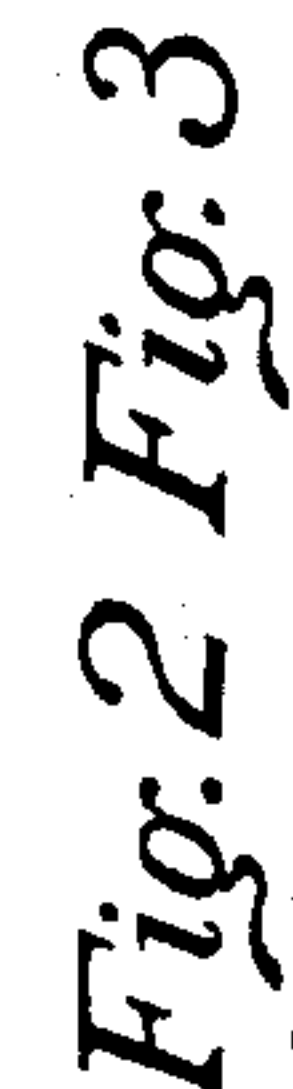


**994,322.**

*Fig: 1*



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# UNITED STATES PATENT OFFICE

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## CASE-HARDENING.

994,322.

Specification of Letters Patent.

Patented June 6, 1911.

Application filed February 18, 1908. Serial No. 416,602.

### *To all whom it may concern:*

Be it known that I, ADOLPH W. MACHLET, a citizen of the United States, residing in Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Case-Harden-

This invention relates principally to case-hardening steel and iron articles, especially small articles in bulk.

The principal object of the invention is to provide means for producing expeditiously and at low cost case-hardened shells or crusts upon metal articles, especially where it is desired to leave the articles with relatively soft exteriors for subsequent working with tools, etc. To these ends, I heat the articles in a suitable retort, and introduce therein a carbon or hydro-carbon in a fluid form and greatly thinned by an inert gas consisting wholly or largely of carbon-monoxid or of carbon-monoxid and hydrogen. I produce the carbon-monoxid in a gas producer by passing a current of compressed air through a body of incandescent charcoal in the producer, and lead the resultant gases, *i. e.*, carbon-monoxid, nitrogen, etc., through a body of naphtha or oil, whereby the gases become charged with hydro-carbon vapor, and pass slowly through the retort. The hydro-carbon vapor is the carburizing agent. When desired, steam may be introduced or generated in the fire-chamber of the gas-producer, in which it is decomposed, the oxygen uniting with the carbon to form additional carbon-monoxid, and the hydrogen (itself inert) serving to thin the carbon-monoxid.

The apparatus also preferably comprises an annealing retort, which corresponds generally in structure and mechanical operation to the case-hardening retort, and is connected to the gas-producer by means of a by-pass around the oil tank, so that annealing and case-hardening may be carried on simultaneously, and so that both retorts may be used for annealing, when desired, by simply first draining the oil tank, so that the gases may pass from the producer

through the first retort without taking up any carburizing fluid.

In the accompanying drawings, Figure 1 is a diagrammatic elevation of an apparatus for carrying out the several features of my invention. Fig. 2 is a sectional side elevation, and Fig. 3 a rear elevation of a water back preferably provided in the door framing at the lower part of the gas producer; although the use of water or steam is optional.

Air under pressure is supplied from a pump or blower 1 through a pipe 2 to an inlet 3 at the bottom of a gas producer 4, the latter usually in the form of an upright cylindrical body and containing a fire chamber 5, provided with a refractory lining and surmounting a grate 6, upon which rests a body of incandescent charcoal 7.

The carbon-monoxid, nitrogen, and other products of combustion pass up through an outlet 8 and a horizontal outlet 9, and thence down through a vertical pipe 10 having a communication 11 with the lower end of a scrubber 12 of the usual type and containing a body of coke 13 resting upon a grate 14, and cleaned by a spray of water 15 admitted into the top of the scrubber through a supply pipe 16.

The gas passes from the upper part of the scrubber through a pipe 17 down to a tank 18 containing naphtha or other hydro-carbon liquid 19, said liquid supplied from any suitable vessel 20, and the supply being regulated by a valve 21. The bottom of the pipe 17 terminates at the bottom of the tank 18 in the form of a spray 22, so that gas bubbles pass up through the naphtha and escape from the tank through a pipe 23 which opens into the top of the tank. The pipe 23 is connected by a gland at 24 to a pipe 25 leading into a revoluble retort 26 mounted within a furnace 27 having controlled burners 28 for air and gas, and also having a constricted vent 29 regulatable by a valve 30. The pump 1 forces the current through the gas-producer, the scrubber, the oil tank and the retort. The retort and furnace may be of the general construction illustrated in my



co-pending application No. 292,515, filed December 19, 1905; the object of rotating the retort being to agitate the articles, and to expose them on all sides evenly to the action of carburizing gas.

I have found that articles may be case-hardened in this apparatus by the described method very cheaply and expeditiously, owing to the very low cost of the inert gas derived from the gas-producer, which enters the retort in relatively large volumes and acts as a carrier for the carburizing vapor taken up from the oil tank. I have also found that articles case-hardened by this method have relatively soft cases or shells, so that they may be readily cut by tools or filed or drilled, or otherwise operated upon or treated, mechanically or otherwise.

The blower 1 or other apparatus, supplies pressure to force the current steadily or uniformly through the entire apparatus and out from the vent 29. Moreover, the air supplied by the blower is converted into nitrogen and carbon-monoxid, the carbon-monoxid performing the function already set forth, and the nitrogen being itself a valuable agent in the process of case-hardening.

The pipe 23 may be provided with a pressure gage 31, and the tank 18 may be provided with a gage glass 32 and a petcock 33 for draining the tank.

The outlet 8 communicates with the top of the fire chamber 5 in the gas-producer 4, and is arranged centrally of said chamber, to induce an even consumption of the charcoal 7 therein. Said outlet is surmounted by a hopper 34 for the fuel, a gate 35 being provided between the hopper and the outlet 8. In the side of the latter is formed or provided a short horizontal pipe 36 from which the pipe 9 leads; and a vent 37 also leads from 36 up to a chimney. A gate or valve 38 in the pipe 9 is closed and a valve 39 in the pipe 37 is opened when the charcoal 7 is being ignited; and after such ignition 39 is closed and 38 is opened. Heretofore, the outlet 36 has been connected directly to the side of the retort at its upper end; but this has been found to cause uneven combustion of the fuel charge, and to be otherwise objectionable. These objections are overcome by connecting the part 36 to the pipe 8 above the body of the producer, and arranging the pipe 8 at the middle of the fire chamber, as shown.

If desired, a water back in the form of a receptacle 40 may be cast upon the inner side of the framing 41 of the usual door 42 in the bottom of the gas producer, said receptacle 40 having at its upper portion openings 43 into the fire chamber of the gas-producer. The water is supplied from a feed glass 44 through a pipe 45; a valve 46 being provided

to regulate the flow of the water; the parts 44, 45, 46 resembling in construction the usual sight feed for supplying oil to steam engines, etc. The water back 40 becomes sufficiently heated to vaporize the water 49 therein, and the vapor passes up through and is decomposed by the incandescent charcoal, the oxygen uniting with the carbon to form carbon-monoxid, and the hydrogen mixing with the products of combustion and thinning the same, thus reducing the cost of the carrier for the carburizing fluid, and gaining other advantages.

Excellent results in ordinary work are gained without steam or hydrogen, thus rendering the water back undesirable except in unusual cases.

A safety valve 47 controlled by a weight 48 may be provided upon the end of the pipe 3, to afford a vent in case of explosion within the apparatus.

The apparatus also preferably includes a second retort 50 in a furnace 51, corresponding to the described parts 26 and 27, and connected to the pipe 17 by means of a by-pass 52 around the oil tank 18. The gas from the gas producer, (either with or without the steam-produced gases), may be caused to flow slowly through the retort 50 while the articles therein are being annealed, to avoid liability of oxidizing the articles, the carbon-monoxid, nitrogen, and hydrogen being inert or neutral. A valve 53 in the by-pass 52 may be closed, and a valve 54 in the pipe 23 may be opened when the case-hardening retort 26 is in operation; and 54 may be closed and 53 opened when the retort 50 is in operation, or both valves 53 and 54 may be left open when it is desired to case harden and anneal at the same time. If it is desired to anneal simultaneously in both retorts 50 and 26, it is only necessary to leave open both valves 53 and 54, first draining the oil from the tank 18, so that the annealing gas passing through said tank shall not take up any carburizing fluid.

Variations may be resorted to within the scope of the invention, and portions of the improvements may be used without others.

Having thus described my invention, I claim:

1. The combination with an apparatus for compressing air and producing carbon-monoxid therefrom, of a case-hardening retort having a vent and provided with heating means and connected to said producing apparatus, and an oil tank connected between the producing means and the retort, to cause the carbon-monoxid to pass through the oil in flowing to the retort; the connection being continuous from said air compressing apparatus to said vent, to enable the former to force the carburizing gas to flow through the retort.



2. The combination with a case-hardening retort having a vent and provided with heating means, of means connected thereto for compressing air and producing carbon-monoxid therefrom and conducting it to the retort, and intermediate means for charging the carbon-monoxid with hydro-carbon vapor; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

3. The combination of a case-hardening retort having a vent, means connected thereto for compressing air and producing carbon-monoxid and nitrogen therefrom, and an intermediate oil tank through which the gases from the gas producing means pass on their way to the retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

4. The combination of a case-hardening retort having a constricted vent, a gas producer connected thereto, an intermediate oil tank through which the gas from the gas-producer passes on its way to the retort; and means connected to said gas-producer for supplying air under pressure; the connection being continuous from said air supplying means to said vent, to enable the former to force the carburizing gas to flow through the retort.

5. The combination of an oil tank, a gas producer, means for compressing air and supplying it to said gas-producer to be converted into carbon monoxid and nitrogen, a pipe leading from said gas-producer and having an outlet within the oil tank near the bottom thereof, a case-hardening retort provided with heating means and having a vent, and a pipe leading from the upper part of said oil tank to said retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

6. The combination of an oil tank, a gas-producer having an outlet into the lower portion of the oil tank, means for compressing air and supplying it to said gas producer, and a case-hardening retort provided with heating means and having a constricted vent and in communication with the oil tank at the upper portion thereof; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

7. The combination of a case-hardening retort having a vent, means connected thereto for producing carbon monoxid and nitrogen from air, including means for compressing the air, an intermediate oil tank through

which the gases from the gas-producing means pass on their way to the retort, and a scrubber between the oil tank and the gas-producing means; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

8. The combination of a case-hardening retort having a constricted vent, a gas-producer in communication with said retort, an oil tank between said gas-producer and said retort, and a scrubber between the oil tank and the gas-producer; means being provided to supply air under pressure to the gas-producer to be converted thereby in carbon monoxid and nitrogen, to flow through said retort.

9. The combination with a case-hardening retort having a vent, of an apparatus connected thereto for compressing air and converting it into carbon-monoxid and nitrogen, and supplying it to the retort, and means for supplying hydro-carbon vapor to the retort simultaneously with the gas; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

10. The combination with a case-hardening retort having a vent, of an apparatus connected thereto for compressing air and converting it into carbon-monoxid and nitrogen and supplying it to the retort, and means for charging the gas with hydro-carbon vapor before it passes into the retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

11. The combination with an apparatus, inclusive of a device for compressing air, for producing carbon-monoxid and hydrogen from air, of a case-hardening retort having a vent and provided with heating means and connected to said producing apparatus, and an oil tank connected between the producing means and the retort, to cause the carbon-monoxid and nitrogen to pass through the oil in flowing to the retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

12. The combination with an apparatus, inclusive of a device for compressing air, for producing carbon-monoxid and nitrogen from air, of a case-hardening retort having a vent and provided with heating means and connected to said producing apparatus, an oil tank connected between the producing means and the retort, to cause the carbon-monoxid and nitrogen to pass through the oil in flowing to the retort, and means independent of said compressing means, for



simultaneously supplying hydrogen to said retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

13. The combination with a carburizing retort having a vent, of a gas-producer, means for compressing air and supplying it to be converted into carbon monoxid and nitrogen, means independent of said air compressing means for also generating steam in the gas-producer to pass through its fire chamber, and means between the gas-producer and the retort for charging the resultant gas with carburizing fluid; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

14. The combination of a case-hardening retort having a constricted vent, a gas-producer connected thereto, means for compressing and supplying air to said gas-producer, means independent of said air-compressing means for generating steam in said gas-producer and passing it through the fire-chamber thereof, and an intermediate oil tank through which the gases from the gas-producer pass on their way to the retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

15. The combination of a case-hardening retort having a constricted vent, a gas-producer connected thereto, means for producing steam in the gas-producer to mingle with the gas, and an intermediate oil tank through which the gas from the gas-producer passes on its way to the retort; the gas-producer connected to a source of supply of air under pressure independently of said steam-producing means.

16. The combination with a retort, of a gas-producer connected thereto, means for compressing air and supplying it to the gas-producer, means for supplying carburizing fluid to the retort simultaneously with the gas from the gas-producer, means independent of said air-compressing means for producing steam in the gas-producer to mingle with the gas, and means for regulating the amount of steam produced; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

17. The combination with a retort, of a gas-producer connected thereto, means for compressing air and supplying it to the gas-producer, means for supplying carburizing fluid to the retort simultaneously with the gas from the gas-producer; the fire-chamber of the gas-producer having a water recep-

tacle in which steam originates to pass through the incandescent mass in the gas producer, and a regulatable water feed to supply the same; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

18. The combination of a case-hardening retort, a gas-producer connected thereto, an intermediate oil tank through which the carbon-monoxid from the gas-producer passes on its way to the retort, and means for compressing air and conducting it to said gas producer; a water receptacle being provided within the lower part of said gas-producer to enable the heat of the latter to convert the water into vapor to pass up through the fuel; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

19. The combination with a case-hardening retort having a vent, of means for producing carburizing gas from fuel and air, including means for compressing the air, means for thinning the gas and passing it through the retort, and means for simultaneously supplying carburizing fluid to the retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

20. The combination of an annealing retort having a constricted vent, a gas-producer in communication with said retort, and a scrubber between the retort and the gas-producer; means being provided to compress air and conduct it to the gas-producer, to be converted into the products of incomplete combustion and to flow through said retort; the connection being continuous from said compressing means to said vent, to enable the former to force the carburizing gas to flow through the retort.

21. The combination with an apparatus for producing carbon-monoxid, including means for compressing air, of a retort provided with heating means and connected to said producing apparatus, an oil tank connected between the producing means and the retort, so that the carbon-monoxid passes through the oil in flowing to the retort, and a retort provided with heating means and connected to said producing apparatus by means of a by-pass around said tank; valves being provided one in said by-pass and one between the first retort and the by-pass; said air-compressing means being in open communication with both of said retorts, to force the gas therethrough.

22. The combination with an apparatus for producing carbon-monoxid, including means for compressing air, of a retort provided with heating means and connected to

said producing apparatus, an oil tank connected between the producing means and the retort, so that the carbon-monoxid passes through the oil in flowing to the retort, and  
5 a retort provided with heating means and connected to said producing apparatus by means of a by-pass around said tank; valves being provided one in said by-pass and one between the first retort and the by-pass; means being provided for draining the oil 10 tank; said air-compressing means being in open communication with both of said retorts, to force the gas therethrough.

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Witnesses:

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