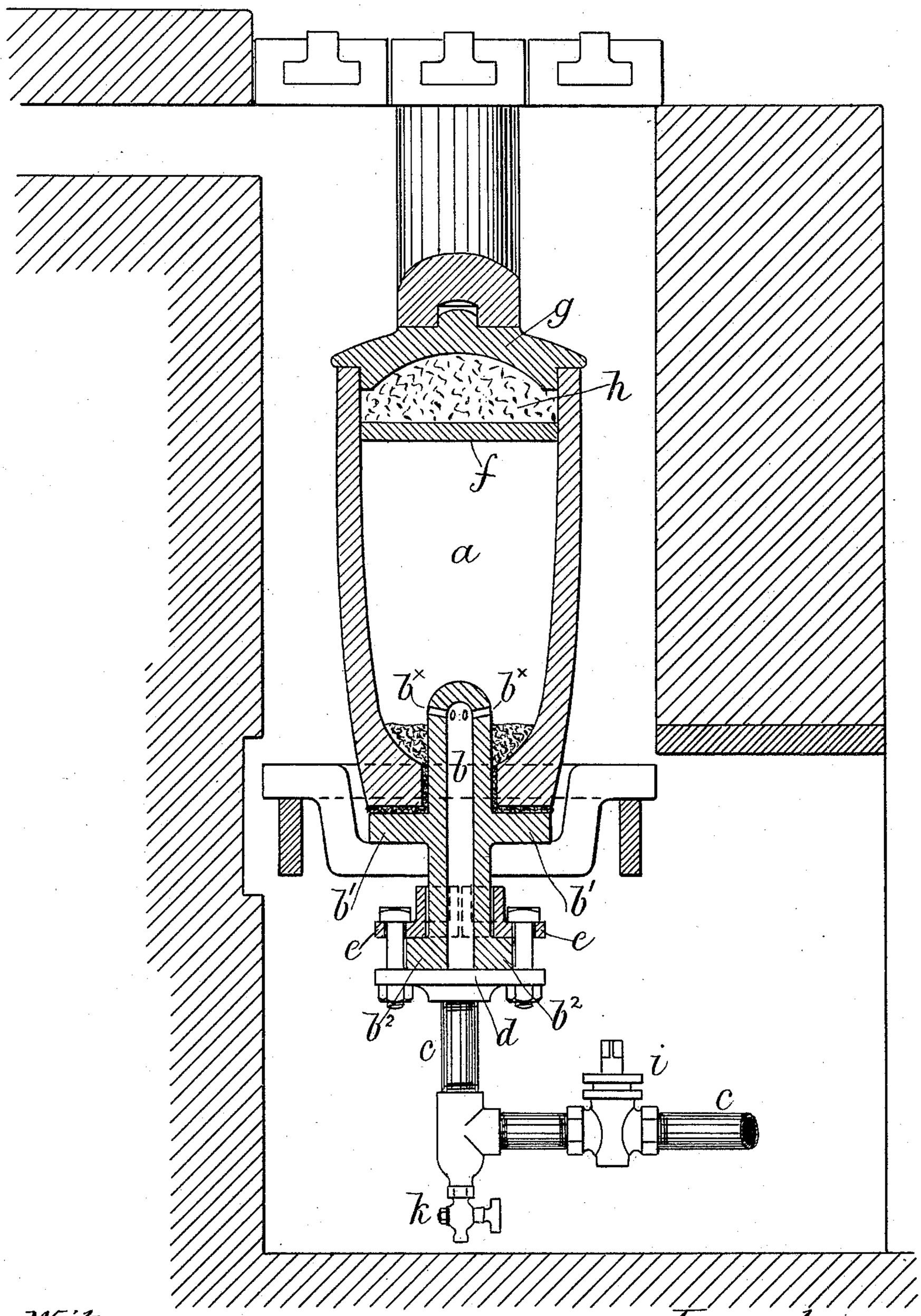
(No Model.)

T. V. HUGHES & C. R. CHAMBERS.

MANUFACTURE OF CARBON FILAMENTS.

No. 405,480. Patented June 18, 1889.



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UNITED STATES PATENT OFFICE.

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MANUFACTURE OF CARBON FILAMENTS.

SPECIFICATION forming part of Letters Patent No. 405,480, dated June 18, 1889.

Application filed August 30, 1886. Serial No. 212,199. (No model.)

To all whom it may concern:

Be it known that we, THEOPHILUS VAUGHAN HUGHES, of Holywell, North Wales, and CHARLES ROLAND CHAMBERS, of South Kensington, in the county of Middlesex, England, have invented certain new and useful Improvements in the Manufacture of Carbon Filaments for Electric Lighting, of which the following is a full, clear, and exact description.

The object of our invention is to produce filaments of greater density and homogeneity, and consequently of greater durability, than those manufactured by the ordinary methods.

The invention consists in the method of manufacturing carbon filaments by the destructive distillation of a gaseous carbon compound capable of yielding carbon when decomposed by heat, whereby we obtain fine hair-like filaments which undergo no appreciable change in their homogeneity during the subsequent process of lamp-making, as almost all of the hydrogen has been eliminated during their formation.

Reference is to be had to the accompanying drawing, forming a part of this specification, which represents an apparatus by which our improved process of manufacturing carbon filaments may be carried out effectively, and the figure represents a vertical section through a furnace with a retort in position.

Heretofore it has been usual to manufacture carbon filaments by carbonizing the filamentous material by baking it when the same is bent into the intended shape. This process, however, destroys the homogeneity of the filaments by rendering them porous, and this defect is only partially remedied by the subsequent process known as "flashing." By our improved method the said operation of baking is avoided, as the filaments from the time of their formation are of dense hard carbon of great purity and having a low specific resistance. The great density of the filaments produced by the method of our invention is due to their formation (more or less molecular) directly from a gaseous carbon compound capable of yielding carbon when decomposed by a high temperature, the carbon being deposited and the hydrogen escaping. These hair-like carbon filaments combine with density great strength and flexibility, so that they may be bent and twisted into various shapes and will spring back to their original form on being released.

The process of this invention is carried on in a nearly-closed retort placed in a furnace, the gas being conveyed into the retort at or just above atmospheric pressure through a distributing inlet or nozzle, from the orifices of which the gas issues in fine streams directed against the sides of the retort. The gas on striking the heated sides of the retort becomes decomposed, and carbon is at first deposited upon the sides and bottom of the retort and over the nozzle in the form of a loose fibrous or cobweb-like mass. This deposit having been formed and the gas continuing to be supplied, the deposit now takes the form of hair-like filaments, growing, as it were, out of the lining as a base toward the central and upper part of the retort, which ultimately becomes nearly filled with a loose and but slightly-entangled mass of said filaments growing more or less in the same general direction, and of a length of four or five inches, (more or less,) according ot the size of the retort employed. The formation of the hair-like threads or filaments of carbon above referred to is due to the carbonization or decomposition of streams or columns of gas in vertical or gyratory motion, which are set up or formed within the hot chamber, the result being that the carbon constituent of the compound is caused to segregate about the axis of motion of the gyratory or vertical column or stream while the hydrogen passes off, the formation of these gyratory or vertical columns being the natural result of the conditions existing within the retort. When the operation is completed and the retort has become cool, it may be opened, and the long filaments can then be easily removed. The filaments are new ready for mounting and flashing.

The conditions which we have found to be essential to the proper formation of the filaments are as follows: The temperature should be that at which the thorough decomposition of the gas used takes place, and should be

maintained as constant as possible during the operation. We prefer to use a gas containing about forty per cent. hydrogen, and not less than forty-five per cent. marsh-gas, together with other usual hydrocarbons equivalent to about seven per cent. ethylene. Such a gas may be obtained from North Staffordshire coal. Where the gas of the required composition is not at hand, ordinary lighting-gas may be treated by passing it over hydrocarbons to enrich it, or if too rich by depriving it of its carbon by passing it over heated brick or charcoal. The gas must be as free from moisture as possible, the presence of moisture in any appreciable quantity being fatal to the formation of the filaments. The gas should, therefore, be passed through refrigerating-worms and over quicklime. The flow of gas and time of firing vary with the size of the apparatus; but if the flow be too rapid or the gas itself be too rich no filaments will be formed.

Having explained the process in its general outlines, we will now proceed to describe the means we have adopted for carrying it out in practice; but we would have it understood that our invention is not limited to the particular apparatus herein described, which may be modified according to circumstances, nor to the particular composition of gas above specified.

The retort we prefer to use is a crucible *a*, of plumbago or iron, of a size known as "Morgan's one hundred and thirty pounds." It is placed in a furnace of any suitable construction.

b is a distributing inlet or nozzle leading through the bottom of the crucible. It is provided with a number of radial orifices $b^{\times}$ at the upper end, through which the gas issues into the crucible. These orifices may be six in number, and for a crucible of the size above mentioned should be about a quarter of an inch in diameter. The nozzle is made of fire-clay and passes through a hole in the bottom of the crucible, which is seated upon a flange *b'* formed upon the nozzle. The pipe *c*, for conveying the gas to the nozzle, passes in under the furnace and is attached to the nozzle *b*, preferably by a flange *d*, screwed on the pipe, bolted to a split collar *e*, embracing the base of the nozzle *b*, a gas-tight joint being made between the flange b^2 on the inlet *b* and the flange *d* on the pipe with red-lead paint and hemp. The flange *b'* of the inlet should be about two inches below the level at which the furnace-bars will be placed and in the center of the furnace. The crucible is bedded on the flange *b'* with fire-clay suitably tempered, which is forced up around the nozzle *b* to make a thoroughly gas-tight joint, dry powdered clay being sprinkled around the nozzle nearly up to the level of the inlet-holes and then well tamped down. The mouth of the crucible is now closed by a disk of fire-clay *f* placed within it an inch or two below the lid *g*, the intervening space *h* being filled up with wet luting-clay, with which may be mixed pieces of broken pot. The shrinkage of this clay plug in drying leaves a minute annular space around the mouth of the crucible for the escape of the hydrogen resulting from the decomposition of the hydrocarbon. The lid *g* is luted on and a heavy weight placed on it.

To prevent the crucible shifting in the furnace, it may be packed with clay wedges at the sides. The furnace-bars are now put in and the fire lighted.

To permit the escape of steam from the luting-clay when drying and prevent it blowing back and condensing in the pipes, a stop-cock *i* is placed on the pipe *c* and immediately next to it a blow-off cock *k*, the former being closed and the latter being opened while the crucible is being heated. When all the steam has been expelled, *k* is closed and *i* opened to allow the flow of gas to commence. The crucible should be kept as constantly as possible at a bright red heat for five to seven hours, after which it is allowed to cool, the gas continuing to be admitted until the crucible is cool enough to permit of its removal.

The crucible must on no account be jarred or disturbed when adding fresh fuel.

We claim—

The herein-described process of manufacturing dense, homogeneous, resilient, and hair-like carbon filaments for glow-lamps, which process consists in causing a gaseous carbon compound (capable of yielding carbon when decomposed by heat) to undergo decomposition in a heated retort, the gases while undergoing the decomposition having such motions impressed upon them that vertical or gyrating currents of gas are set up through the atmosphere of the retort, from which currents the carbon resulting from the decomposition segregates directly in the form of filaments, as hereinbefore described.

The foregoing specification of our improvements in the manufacture of carbon filaments for electric lighting signed by us this 30th day of July, 1886.

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