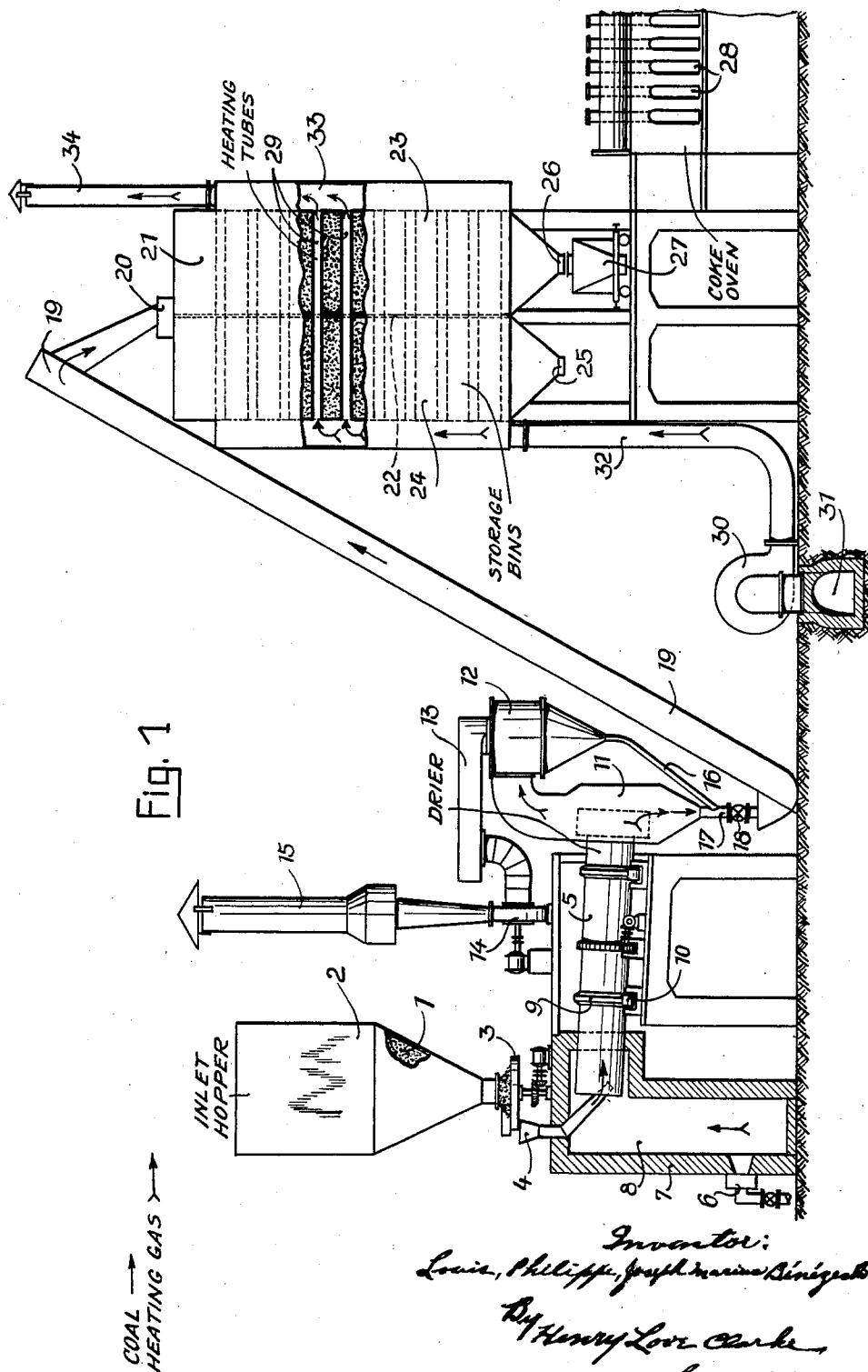
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PROCESS OF PRELIMINARY OXIDATION OF CAKING COAL

WITH SUBSEQUENT COKING THEREOF.

Filed Feb. 12, 1937

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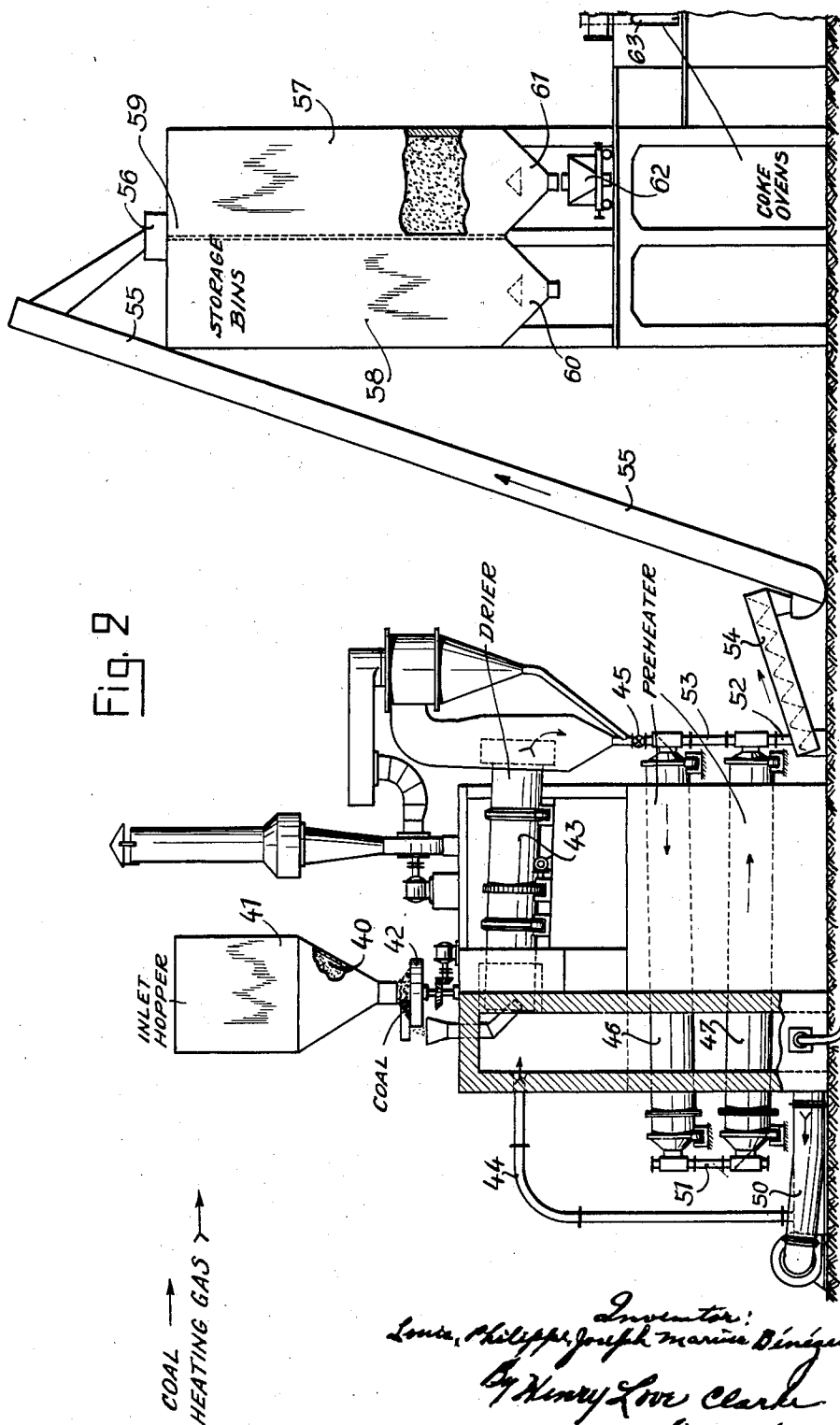
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2 Sheets-Sheet 2

Fig. 2



Inventor:
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his atty

UNITED STATES PATENT OFFICE

2,167,100

PROCESS OF PRELIMINARY OXIDATION OF
CAKING COAL WITH SUBSEQUENT COK-
ING THEREOF

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maux, Tarn, France, assignor, by mesne as-
signments, to Koppers Company, Pittsburgh,
Pa., a corporation of Delaware

Application February 12, 1937, Serial No. 125,392
In France February 14, 1936

1 Claim. (Cl. 202—25)

The present invention relates to the produc-
tion of coke out of caking coals and more par-
ticularly to the preliminary preparation of such
coals for subsequent carbonization at a distilla-
tion temperature of 550–1200° C. (measured in
the coal charge of the chamber), in vertical, in-
clined or horizontal chamber ovens. The object
of my invention is to provide such improvements,
which result in producing a coke or semi-coke
of an extraordinarily high homogeneity and other
valuable properties.

Hitherto, the homogeneity as well as also other
properties for semi-coke and coke has been im-
proved by mixing the caking coal (i. e. the basic
material of the mixture to be coked) of various,
but definite proportions with semi-coke, coke-
dust, lean coal, oxidized caking coals or any other
suitable material.

It is well known that the caking coal, rich in
bituminous matter, will heat up to the ignition
point if stored during the summer months in
high heaps or layers, and that the danger of such
heating will increase, the longer the hot season
and the higher the atmospheric temperature.
If the temperature exceeds the ignition point of
the coal, fire nests will break out and finally, as
the case may be, the whole coal mass will burn.
It is also known, that caking coal, which during
storage has undergone a comparatively low heat-
ing, loses its caking power.

It has now been found, that the oxidation of
caking coal can be conducted and limited by
heating in such a way, that the carbonization of
the coal at temperatures between 550–1200° C.
results in a semi-coke, which is well flown, re-
sistant, dense, reactive and extremely homoge-
neous, without any inert materials, such as coke
dust, lean coal, being admixed to the caking coal.
In fact such cokes or semi-cokes, made from cak-
ing coals partially oxidized to a definite and
limited degree, are practically monolithic. They
form a coherent cake, extending over the whole
length of the coking chamber or retort. Such
cokes are, moreover, well molten, even in the
middle zone of the oven charge, as well as in the
parts of the cake adjacent to the chamber walls,
i. e. in those zones, which are often called the
"cauliflower end", which is formed under the in-
fluence of the heat transmitted from the cham-
ber walls during carbonization. No tar seam will
be found in the center of the coking cake and no
spongy or porous coke is produced. A further
interesting effect of this improved homogeneity is
the remarkably high reactivity of the coke. The
products, (semi-coke and coke) as produced in

the manner described above, are considerably
more reactive than those materials, which are
obtained under similar distillation conditions, by
mixing the basic coal with other carbonaceous
but inert, i. e. non-caking, substances.

On the other hand, under certain heating con-
ditions the coking time of those coals, which were
subjected to a suitably adjusted oxidation, is less
than the coking time of a corresponding mixture
of raw coal and inert substances, so that the
capacity of the battery will be increased, pro-
vided of course, that other operating conditions
are unchanged.

The process according to my present invention
consists principally in that the total quantity of
the caking coal, to be treated, is subjected pre-
viously to the carbonization to a controlled heat
treatment for oxidation.

This fundamental idea of the invention is pref-
erably accomplished by carrying out the oxidiz-
ing heat treatment to the desired extent within a
tower-like storage bunker, in which the coal is
kept at a raised temperature below the softening
point of the coal, in the presence of oxidizing
gases such as air. The coal remains for a defi-
nite regulatable time in this bunker. By alter-
ing the time for the storage of the coal in this
bunker, the degree of oxidation is controlled.
The period for the storage of the coal in the
bunker naturally depends upon the properties of
the coal, upon the re-storages and conversions,
which are taken up by the coal in the pre-
treatment before it is stored in the coal bunker
and also upon the temperature prevailing in the
coal bunker.

The coal treatment bunker can be heated in
any desired way. A direct heating is not neces-
sary if the bunker is charged with a hot coal.
The walls of the coal bunker may be lined with
a heat insulating material.

Further objects and advantages of my inven-
tion will be in part obvious and in part specifically
pointed out in the description hereinafter con-
tained, which, taken in conjunction with the ac-
companying drawings, discloses a preferred em-
bodiment thereof. Such embodiment however is
to be considered as illustrative of the principles
of the invention.

The drawings illustrate two different modes
of carrying out the process according to my in-
vention, of which

Figure 1 shows a plant for the reception of
raw coal 1 in a bunker 2 from the lower outlet
of which the coal is delivered by means of an
extractor 3 to the feeding pipe 4 of a drying

drum 5. In conjunction with the raw coal, the hot gases are introduced into the upper end of the drying drum 5, the hot gases being produced by the combustion of gas and air in a gas burner 6, situated in a chamber 7, which is formed by the refractory brickwork 7. The space 8 surrounds the feeding end of the drying drum. The drying drum is fitted with ball-races 9, revolving on bearings 10. The lower end of the drum 5 reaches into a casing 11, where the separation of heating gases and vapours from the largest amount of drying coal takes place. The joints, between the casing 11 and the drum 5, and between the furnace chamber 8 and the drum, need not be sealed, a close fit sufficing or, if desired, a packing gland of any usual or well known construction for the purpose may be provided for such joints. The vapours and gases from the casing 11 flow to a dust separator 12, from which they are withdrawn through a pipeline 13, by means of a blower 14, into the chimney 15. The coal precipitated in the dust separator 12 runs through the pipe 16 into the exit 17 of the casing 11, and meets there with the other dry coal. The dry coal is delivered through a sluice 18 onto a bucket elevator 19, by means of which it is conveyed into the charging opening 20 of a tower-like holder 21, which is sub-divided by a middle partition wall 22 into two compartments 23 and 24. Special discharging equipment, 25 and 26 respectively, is provided for each bunker. The discharging devices 25 and 26 are arranged in such a way, that a coal charging car 27 of a horizontal chamber oven battery 28 can travel underneath them.

As described above, the coal is stored for a certain period at a fixed temperature in the treatment tower 21. In order to bring the coal that is aging in the treatment tower 21, to the desired temperature, quite a number of suitably staggered heating pipes 29 are provided in the coal tower. A controlled quantity of hot waste gases is supplied to the heating pipes by means of a blower 30 from the waste gas channel 31 of the coke oven battery, through a pipeline 32. If the inlet of the pipes 29 is suitably dimensioned, the heating media are uniformly distributed in the desired way through the heating pipes. On the other side, the heating pipes open into a waste-gas collecting pipe 33, from which they escape into the chimney 34.

The process for carrying out the invention according to Figure 2 differs in principle from the plant shown in Figure 1, in that the coal is not heated in the treatment tower itself, but is charged in hot condition into the treatment tower. The raw coal 40 runs from the raw coal bunker 41 through a discharge arrangement 42, into the drying drum 43, which is supplied with hot gases, being delivered through the pipeline 44. A contrivance by which the heating gases and vapours are separated from the coal, is fitted at the outlet of the drying drum 43, similar to the apparatus of Figure 1. The dried coal is then fed through the sluice 45 into a set of drums, consisting of two revolving furnace drums, 46 and 47. The set of drums is arranged in an oven chamber, formed by the refractory brickwork 48. The oven chamber 48 is heated by means of gas-air burners, which are supplied with heating gas through the pipeline 49. The waste gases are withdrawn from the oven chamber 48 through pipeline 50.

The coal charged into the upper revolving furnace drum 46 is warmed up and finally flows

through a connecting main 51, arranged at the other end of the revolving furnace, into the lower revolving furnace drum 47, in which the coal is further heated up to the desired temperature. The heated coal leaves the set of drums through the pipeline 52, which is connected to the sluice 45 by means of an adjustable connecting pipeline 53, so that, if necessary, hot coal can be mixed with cold, dried coal and the temperature can be adjusted exactly corresponding to the coal. A mixer 54, holding the mixture of cold and hot coal, takes care of an intimate mixing of both media.

The coal is delivered from the mixer 54 to a bucket elevator 55, by which the coal is conveyed into the inlet 56 of a coal bunker 59, comprising two compartments 57 and 58. Each compartment is connected to a special discharge contrivance 60 and 61. The arrangement of the coal treatment tower 59, similar to the design shown in Figure 1, is such, that the coal charging car 62 of the oven battery 63 can immediately be driven underneath the outlets 60 and 61.

The heat treatment of the coal in the apparatus as shown in Figure 2 is done in such a way, that the coal at the outlet of the furnace 47 has reached a temperature as high as possible, but below the point at which the coal begins to soften. The coal temperature at this part of the plant is for instance 300-310° C., if a coal with about 26% volatiles is to be dealt with, which is often the case in Southern France.

The coal remains in the treatment tower 59 at an increased temperature so long as may be necessary, until its cakeability is reduced to the desired degree. With a proper selection and construction of the extracting devices 60 and 61, it must be seen to it, that the coal is uniformly moved within the treatment bunker from the top downwards.

The storing of coal in the compartments 57 and 58 takes about 120 hours. Under these circumstances, the fuel at the inlet into the treatment tower has for instance a temperature of 150-160° C. and when the coal is filled into the coal charging car, the temperature amounts to 130-140° C.

Cooling means may also be arranged in the treatment towers, in order to reduce the temperature of the coal charge in the tower, if necessary.

On account of the prolonged heat treatment, the coal is subjected in the pre-treatment plant to a partial oxidation, which begins already in the rotary furnace and which is continued in the treatment tower. In the latter, the oxidation is effected by means of oxygen in the air, which surrounds the coal particles and by the oxygen fixed in the coal. The control of the time for storing the coal in the treatment tower is done in such a way, that the coal at the exit of the treatment tower has the desired optimum cakeability.

If based upon dry coal, which for instance is produced if a pneumatic preparation of coal is provided for, it will be sufficient to charge the coal regularly at a certain interval or continuously into the treatment towers, which depends upon the properties of the coal, for instance upon the oxidation degree, the temperature and the time for storing the coal in the tower, i. e. those factors, which have an influence upon the cakeability.

If based upon moist coal, which is delivered to the process by means of a Teines-plate-like apparatus or some similar feeding arrangement, for

instance into the drying drum 5 or 43, as illustrated on the drawings, collaborating with a suitable dust-extractor, the dry and slightly heated coal at a temperature of about 80-100° C. is methodically filled into the treatment towers, which as above described, are arranged at their exit with those contrivances, producing a uniform movement of coal through the tower.

I have now described my present invention on the lines of a preferred embodiment thereof, but my invention is not limited in all its aspects to the mode of carrying out as described and shown, since the invention may be variously embodied within the scope of the following claim.

I claim:

In a process for the production of coke and semi-coke from coking coal which previously to the carbonization thereof, had been subjected to a predetermined limited degree of oxidation to reduce the cakeability of the coal, the improvement comprising: storing the total quantity of coal to be coked in a downwardly moving tower-like bunker column thereof; oxidizing the coal during its storage with only the air normally en-

trained in the coal when charged into storage by merely aging the coal in the bunker column, in the absence of direct contact with heating gas, and while being maintained at a temperature between 150-160° C. at the top of the column and 130°-140° C. at its bottom, for the period of time, comprising at least several days, predetermined as being required for oxidizing of the coal by aging it with its entrained air to attain the required degree of oxidation before the coal is withdrawn at the bottom for carbonization; the coal to be oxidized being supplied at the top and the oxidized coal being withdrawn at the bottom of the bunker column regularly as required for the coking step; the aging being effected so that the coal introduced at the top is aged in passing to the bottom in its progressive descent through the column; and thereupon carbonizing the aged oxidized coal as it is withdrawn from the bottom of the bunker column.

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