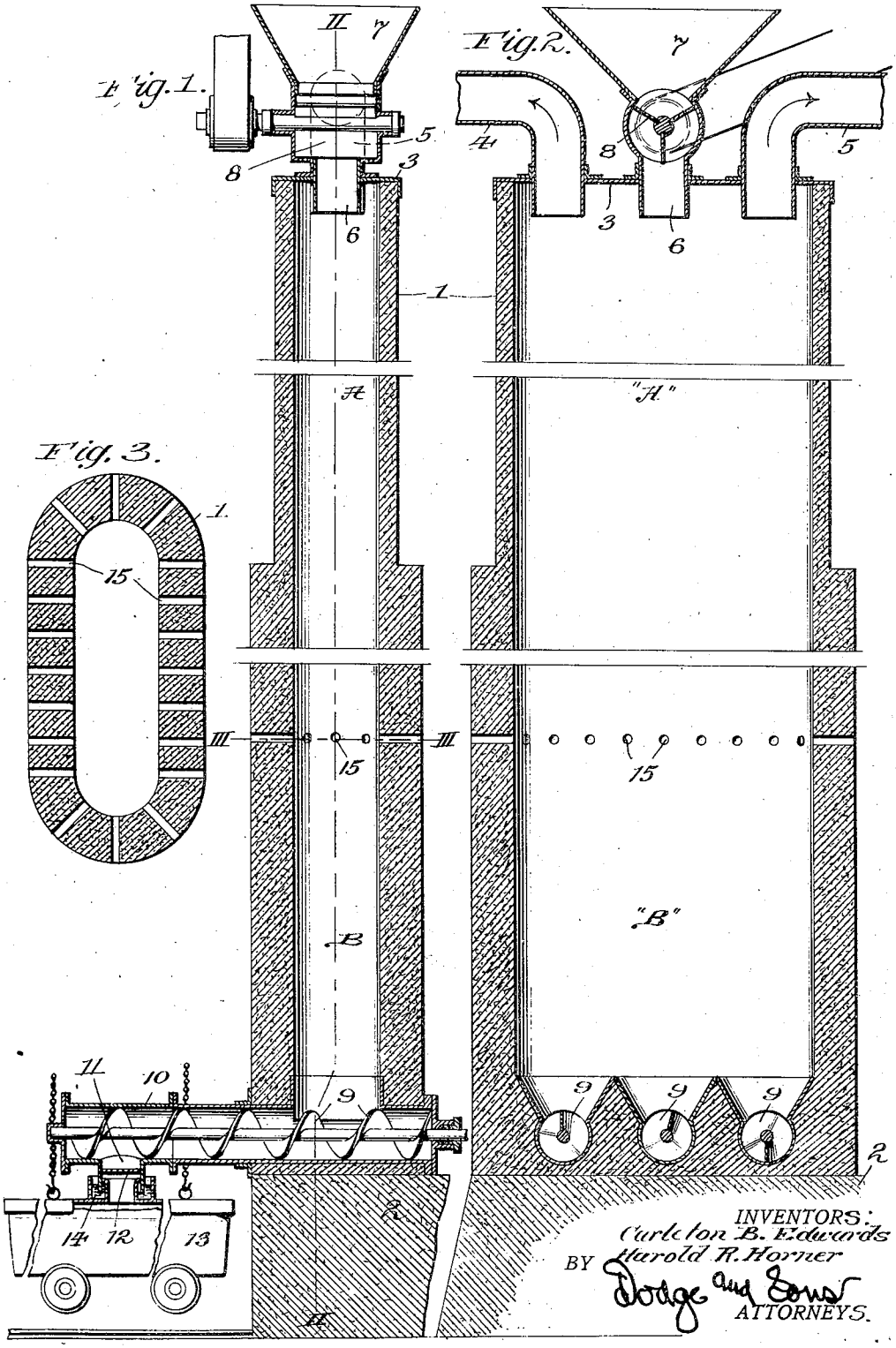
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METHOD OF PRODUCING CARBON AND SUCH CARBON

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METHOD OF PRODUCING CARBON AND SUCH CARBON

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This invention pertains to a method of producing carbon and to the carbon as a new article of manufacture, the carbon possessing certain peculiar and highly valuable characteristics as will hereinafter appear in detail.

Broadly stated, the method consists in calcining pitch coke and thereby converting the same into a substantially pure carbon especially adapted for the production of electrodes. The coke employed may be derived from various sources but more particularly we propose to employ coke produced from coal tar, or coal tar pitch, or petroleum coke. Preferably, we employ the former as the starting material. Such coke is set forth and claimed in U. S. Letters Patent to Reilly No. 1,230,782, dated June 20, 1917, and for the purposes of description will hereinafter be referred to as Reilly coke. Said Reilly coke is characterized by being dry and sponge-like in appearance, amorphous, presenting, when fractured, a steel-gray surface with a brilliant, glossy surface upon the walls of the depressions or recesses appearing therein. This coke is a non-conductor of electricity as is also the petroleum coke, but by the process hereinafter set forth, such cokes are so changed as to produce a carbon having a high degree of electrical conductivity and, as a consequence, well adapted for the manufacture of electrodes.

In carrying out our process we employ a suitable retort and in the annexed drawings there is shown one embodiment wherein our process may be effectuated.

In said drawings:

Figure 1 is a vertical sectional view of the retort,

Figure 2 a similar view taken on the line II—II of Figure 1, and

Figure 3 a horizontal sectional view taken on the line III—III of Figure 1.

The body of the retort denoted by 1 is built up of suitable refractory and, from the base or foundation 2, is of a height of approximately twenty-two feet.

The interior of the retort is preferably of the same dimensions throughout and, with a view of securing uniform production, is made substantially oblong or elliptical in cross section;—this for the reason that it is necessary to effect the same reaction throughout the entire mass as it passes down through the retort.

Where the mass is of a cross section too great to permit the indrawn air to penetrate the same, unsatisfactory results obtain.

It is, of course, apparent that a retort circular in cross section, where the diameter is small enough, could be employed with, however, a reduction in the bulk of material treated.

The upper end of the retort is provided with a suitable top 3 through which extend one or more gas off-take pipes 4 and 5 which pipes are connected with suitable exhausters (not shown).

A feed pipe 6 is also supported by the top 3 and is surmounted by a hopper 7 with which is associated a sealing feeding valve 8 of conventional form.

Located at the lower end of the retort chamber is a series of conveyor screws 9, said screws extending outwardly into housings 10 each of which is provided with a lipped discharge opening 11, which opening is controlled by a valve 12. Means, not shown, is employed to continuously drive the discharge screws.

The finished product is discharged into cars or other suitable receptacles designated by 13 which are provided with water chambers 14 adapted, when the car is raised, to form a seal with the lip and thus prevent ingress of air through the discharge opening when valve 12 is opened.

Opening through the wall of the retort on a line between say eight and ten feet above the base, is a series of air inlet openings 15 and through which air is drawn inwardly to support the combustion of the coke as it passes downwardly from the upper end of the retort.

In operation, the coke, in lump form and of the character set forth, is charged into the retort and suction established through the gas off-takes 4 and 5, valves 12 at such time being closed.

Initial ignition may be effected in any approved manner, and once ignition is had

and the requisite temperature is reached, the process becomes a continuous one.

The coke passes slowly down through the retort in counter-current to the hot gases passing up from the combustion zone designated by A and out through the exhaust lines 4 and 5. The coke as it passes downwardly through the retort is subjected to increasing temperature at the rate of approximately 160° C. per foot of distance of fall from the upper end of the retort to the combustion zone.

At the lower temperatures the moisture is driven off. When 450° C. is reached decomposition of the hydrocarbons remaining in the coke occurs and this continues steadily until the coke reaches the combustion zone where oxygen from the air entering the air holes 15 burns around the surface of each piece, raising it to the maximum temperature obtainable in such internal combustion arrangement. The temperature obtaining in the combustion zone is from 1600° C. to 1930° C. and this intense heat decomposes the last portion of the hydrocarbons and produces a carbon approaching graphite in purity, electrical conductivity, specific gravity, and likewise difficult to ignite.

After passing the combustion zone the pieces of carbon immediately begin to cool and no further loss is sustained. In the lower portion of the retort, or that marked B, the carbon is gradually cooled and is continuously removed by the conveyers 9 or any equivalent means.

As before noted, the raw coke is continuously fed into the upper end of the retort by the valve 8. The gas generated in the combustion zone A is drawn upwardly through the suction applied to the outlet pipes 4 and 5 and steadily drops from its maximum temperature as it passes upwardly in counter-current to the down coming coke. In its passage up through the charge, the gas loses its heat until it is removed, the temperature at such time approximating 150° C. Thus a very efficient heat exchange is obtained and a very great fuel economy results. The gas which is drawn off is a very satisfactory type of producer gas and is utilized for generating power for operation of the mechanical elements associated with the retort and may be used for other purposes as well.

As above noted, the retort must necessarily be rather narrow in cross section, not exceeding twenty-four inches in diameter if the retort is circular, or not more than twenty-four inches across if the retort is of the form shown in the drawings. This is necessary in order that combustion be obtained around every piece of coke or carbon and is seemingly the only way of obtaining a perfectly uniform product and the greatest economy in carbon consumption.

The carbon produced by the method above outlined is especially adapted for the production of electrodes. Electrodes manufactured from carbon produced by the above method are burned with great difficulty and are superior to ordinary electrodes and have a relatively long life.

The various properties, chemical and physical, which clearly distinguish the present carbon from others, when Reilly coke is employed as the starting material, are as follows:

Characteristics

1. Apparent density of size .37″ to 18″.	.42
2. Friability	Very friable, easily ground
3. Ash	Light, fluffy
4. Porosity	Highly porous
5. Sulfur	.18%–40%
6. Soluble salts	.04%
7. Electrical resistance.	.05–.08 ohms (conditions in next table)
8. Structure under magnifying glass.	Walls jagged, many cracks
9. Outer surface	All pieces dark from combustion occurring at the surface
10. Specific gravity	2.05–2.10

In addition to the foregoing, the highest grade electrode carbon we have been able to produce has the following characteristics:

Moisture	None
Volatile	None
Ash	.12%
Sulfur	.22%
Electrical resistance	.05 ohms (per linear inch of a one inch diameter cylinder, pressure of 150 lbs. per sq. inch. Size of carbon—35 to 65 mesh)
Fixed carbon	99.6%
Specific gravity	2.10

In passing through the retort, the carbon which is consumed amounts to from 10% to 35% of the raw coke introduced.

No appreciable amount of condensible material is obtained in the gas, the action being principally a very high temperature chemical decomposition of the hydrocarbons remaining in the so-called Reilly coke, by which the hydrocarbons are cracked to yield methane, hydrogen, ammonia, hydrogen sulfide and other gases. It may be said to be a cracking process which removes everything but the carbon and a small amount of ash. The carbon resulting from the treatment

above described has a gray, dull appearance, is free from volatiles and is essentially pure carbon.

A reduced pressure is essential to the operation of the process. The apparatus is operated at twenty-five inches to fifty inches of vacuum at the top of the retort and approximately one and one-half inches or more of vacuum at the air inlet. Such a reduced pressure apparently distributes the combustion over a large area and entirely to the center of the charge giving far more satisfactory results than when a blower is employed to force the air into and through the air holes.

The uniformity of action throughout the mass is evidenced by the fact that each and every piece of treated coke presents the same exterior condition—the surface exhibiting a dull gray appearance quite different from that of the starting material. That the process is the same throughout the mass is evidenced by the fact that pieces taken from different sections of the combustion zone are the same in all characteristics.

The calcination of the coke acts to produce a shrinkage in the pieces of the material, which shrinkage prevents bridging or stoppage of the flow of the charge downwardly through the retort.

What is claimed is:

1. That method of producing carbon having a low electrical resistance, which consists in feeding coke into the upper end of a vertical retort having a relatively small cross sectional area; subjecting the coke thus fed to a temperature of approximately 1790° C. in a portion of the retort at a point removed from the upper end thereof; drawing air through the walls of the retort at such a point and upwardly through the down coming charge of coke; and gradually withdrawing, from the lower end of the retort, the carbon produced.

2. As a new article of manufacture a carbon suitable for utilization as an electrode, said carbon being characterized by being free from moisture and volatile matter, low in ash (.15%), having a low sulfur content (.30% to .40%), having a high specific gravity (2.08–2.10), having a low electrical resistance (.05–.07 ohms) and being distinguishable by the fact that it is easily ground.

3. That method of producing carbon of low electrical resistance which consists of preparing coal tar coke and thereafter passing said coke to, through and beyond a combustion zone, the temperature progressively rising as the coke approaches the combustion zone to approximately 1790° C.; admitting air to the combustion zone; causing said air and gaseous products of combustion to flow in counter-current to the coke approaching the combustion zone; and maintaining sub-atmospheric pressure on the material being treated.

4. That method of producing carbon of low electrical resistance from coal tar coke which consists in feeding the coke in lump form in a compact stream; sustaining surface combustion of said lumps in a definite zone in said stream by feeding air to the stream in the desired zone; and withdrawing the products of combustion in counter-current to the entering coke stream.

5. That method of producing carbon of low electrical resistance from coal tar coke which consists in feeding the coke in lump form in a compact stream; sustaining surface combustion of said lumps in a definite zone in said stream by feeding air at sub-atmospheric pressure to the stream in the desired zone; and withdrawing the products of combustion in counter-current to the entering coke stream.

6. That method of producing carbon of low electrical resistance which consists in treating coke, produced as the result of the complete distillation of coal tar, in a retort of small cross sectional area and therein subjecting the coke, as the same passes downwardly therethrough by the action of gravity, to a calcining temperature approximately 1790° C. in the presence of a current of air and at sub-atmospheric pressure.

7. That method of producing carbon having a low electrical resistance which consists in treating coke, produced as the result of complete distillation of coal tar, by continuously passing the same, in the form of lumps, by gravity action through a vertical retort of small cross sectional area and therein subjecting the coke, as it passes downwardly, to a calcining temperature approximately 1790° C. in the presence of a current of air and at sub-atmospheric pressure.

In testimony whereof we have signed our names to this specification.

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