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-Hardening Apparatus, of which the following is a specification.

This invention relates principally to case-hardening steel or iron articles.

In my co-pending application No. 244,244 Patent No. 822,400 is set forth a manner of case-hardening by inclosing articles in a retort, and both heating and rotating the retort while a current of carburizing gas circulates therethrough; and in my co-pending application No. 299,515 filed December 19, 1905, is disclosed a manner of thinning the carburizing gas by means of ammonia.

One of the objects of the present invention is to simplify and reduce the cost of the heating apparatus and the operation thereof, as well as to adapt the same for certain kinds of work, and another object is to provide for securing the proper quality of carburizing gas, as well as for diluting the same, whereby the user may operate independently of the ordinary illuminating gas supply, which is not always available, and which in some cases is not suitable for carburizing.

According to the first part of the present invention, the articles are placed directly in the flame chamber of a retort which is in the form of an oven, and heated directly by the flames, and then the flames are extinguished, and the oven is filled with carburizing gas, which cements the articles by means of their own-retained heat. The walls of the oven are greatly thickened for the purpose of retaining heat, thus delaying the cooling of the articles sufficiently to enable them to be substantially cemented by their retained heat, or by the heat retained in the oven.

The top of the oven is provided with one or more capacious vents for the escape of products of combustion during the heating of the articles, and these vents are provided with closures, whereby they may be closed during the subsequent carburizing operation; and the oven is also provided with a constricted regulatable vent for controlling the flow of carburizing gas therethrough.

The carburizing gas is preferably introduced into the oven through the same pipe which feeds the burners.

In practicing my invention in one way, ammonia gas may be led from a tank through a body of naphtha, the ammonia taking up a quantity of naphtha, and being then led into the retort or oven to carburize the articles; the ammonia serving as a diluent for the carburizing gas which it derives from the naphtha, and avoiding the deposit of free carbon upon the articles, and hastening the carburizing operation. By this means, the user becomes independent of the supply of illuminating or heating gas from the usual sources, which is liable to fluctuate in quality, or which may not be available, and is assured a continuous supply of carburizing gas of uniform quality.

Other objects, features and advantages will hereinafter appear.

In the accompanying drawings, Figure 1 shows one form of apparatus operating in accordance with my present invention; portions of the oven and the oil tank being broken away to disclose the construction. Fig. 2 is a cross-section of the oven, showing the burners let into the opposite walls thereof.

The oven comprises side walls 1, 2, rear walls 3, top 4, front wall 5 and base 6, all made of refractory material and greatly thickened in proportion to the capacity of the oven, so that they retain heat, thereby to delay the cooling of the articles, and hence prolong the cementing operation until a substantial shell is formed upon the articles. The oven is preferably contained in an iron boxing 7, and rests upon an iron base 8 supported upon legs 9. At the front of the oven is provided a door or lid 10 of thick refractory material, which may be lifted by means of hooks 11. In the top of the oven are provided capacious vents 12, which are made open during the generation of flames in the oven and may be closed by conical plugs 12a during the subsequent filling of the oven with carburizing gas.

Gas or other fuel is supplied to the oven through a pipe 13 controlled by a valve 14; and air is supplied through a pipe 15 con-
trolled by a valve 16; the air being prefer-
ably supplied under pressure. The mixed
air and fuel are distributed by means of
pipes 17, 18, 19 and 20, to burners 21 in the
base of the oven. Preferably the burners
are arranged in two series in the opposite
cells 1, 2, so as to direct the flames along the
floor 6 of the oven. A thick plate 22 of
either iron or refractory material may lie
horizontally just above the burners, spaces
being left at 23 around the edges of the
screen for the passage of flames up into the
body of the oven, whereby the flames are
calculated to heat the walls of the oven very
hot, as well as articles contained therein.
The screen also because of its great thickness
serves as a reservoir of heat to prolonged the carburizing operation.

In operation the door 10 is lifted and the
articles 24, such as tubes, or bars or devices
of any shape, are placed upon the screen or
table 22. Before the door 10 is dropped,
the valves 14 and 16 are opened and the
mixture of the gas and fuel is ignited at
the burners 21, the products of combustion
escaping through the vents or vents 12. The
heating proceeds until the articles
reach a carburizing heat which is say above
red heat and below the melting point; at
which time the door and the walls of the oven,
as well as the screen 22, are heated to
about the same temperature as the articles,
and serve as reservoirs of heat to prolong
the carburizing operation. Thereupon the
valve 16 is closed to cut off the air and ex-
tinguish the flames at the burners, and the
vents 12 are closed by the plugs 12*. And
gas may continue to flow in through the pipe
13 to immediately fill the oven and
carburize the articles; this gas being of any
suitable quality, as coal gas or any other
carburizing fluid. Preferably a constricted
vent pipe 46 is fitted in the lower part of the
doors 10 or one of the walls of the oven,
so that the current of carburizing gas may
pass slowly through the oven, thus insuring
the drawing off of the vitiated gas, and
the renewal through the pipe 13 of fresh
gas. This vent may be regulated by a valve
47. The gas escaping through this vent
and igniting in the air shows its condition
by the color of its flame. The operator is
hence enabled to control the condition and
flow of the gaseous atmosphere in the oven
by regulating either valve 47 or 14 or both.
Owing to the thickness of the heated walls,
the cooling of the metal articles is greatly
delayed, and they are enabled to become
cemented to a substantial depth by means
of their own retained heat, or by means of
the heat retained in the oven. After the
articles cool to a certain extent, the chemi-
ical action of the gas thereon ceases; and
they may then be removed from the oven
or retort and immediately replaced by other
articles, so that the operation of heating
may be repeated before the walls of the oven have lost a great amount of heat.

In case the cementation does not pro-
duce to a sufficient depth, they may be al-
lowed to remain in the oven, and the valve
18 may be opened to admit air and the oven
again heated as before by raising the arti-
cles to the carburizing point, whereupon the
flames may be again extinguished and car-
burizing gas supplied to the oven, thus
causing the cementation of the articles to proceed to a greater depth; and this op-
eration may be repeated on the same arti-
cles until they have the required depth of
cementation.

Ammonia or other inert gas may if de-
sired be admitted through a pipe 48 which
joins the pipe 17, and is provided with a
valve 49, the latter being closed during the
operation of heating the oven. The mix-
ture of gas and ammonia may be controlled
by said valve 49; or other means may be
provided for securing a supply of diluted
gas to the oven. It will be seen that not
only the burning mixture, but also the car-
burizing gas, with or without its dilutant,
are admitted through the burners; but the
carburizing gas either diluted or not may
be otherwise introduced into the oven.

In case the heating gas is not of a qual-
ity suitable for case-hardening, or if no
gas is available from ordinary sources, for
the purpose of carburizing, the device now
to be described may be employed. A tank
50 is nearly filled with naphtha 51. A tank
52 containing ammonia or other suitable
inert gas under pressure, is put in connec-
tion with the tank 50 by means of a pipe
53, the flow of ammonia being controlled by
valve 54 in said pipe. The latter extends
down into the oil tank 50, and terminates
near the bottom thereof in a spray 55. Bubbles of ammonia are seen at 56 rising
from the spray, and during this action they
110 take up a plum of naphtha or carbon
filling the top of the tank 50 with gas com-
prising ammonia and carbon. This gas
may be led through the pipe 48 from the
top of the tank 50 through the pipes 17, 18
and 19, and into the oven through the
burners 21; the valves 14 and 16 being
closed and the flames extinguished. Pref-
ervably the proportion of ammonia which
enters the retort or oven is large relatively
to the carbon, so that deposit of surplus
iron upon the articles is avoided or at
least reduced to such an extent as to be
insignificant, while the process of carburiz-
ing is much hastened, thereby saving fuel.
125 while a uniform shell of very high quality
is produced. Little if any more carburiz-
ging gas is admitted to the retort than is
readily taken up by the iron or steel arti-
cles therein.
In order to maintain a sufficient quantity of naphtha or other suitable mineral oil in the tank 50, it may be connected by a pipe 57 to a reservoir 58 above the tank. In the latter may be placed a float 59 attached to a lever 60 controlling a valve 61, which regulates the flow of oil from the reservoir into the tank. The latter may also be provided with a gage glass 62. The herein described method of passing ammonia through naphtha may be employed in connection with other retorts or carburizing apparatus. 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. In combination, a closed oven having walls of refractory material, a series of burners opening within said oven; the latter provided with a capacious vent for products of combustion, and with means for closing said vent, and means for supplying to said burners either carburizing gas alone or mixed air and fuel at will, a vented means being provided for slowly venting carburizing gas from the oven; said walls being sufficient in thickness to maintain iron or steel articles therein at carburizing heat for a substantial length of time after the extinction of flames at the burners, to enable cementation of the articles to proceed to a substantial depth before they cool.

2. In combination, a closed oven having greatly thickened walls of refractory material and provided with a capacious vent for products of combustion and with means for closing said vent, a series of burners for permitting extinction of flames at the burners, means for supplying mixed air and fuel to said burners and for supplying the oven with carburizing gas after extinction of flames at the burners, regulatable means being provided for slowly venting the carburizing gas from the oven.

3. A case-hardening apparatus comprising a closed oven having walls of refractory material which are greatly thickened in proportion to the capacity of the oven, a series of burners in said oven, means for permitting extinction of flames at the burners, means for supplying mixed air and fuel to said burners, and means for closing the oven at extinction of flames at the burners; said oven having a capacious vent for products of combustion, and a closure for said vent.

4. The combination with a closed oven whose walls are formed of refractory material, of burners for mixed air and fuel in said oven, and means for filling the oven, after extinction of the flames at the burners, with a different gas capable of chemically acting upon the articles contained in the oven while they remain heated; the walls of the oven being greatly thickened so as to retain sufficient heat to maintain the articles in the oven at the required heat during such chemical action; said oven provided with a vent for the products of combustion and a closure for said vent.

5. The combination of a closed oven having walls thickened to retain heat, a series of burners for mixed air and fuel opening into said oven at the base thereof, a thick heat-retaining bed slab between said burners and the body of the oven, flame passages being left between the edges of the bed and the walls of the oven, and means for supplying carburizing gas to said oven after extinction of flames at said burners; the oven being provided with a capacious vent for the products of combustion and with a closure for said vent, and also having a regulatable constrained vent for the carburizing gas.

6. The combination of an oil tank connected with an oil supply and having automatic means to regulate the flow of oil into the tank, an ammonia tank, a pipe leading from the ammonia tank and terminating in a spray in the lower portion of the oil tank, means for controlling the flow of ammonia into the oil tank, and a case-hardening retort provided with heating means and a vent and in communication with the upper part of said oil tank.

7. The combination with a retort in the form of a closed oven having thickened heat-retaining walls, of a series of burners opening into said oven, means for supplying mixed air and fuel to said burners, and means for supplying and with means for permitting extinction of flames at the burners, latter provided with a capacious vent for the products of combustion and with a tapering solid plug to fit said vent, means being provided for supplying carburizing gas to the oven after extinction of flames at the burners, and the oven also having a regulatable constrained vent for the carburizing gas.

8. The combination of a closed oven having its walls thickened to retain heat and provided with a door, a series of burners for mixed air and fuel opening into said oven, means for permitting extinction of flames at the burners, the latter provided with a capacious vent for the products of combustion and with a tapering solid plug to fit said vent, means being provided for supplying carburizing gas to the oven after extinction of flames at the burners, and the oven also having a regulatable constrained vent for the carburizing gas.

9. In combination, an oven having greatly thickened walls of refractory material and provided with a capacious vent for products of combustion and with means for closing said vent, a series of burners in said oven, means for permitting extinction of flames at
the burners, and means for supplying mixed air and fuel to said burners and for supplying the oven with carburizing gas diluted with another gas after extinction of flames at the burners.

10. A carburizing retort in the form of a closed oven having a door and provided with burners and means for permitting the extinction of flames at the burners, and having walls of refractory material and provided in the bottom portion of its flame chamber with a heat-bed distinct from the walls of the oven; said walls and door being sufficiently thick in proportion to the capacity of the oven, to serve as a reservoir of heat to maintain iron or steel articles therein at carburizing heat for a substantial length of time after the extinction of flames at the burners, to enable cementation of the articles to proceed to a substantial depth before they cool, provision being made for passing carburizing gas slowly through the heated oven.

11. A carburizing retort in the form of a closed oven having walls and a door all of refractory material and provided in its bottom portion with a heat-bed distinct from the walls of the oven; burners for mixing air and fuel provided in the bottom portion of said oven; and means for permitting the extinction of flames at the burners, said walls and door being sufficiently thick in proportion to the capacity of the oven, to serve as an ample reservoir for heat to maintain iron or steel articles therein at carburizing heat for a substantial length of time after the extinction of flames at the burners, to enable cementation of the articles to proceed to a substantial depth before they cool, means being provided for passing carburizing gas slowly through the heated oven.

12. The combination of a closed oven having a door, walls, and a heat-bed and burners and means for permitting the extinction of flames at the burners, said furnace provided with a constricted gas-vent, and also with closable escapes for the interior flames, gas supply pipes 13, air supply pipe 15, and a pipe 48 for the supply of inert gas; said walls, heat-bed and door being sufficiently thick in proportion to the capacity of the oven, to maintain iron or steel articles therein at carburizing heat for a substantial length of time after the extinction of flames at the burners, to enable cementation of the articles to proceed to a substantial depth before they cool.

13. A carburizing retort in the form of a closed oven having walls and a door all of refractory material and provided in the bottom portion of its flame chamber with a heat-bed distinct from the walls of the oven; burners for mixing air and fuel provided in the bottom portion of said oven; means for permitting the extinction of flames at the burners; a closable escape for the flames from the oven, and a constricted gas-vent; said walls being sufficiently thick in proportion to the capacity of the oven to form a heat reservoir, to maintain iron or steel articles therein at carburizing heat for a substantial length of time after the extinction of flames at the burners, to enable cementation of the articles to proceed to a substantial depth before they cool.

14. The combination of a closed oven, burners opening in said oven for mixed air and gas, means for extinguishing the burners, means for supplying carburizing gas alone to said oven, a heat bed in said oven above the bottom thereof, said oven provided with a door having a constricted vent, and closable means for permitting voluminous escape of products of combustion from said oven; the walls of said oven, said door and said heat bed being formed of refractory material of sufficiently great thickness to constitute a heat reservoir capable of maintaining the contained articles at the necessary temperature to enable them to become carburized to a substantial depth.

ADOLPH W. MACHLET.

Witnesses:

SAMUEL R. ODEN,
PHILIP C. OSTERMAN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."