(No Model.)

H. S. MAXIM.

Process of Manufacturing Carbon Conductors.

No. 230,309. Patented July 20, 1880.

Fig: 1.

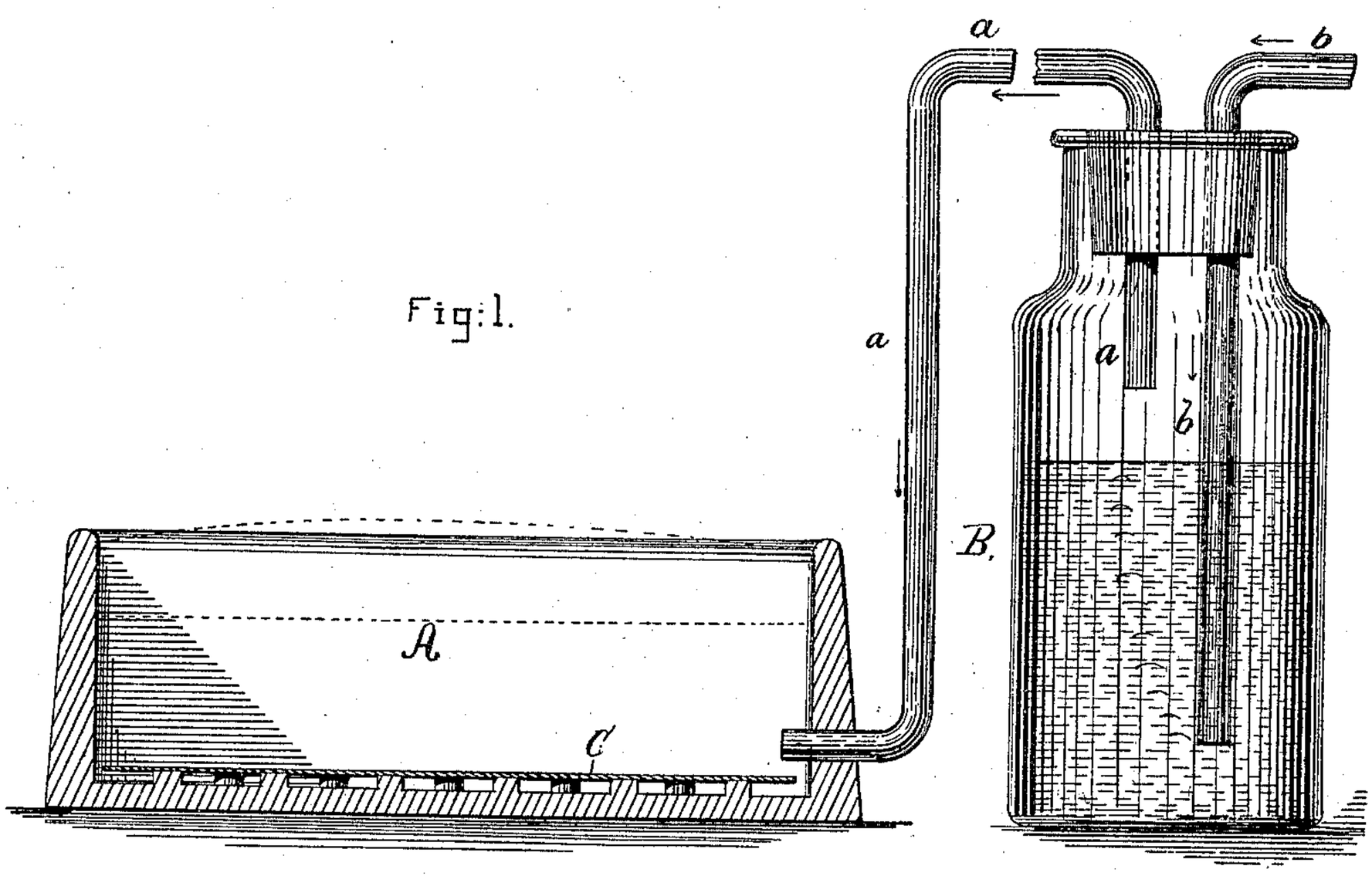


Fig: 2.

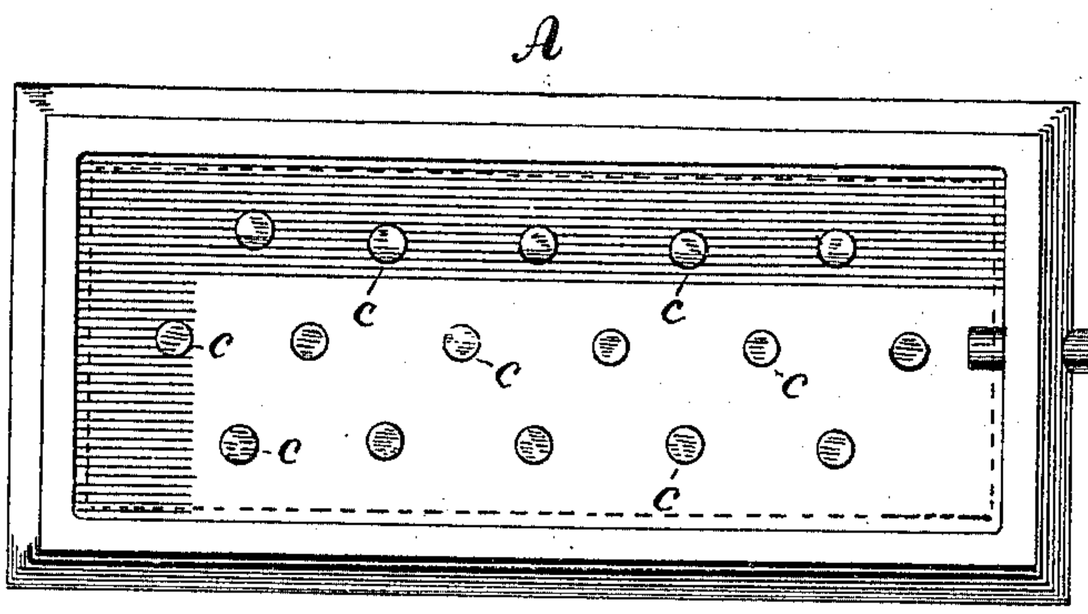
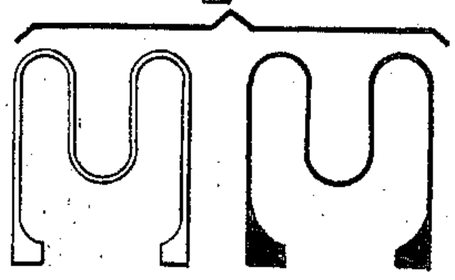
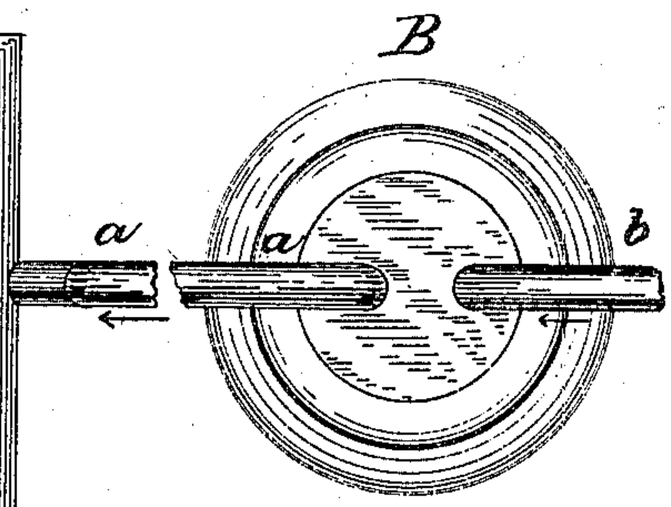


Fig: 3.





Witnesses:
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UNITED STATES PATENT OFFICE.

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PROCESS OF MANUFACTURING CARBON CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 230,309, dated July 20, 1880.

Application filed March 22, 1880. (No model.)

To all whom it may concern:

Be it known that I, HIRAM S. MAXIM, of the city of Brooklyn, county of Kings, and State of New York, have invented a certain new and useful Process of Manufacturing Carbon Conductors for Electric Lamps, of which the following is a specification, reference being had to the accompanying drawings, which form a part hereof.

My invention relates more particularly to making carbon conductors for electric lamps producing light by the incandescence of a continuous strip or conductor; but it may be applied to manufacturing carbon for other uses where comparatively small strips or pieces of dense and tough carbon are desired.

A variety of different carbonaceous substances may be carbonized by my improved process, such as wood, the inner bark of trees, card-board, paper and silk, cotton, or linen fabrics. The material used is cut or bent into pieces of the shape desired for the conductor of the lamp, but somewhat larger in each dimension to allow for shrinkage, and is then charred in a suitable retort while a current of hydrocarbon vapor or gas is flowing through the retort and enveloping the material.

I have shown in the drawings an apparatus suitable for making carbon conductors according to this process; but I do not wish to be confined to the particular apparatus shown, as the process may be performed with equal facility with other forms of apparatus.

In the drawings, Figure 1 is a longitudinal vertical section of the apparatus. Fig. 2 is a plan or top view, and Fig. 3 shows a form of a carbon-conductor as it appears before and after carbonizing.

A is a carbonizer or retort for holding the material to be charred.

B is a carbureter containing gasoline or other volatile hydrocarbon oil.

a is a pipe leading from the carbureter to the carbonizer, and *b* is a gas-supply pipe.

C is a sheet of metal placed in the carbonizer, and supported a short distance above the bottom of it by short posts *c c*.

A sheet of tissue-paper is placed upon the plate C, and a layer of the forms of material is placed upon this, inclosed between pieces of card-board, and another sheet of tissue-paper is spread over the layer thus formed. Other sheets of metal and layers of material are added until the carbonizer is full, and the whole is then covered with sand. The sheets of metal are made somewhat smaller than the inside of the carbonizer, so as to leave a space for the escape of the gas, and this space is covered with cotton-batting, so as to prevent the sand from sifting down into it. The carbonizer thus filled is placed over a gas-flame or upon a stove and heated to a temperature sufficiently high to expel the aqueous vapor contained in the pores of the material, but not sufficiently high to char the material to any considerable extent, and the carbureted gas is admitted to the carbonizer through the pipe *a* and ignited where it escapes through the sand at the top. After the material has been subjected to this heating for a considerable time—say ten or twelve hours—the carbonizer is placed in a muffle-furnace and raised to a white heat and kept there until all the material is thoroughly charred, the gas being all the time supplied to the carbonizer through the pipe *a* and circulating about the forms, so as to envelop them on all sides. Ordinary coal-gas may be used for this purpose; but, unless it is rich in carbon, it should be carbureted with gasoline or some other volatile hydrocarbon oil, and I prefer to carburet it in all cases. A convenient form of carbureter to be used for this purpose is shown at B in the drawings, where *b* is a pipe supplying coal-gas and opening below the surface of the oil, and *a* is the delivery-pipe for the carbureted gas. The function of the gas during the first part of the process, as nearly as I can at present ascertain, is to permeate the pores of the material and drive out the aqueous vapor and air contained in them as far as possible, and its function during the latter or charring part of the process seems to be to protect and consolidate the carbon of the material. When the hydrogen and other constituents are disassociated from the carbon of the material by the heat of the furnace the surrounding hydrocarbon vapor or gas is also probably decomposed, and some part of the

carbon thus liberated, especially that which is contained in the pores of the material, is apparently deposited upon the carbon of the forms, and serves to consolidate it. The hydrogen, when liberated, does not corrode the carbon of the forms, but, if it has any tendency to again take up carbon, probably unites with some part of the free carbon liberated from the gas or vapor. In this way nearly if not quite all of the carbon of the carbonized material is preserved, and, as carbon liberated from a gas or vapor at high temperatures has a tendency to deposit upon any solid carbon present, the carbons of the forms may apparently be built up to a considerable extent by maintaining the white heat for a sufficiently long period and keeping up the supply of gas. I prefer, however, to remove the carbonizer from the furnace soon after the forms have become thoroughly carbonized and before any considerable amount of carbon from the gas has been deposited upon them. I find that two or three hours is usually sufficient for this purpose, and the carbonizer is then removed from the furnace and allowed to cool. The current of gas is kept passing through the carbonizer until it is so far cooled that it will not ignite dry sawdust, so as to prevent all access of air to the forms while they are hot.

I find that carbon made by this process is more dense and tough than any which I have seen made by other processes, and the forms shrink less than when carbonized in the usual way.

The essential feature of the process is the enveloping of the forms in an atmosphere or current of hydrocarbon gas or vapor during the carbonizing, and the preliminary heating and the subsequent passage of the gas through the carbonizer are not essential, although I find that better results are secured by so conducting the process.

I am aware that such carbon conductors have heretofore been made by carbonizing wood, paper, pith of trees, and other carbonaceous vegetable substances at a high temperature, and I do not claim carbonizing such materials independently of the process described; but,

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

1. The process of carbonizing carbonaceous substances by exposing them to a high temperature while surrounded by hydrocarbon gas or vapor, substantially as described.

2. The process of making carbon conductors for electric lamps by carbonizing forms of carbonaceous material in a vessel heated to a high temperature and supplied with hydrocarbon gas or vapor, substantially as described.

HIRAM S. MAXIM.

Witnesses:
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