(No Model.) 4 Sheets—Sheet 1.

J. H. R. DINSMORE.

APPARATUS FOR MAKING ILLUMINATING GAS FROM COAL.

No. 413,226. Patented Oct. 22, 1889.

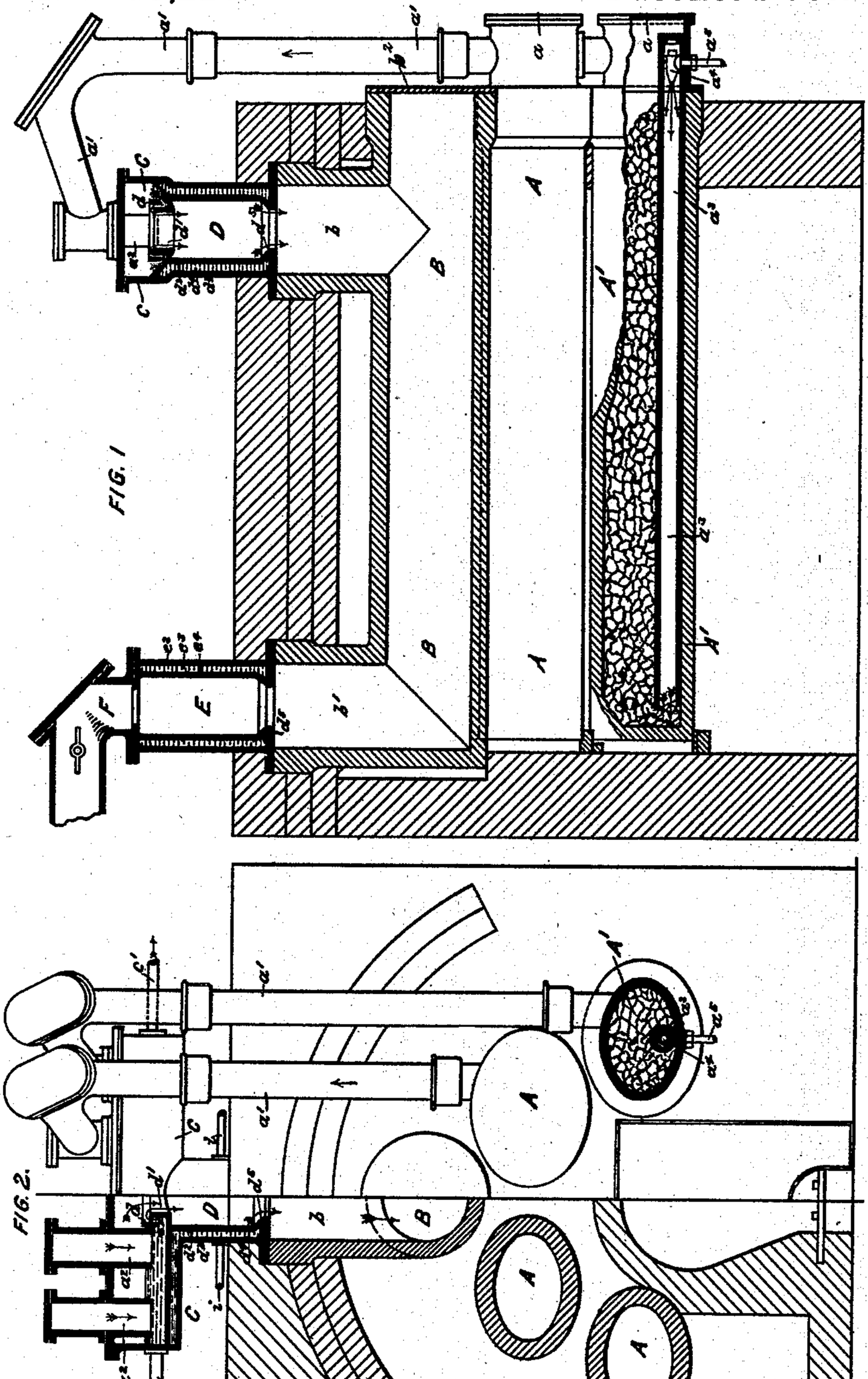

FIG. 1

FIG. 2.

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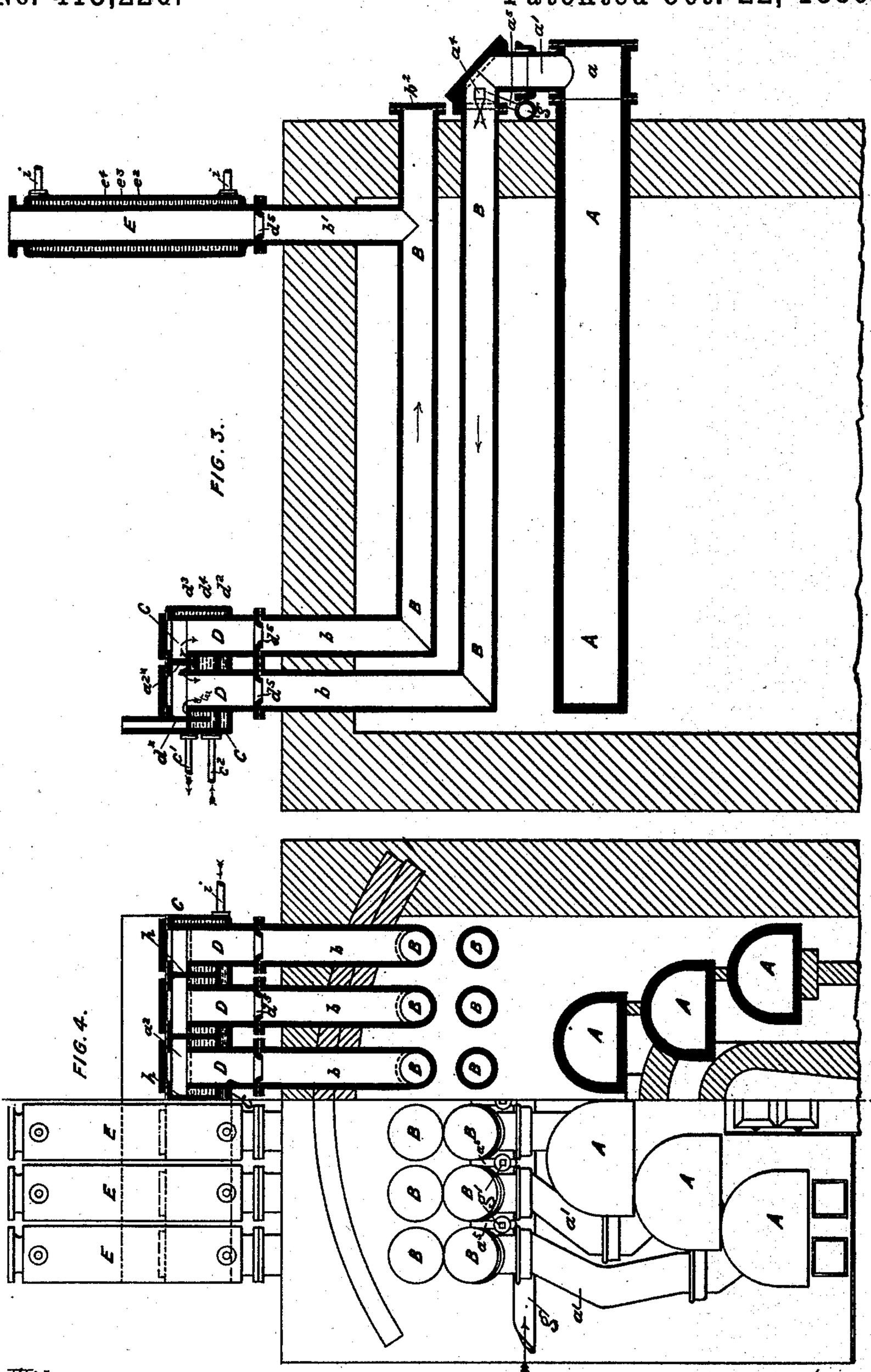

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APPARATUS FOR MAKING ILLUMINATING GAS FROM COAL.

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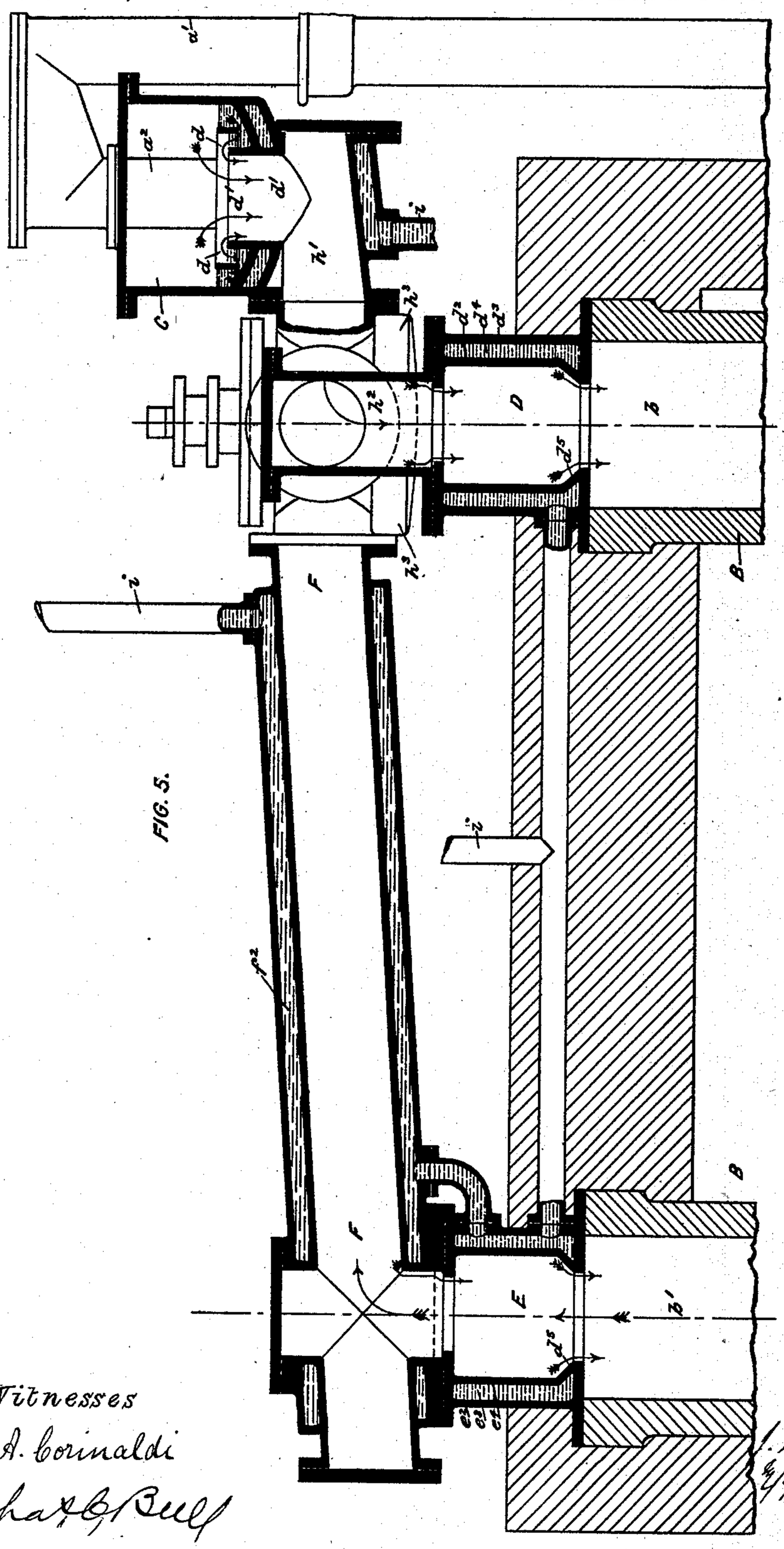

FIG. 5.

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APPARATUS FOR MAKING ILLUMINATING GAS FROM COAL.

No. 413,226. Patented Oct. 22, 1889.

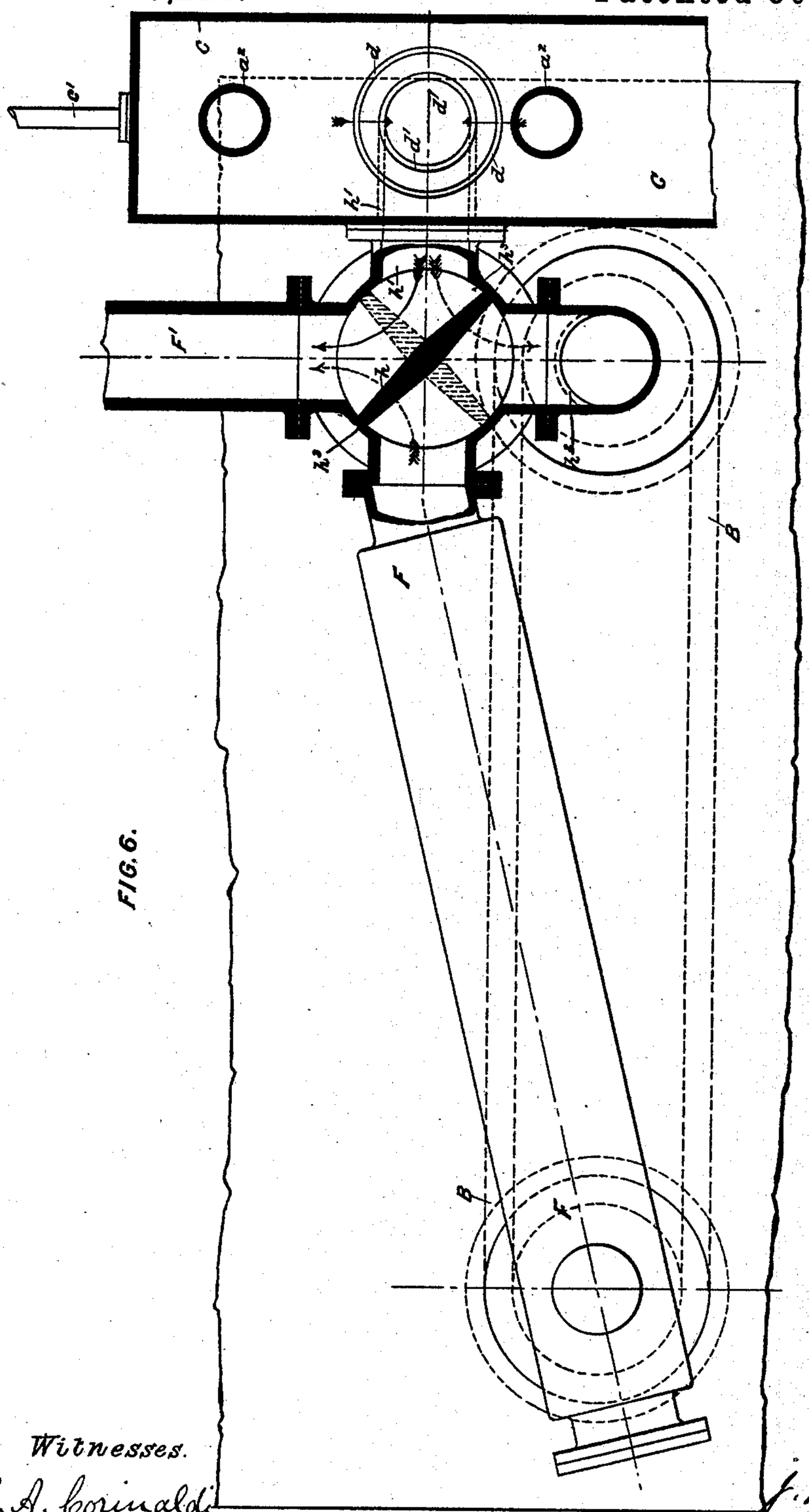

FIG. 6.

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UNITED STATES PATENT OFFICE.

JOHN HENRY RICHARDSON DINSMORE, OF LIVERPOOL, COUNTY OF LANCASTER, ENGLAND.

APPARATUS FOR MAKING ILLUMINATING-GAS FROM COAL.

SPECIFICATION forming part of Letters Patent No. 413,226, dated October 22, 1889.

Application filed July 18, 1888. Serial No. 280,309. (No model.) Patented in France July 17, 1888, No. 191,851; in Belgium July 18, 1888, No. 82,605; in Spain October 2, 1888, No. 8,519; in Canada November 16, 1888, No. 30,201, and in Austria-Hungary January 13, 1889, No. 29,683 and No. 49,982.

To all whom it may concern:

Be it known that I, JOHN HENRY RICHARDSON DINSMORE, a subject of the Queen of Great Britain, and a resident of Liverpool, Lancashire, England, have invented certain Improvements in Apparatus for Making Illuminating-Gas from Coal, (for which I have received Letters Patent in France, No. 191,851, dated July 17, 1888; in Belgium, No. 82,605, dated July 18, 1888; in Canada, No. 30,201, dated November 16, 1888; in Austria-Hungary, No. 29,683 and No. 49,982, dated January 13, 1889, and in Spain, No. 8,519, dated October 2, 1888,) of which the following is a specification.

This invention relates to apparatus for manufacturing illuminating-gas from coal in closed vessels or retorts, and more particularly to that kind of apparatus by which it is or has been proposed to render permanent practically all the heavy or tarry vapors or liquids, as well as the lighter products given off from the coal by distillation, and to so make them useful for the production of light and heat.

My present invention has mainly for its object, among other things, (*a*) to convert the tar or tarry vapors or liquors given off from or resulting from the manufacture of gas from coal into permanent gas; (*b*) to carry out this and other objects incident to the said manufacture by apparatus in which the ordinary retorts of gas-works are rendered available for making gas according to my invention, and (*c*) to provide certain constructions and arrangements of parts by which this invention can be most conveniently practiced.

For convenience of description I will set forth, first, that part of my invention relating to the mode or arrangement by which I render useful the existing ordinary retorts of gas-works to the manufacture of gas according to my invention. This I effect as follows: The ordinary distilling-retorts may be taken in their existing arrangement; then above each bench or group of them I arrange one retort or a set of retorts through which the gases after leaving the distilling-retorts are passed to be fixed. The fixing retort or retorts are heated by the same furnace-gases which are used to heat the distilling-retorts. On or in connection with these retorts I use a tar or liquor seal or seal trough or chamber, by which gas is prevented from flowing back and escaping when a retort-door is opened, and from which the tar deposited in it is caused to pass to the fixing-retort. I also use on or in connection with these fixing-retorts a cooled passage or passages by which the well-known difficulty of "stopped" or blocked-up pipes or "passages" is prevented. The cooled parts preferably consist of passages kept in a comparatively cool condition by water or other fluid circulated round or over their exterior; but any other cooling-fluid may be used. These cooled passages, besides preventing stopped pipes, condense and arrest a portion of the tarry or heavy vapors in the gas; and these condensed liquors fall back into the fixing-retort and are converted into permanent gas. Into the heated retorts I also introduce tar condensed from the gas after it has left such retorts. This returned tar may very conveniently be delivered into the seal troughs or chambers.

The illuminative quality of the gas produced by the apparatus just described is considerably higher than that possessed by gas produced in the ordinary way from coal, and the quantity given off from a given quantity of coal is also far greater than that manufactured by the processes commonly practiced.

The above description sets forth generally the nature, object, and purposes of my invention; but to make the same more clear I will now proceed to describe it with the aid of the drawings accompanying this specification and forming a part thereof. The drawings, together with the following description of them, set forth examples of apparatus or plant in and by which the manufacture of gas according to this invention may be conveniently and successfully conducted. At the same time they illustrate apparatus specially designed for carrying out my invention.

In the drawings, Figure 1 shows in sectional elevation an apparatus embodying im-

provements according to my invention. Fig. 2 is an end view, partly in section, of the apparatus shown in Fig. 1. Fig. 3 shows a modified arrangement of the apparatus illustrated in Figs. 1 and 2; and Fig. 4 is an end view, partly in section, of this apparatus. Figs. 5 and 6, respectively, are a sectional elevation and plan of a slightly-modified form and arrangement of the parts connected with the heated retort illustrated in Figs. 1 and 2.

Throughout the figures of the drawings like letters and figures are used to denote like or corresponding parts of the apparatus.

With reference, in the first instance, to Figs. 1 and 2 of the drawings, A designates the ordinary distilling-retorts of a bench set closely together in the ordinary way; B, the fixing-retort, common to all the retorts A; C, the seal-chamber, which is in the form of a trough, and D E cooled passages. a are the retort-mouths, and a' a^2 are the ascension-pipes and dip-pipes, respectively, communicating between the retorts A and the seal-trough C. The retorts A are those in which the coal is distilled in the usual way, and are set in any known way. In the example four of the ordinary retorts A are used and set in a bench. It will, however, be evident that the improvements according to this invention can be applied and carried out in benches of retorts having three distilling-retorts and upward, accordingly as the number of retorts existing or required in gas-works varies.

Assuming that the bench of distilling-retorts illustrated in this example represents one of a number of benches having four or five retorts in each, then, mainly, all that is necessary to do to render the existing retorts applicable for use in carrying out this invention is to introduce the fixing-retort B (or, if five distilling-retorts exist, remove the uppermost and introduce the fixing-retort) and apply the seal-trough and cooled passages, the main parts being either retained or others used in their places, as may be required or deemed expedient.

The seal-chamber C and cooled passage D consist of a horizontally-arranged trough and a passage descending from such trough at right angles to it, the whole being supported upon the upper end of the vertical entrance b of the retort B. The liquid of the trough, which will consist chiefly of tar, ammoniacal liquor, and some watery liquor, is maintained in it at a constant level by the wall of the passage d' and overflow-pipe c', and the dip-pipes a^2 are immersed in the liquor to a depth just sufficient to seal them under working conditions. The cooling-passage D is composed of annular walls d^2 d^3, leaving an annular space d^4 between them, in which space the cooling-fluid, preferably water, is circulated. The bottom of the trough C is also of double formation, as shown, forming a space for cooling-fluid. This space and the space d^4 of the cooling-passage D communicate freely with each other, and the cooling-fluid used is common to both. The chief object and effect of cooling the trough C are to keep the tar in it in a fluid state. It will be obvious if the cooling-fluid be water that its temperature will be considerably greater than that of the atmosphere; but it will be sufficiently low for the purposes which will now be explained. The combined effect upon the trough C and passage D is that the tar in the trough C is kept in a freely liquid state and the passage cool enough to prevent deposition of carbon or pitch therein. It will be seen that by sealing the pipes from the distilling-retorts, as described, and providing a common outlet d' to the common fixing-retort B no through-communication between the fixing-retort and the distilling-retorts A exists, and that when any one or more retorts A are opened for any purpose the escape of gas from the trough back to such retort or retorts is prevented and the process of distillation in the others is not impeded. The cooled passage E, at the exit end of the retort B, consists of outer and inner walls e^2 e^4, having between them the annular space e^3. Onto the upper end of this passage the outlet-pipe F is placed, and the passage itself is supported by the vertical exit portion b' of the retort B. The cooling-fluid is circulated through the space e^3, inlet and outlet pipes being provided, as will be understood.

The operation and effects of manufacturing gas in the apparatus above set forth are as follows: The coal is placed in the retorts A and distilled by heat in the ordinary way, and the gas evolved from the coal is passed into the common seal-trough C. Here it deposits a part of its tar and condensable matters, such as ammoniacal vapors. It then passes through the artificially-cooled passage D, wherein further quantities of the tar and other condensable matters in it are arrested. After leaving this passage the bulk then passes onto the fixing-retort B. In the condition the gas enters the duct a considerable portion of it is not permanent; but in passing through it the whole is subject to the heat of the fixing-retort, and thereby the greater part of the non-permanent portion is rendered permanent. At the termination of the fixing-retort the gas comes under the cooling influence of the artificially-cooled passage E, and the greater portion of the tarry or non-permanent vapors still existing in the gas are condensed and arrested. The matters condensed in this passage E, as well as the heavier portion of those condensed in the trough C and passage D, (and the returned tar, as hereinafter described,) fall back into the retort B, and in the presence of freshly-distilled gas from the retort A are converted into gas. The ammoniacal and other lighter liquors condensed in the trough C are, however, drained away by a pipe c', which is placed at such a height in the trough as to drain them off, but so as to leave the heavier matters, mainly tar. This latter liquid, being the

heaviest, lies at the bottom of the trough, and it has to be raised over the lip of the pipe d' in order to get into the retort B. This is done automatically, as follows: As soon as the head of the lighter liquids in the trough C reaches a certain level the tar lying at the bottom of the trough is forced under the lower edge of the pipe d, up between this pipe and the pipe d', and so on up to the level of the lip of the overflow-pipe d'. When it rises to this level, it falls over the lip and flows down to the lower edge thereof, from which it falls direct onto the highly-heated surface of the bottom of the retort B. The pipe d' is purposely made smaller than either the passage D or the entrance b, so that the liquids falling from the pipe d' shall not, in falling, touch any heated surface which is not red-hot and of sufficient temperature to gasify them. The pipe d' is so made that this end is obtained, and the lower part of the passage D is also contracted at d^5, whereby a like effect is obtained—that is to say, the matters condensed within the passsage D gravitate to the contracted opening d^5, whence they fall direct onto the bottom of the retort B. I have found that if tar be supplied to heated pipes or retorts, in the manner I have just described—that is, direct on to red-hot surfaces and in the presence of gas freshly distilled in the retorts—nearly the whole of the tar is converted into permanent illuminating-gas; but if the tar be allowed to flow to heated ducts or pipes over a surface of gradually-increasing heat, or one not at a red heat to one that is red-hot, the greater part of the tar will not be distilled or gasified, a large proportion of it being deposited as pitch upon that part of the surface which is not red-hot. The construction of passages D and E above set forth affords a very convenient means or mode of effecting the complete, or nearly complete, gasification of the tar.

A suitable temperature to which the retorts may be heated and at which they may be worked is that denoted by a clear cherry-red color, known in gas-making as a "medium temperature."

After the gas leaves the distilling apparatus illustrated it may be conducted through a considerable length of inclined pipe, as is very commonly practiced, before delivery to the condensing and washing apparatus. In this pipe, and also in the process of washing and condensing, a certain quantity of tar will be removed from the gas. Now, this tar I bring back to the distilling apparatus, by gravity or otherwise, to convert it into gas, and introduce it preferably into the seal-trough C by a pipe c^2, whence it finds its way, with the tar deposited therein, into the fixing-retort B, as described, and is there gasified in the presence of freshly-distilled gas coming over from one or more of the retorts A, and is thereby made into permanent illuminating-gas.

It will be observed that the tar introduced into the fixing-retort at its entrance end is there converted into gas, which thence passes through the length of the fixing-retort, and is, along with the other gas, rendered permanent or fixed before it is discharged from the exit end of the fixing-retort.

The ammoniacal liquor is led off from the seal-trough C, as above described, in order to prevent the temperature of that portion of the retort B onto which the tar from the seal-trough C drops from falling below that necessary to gasify it all or nearly all. Were the ammoniacal liquor admitted with the tar this end might not be so effectively obtained, as the extra quantity of liquor to be gasified or vaporized would materially reduce the temperature of the duct at the said part onto which it would fall.

Any deposits that may take place in the retort B can be readily removed through the open end of the retort, which, under ordinary conditions, is closed by the door b^2.

A modified arrangement of the exit end of the retort B consists in prolonging the duct and carrying it outside the end wall of the retort-bench. In such a case the vertical upright portion b' might be dispensed with, and the cooling-passage E would be secured directly onto the end of the retort B and provided with an inclined bottom so formed as to cause the matters condensed therein to gravitate into the hot duct. I however prefer to employ the arrangement of duct and passage E, as shown in the drawings.

The gas resulting from the process of manufacture thus far definitely described would, if made from ordinary bituminous gas-making coal—such as that known as "Lancashire" or "Yorkshire" coal, not cannel—possess an illuminating power equal to about twenty-three candles, and the volume of permanent or fixed gas produced per ton of coal would be from about twelve thousand to thirteen thousand cubic feet. This quality of gas is higher than is desired by most gas-manufacturers. Now, the excess of illuminative properties above that required I turn to that which is more a desideratum to gas-makers—namely, an increase of volume per unit of coal. This I do by admixing hydrogen, water-gas, or other diluent gas with the coal-gas to such an extent as to reduce its illuminative qualities to that required. If the quality of gas required be equal to, say, seventeen candles, the volume will be increased to about seventeen thousand cubic feet. Thus the quantity of water-gas added would be four thousand cubic feet. To this end I use one of the retorts A′ to produce the water-gas or hydrogen.

The operation is as follows: The retort is filled with coke, and steam is admitted to the steam-nozzle a^4 through the pipe a^5. It passes through the pipe a^3 to the end of the retort, thereby becoming superheated, and then travels back through the incandescent coke to the mouth of the retort, and so on up to

the ascension-pipe a', and dip-pipe a^2 into the trough C. Here the water-gas produced joins with the coal-gas coming from the retorts A, and in passing together through the passages and the fixing-retort B they become intimately and homogeneously mixed and blended. In passing through the coke the oxygen of the steam combines with the carbon of the coke, becoming carbonic oxide, the hydrogen being thereby liberated. If desired, the pipe a^3 may be filled with iron filings or cuttings for producing hydrogen, or with refractory material for superheating the steam when hydrogen is not required.

In Figs. 3 and 4 of the drawings there is illustrated another arrangement of apparatus by which the existing distilling-retorts of a gas-works may be used in manufacturing gas according to this invention, but in which each retort is provided with a separate fixing-retort. In this modification each retort is provided with a double retort B B, and each double retort is provided with the separate cooled passages D D and seal-trough C, and also with a separate terminal cooled passage E. All the troughs of a bench C are cast in one piece, the several compartments being separated by partitions h. The gas made in the retorts A passes by the pipes a into the lower of its fixing-retorts B, and to the seal-trough C. It then passes down the second fixing-retort B and on through the terminal cooled passage E to the gas-main. Thus the gas in this case is, after leaving the fixing-retort proper, first subjected to the heat of the retort B. It is then subjected to the cooling influence of the passages D, and then is again heated in passing through the second hot retort B, and, finally, it is subjected to a second cooling influence in passing through the cooled passage E. The sealing in the tanks C, by which gas is prevented from returning to the retorts when their doors are opened, is effected by the curtain $a^{2\times}$, (this curtain is equivalent to the dip-pipes a^2,) the lower edge of which dips into the tar which lies in the trough C between the two pipes forming the passages D D. A second curtain $d^\times$ is provided and separates the trough into two parts, one being the part through which the gas from the cooled passage D passes to the other, and the other being the part to which the tar-return pipe c^2 is connected, and to which the tar returned from the gas-main, scrubbers, and condensers is introduced. The upper part of this portion is open to the atmosphere, as shown, and the lighter liquors are taken away from it by the pipe c'. This curtain $d^\times$ serves the same purpose as the pipe d, set forth with reference to Figs. 1 and 2, namely: When the liquid rises in the outer open part to a certain height above the level of the lips of the passages D in the trough the tar which will lie at the bottom will be forced under the edge of the curtain d and up into the inner portion of the trough, and so on to the passages D. In all cases, it will be obvious, inlet and outlet pipes for supplying and carrying away the cooling-fluids to the spaces or jackets of the different cooled passages and parts are provided. These are designated i throughout the views. The tar from the seal-trough C, in flowing down the pipes D and E, before entering the heated retort B, has to flow over the toe d^5, at which point the passages are contracted. From this toe it drops directly onto the red-hot surfaces of the horizontal portions of the retort B. This construction and the effect thereof are in substance the same as that previously set forth with reference to Figs. 1 and 2.

The modification of apparatus illustrated in Figs. 5 and 6 consists, essentially, in providing an arrangement of parts by which the gas can be diverted from its normal passage or course through the fixing-retort B, as previously set forth with reference to Figs. 3 and 4. The condition which may render this necessary is when from time to time access must be had to the interior of the retort B, in order to clean or scrape it, or for other purposes; and this necessitates the removal or opening of the door b^2 of such fixing-retort, which obviously cannot be done while one or more distilling-retorts of a bench are in operation without a large loss of gas. To avoid this loss, I provide a valve h, placed and working in a valve-case h^3, with which case are provided four openings or apertures communicating with the four pipes or passages h', h^2, F, and F', by means of which the gas coming from the distilling-retorts can be caused to pass either directly from the chamber C to the outlet-pipe F', or first through the fixing-retort B and then through the outlet-pipe F'. These pipes and passages are arranged as follows: The passage h' leads to the seal-chamber C through the pipe d' of its trapped outlet, comprising the passage or pipe d' and the annular pipe d, previously described. The pipe h^2 leads to the cooling-passage D of the retort B. The pipe F leads to the cooling-passage E, and the pipe F' is that by which the gas is led away from the bench. Then, if it be assumed the door b^2 of the retort B is to be opened or removed, and it is desired to divert the gas from its normal course or passage, the valve h is placed in the position shown in full lines in Fig. 6, whereby as the gas comes from the chamber C it is short-circuited through the outlet-pipe F'—that is, it is passed directly from the chamber C through the casing h^3 of the valve, and out by the pipe F', without first being allowed to pass through the retort B. Now, if the door of the fixing-retort be closed and the gas is to take its normal course through the said retort B, as set forth with reference to Figs. 1 and 2, the valve h is turned until it takes the position shown in dotted lines, and the gas then passes from the chamber C through the valve-case h^3 in the direction shown by the arrows drawn in dotted lines—that is, it first

passes by the passages h', valve-case h^3, and passage h^2, and so on into the retort B. Then from the retort B it passes through the pipe F, valve-case h^3 a second time, on the opposite side of the valve h, and away by the outlet-pipe F'. The ammoniacal liquors deposited in the chamber C in this case flow away by the pipe c', and the tar is returned to the trough, as previously set forth; also, the tar is caused to leave the chamber by the trapped outlet in the same manner as already described with reference to Figs. 1 and 2; but instead of falling directly from the pipe i into the heated retort B, as set forth with reference to those figures, in this instance it first flows down the pipe i^3 into the pipe h', whence it gravitates by way of the valve-case h^3 into and through the passage h^2, and so on to the upper opening or aperture in the cooling-passage D, whence it falls directly onto the red-hot surface of the retort B, as and for the purposes already described.

Although, as stated, this invention can be applied in part or as a whole with advantage to existing gas-making apparatus, yet at the same time it is evident that it can be used and embodied in new works and with equally efficient results.

I do not claim herein the process or method of making gas described in the foregoing specification and illustrated in the drawings filed herewith, since it forms the subject-matter of a pending application filed by me on even date herewith, bearing Serial No. 280,308.

Having thus fully described the said invention and the manner of operating the same, I wish it to be understood that I do not bind or confine myself to the special forms of the apparatus above described, for it will be evident to those skilled in the art of manufacturing gas and making gas-manufacturing apparatus that the several details or parts and the exact arrangement of them, as well as their forms, may be greatly varied without departing from the nature, spirit, or scope of the said invention. On the other hand, I wish it to be understood I do not claim the application and use generally as separate things of a heated fixing retort or retorts in connection with coal-distilling retorts or cooling-passages, as these features, as separate things, have been hitherto proposed; but

What I do claim is—

1. In a bench of coal-distilling apparatus, the combination of a distilling-retort adapted to receive the fuel to be distilled, a fixing-retort adapted to be externally heated, and a duct adapted to be artificially cooled, said duct being arranged directly above and springing vertically from said fixing-retort, and provided with a pipe connecting the distilling-retort with said duct, substantially as described.

2. In a bench of coal-distilling apparatus, the combination of a distilling-retort adapted to receive the fuel to be distilled, a fixing-retort adapted to be externally heated, ducts adapted to be artificially cooled, one of said ducts being at each end of said fixing-retort and both being arranged directly above and springing vertically from the same, a liquid seal in direct contact with one of said ducts, and a pipe connecting the distilling-retort with said duct, substantially as described.

3. In a bench of coal-distilling apparatus, the combination of a distilling-retort adapted to receive the fuel to be distilled, a fixing-retort adapted to be externally heated, a duct adapted to be artificially cooled, a liquid seal in direct contact with said duct, and a pipe connecting the distilling-retort with said liquid seal, substantially as described.

4. In a bench of coal-distilling apparatus, the combination of a fixing-retort adapted to be externally heated, ducts adapted to be artificially cooled, one arranged on each end of said retort, in communication therewith and arranged directly above and springing vertically from it, and a liquid seal in connection with one of said ducts, substantially as described.

5. In a bench of coal-distilling apparatus, the combination of a retort, a duct adapted to be artificially cooled in communication therewith and arranged directly above and springing vertically from said retort, provided with an opening thereto smaller than the communicating passage, substantially as described.

6. In a bench of gas-making retorts, a distilling-retort adapted to receive the fuel to be distilled, a fixing-retort adapted to be externally heated, a duct adapted to be artificially cooled, and a valve-chamber having inlet-pipes connected, respectively, with said duct, said distilling-retort, said fixing-retort, and with an exit-pipe, combined with a four-way valve within said valve-chamber, so arranged that the course of the gas from said distilling-retort to said exit-pipe may be either through said duct and said fixing-retort or from said distilling-retort directly to said exit-pipe, substantially as described.

7. In an apparatus for making gas, the combination of a distilling-retort, a fixing-retort adapted to be externally heated, a suitable device for introducing liquid tar into said fixing-retort at the entrance end, and an artificially-cooled duct arranged immediately upon the exit or gas-outlet end of said fixing-retort, whereby the tar-gas after it is distilled passes through the fixing-retort to make it permanent, and on leaving said retort immediately enters the cooled duct, substantially as described.

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