(No Model.) 2 Sheets—Sheet 1.

A. O. GRANGER & J. H COLLINS, Jr.

Process and Apparatus for Manufacturing Illuminating Gas.

No. 234,400. **Patented Nov. 16, 1880.**

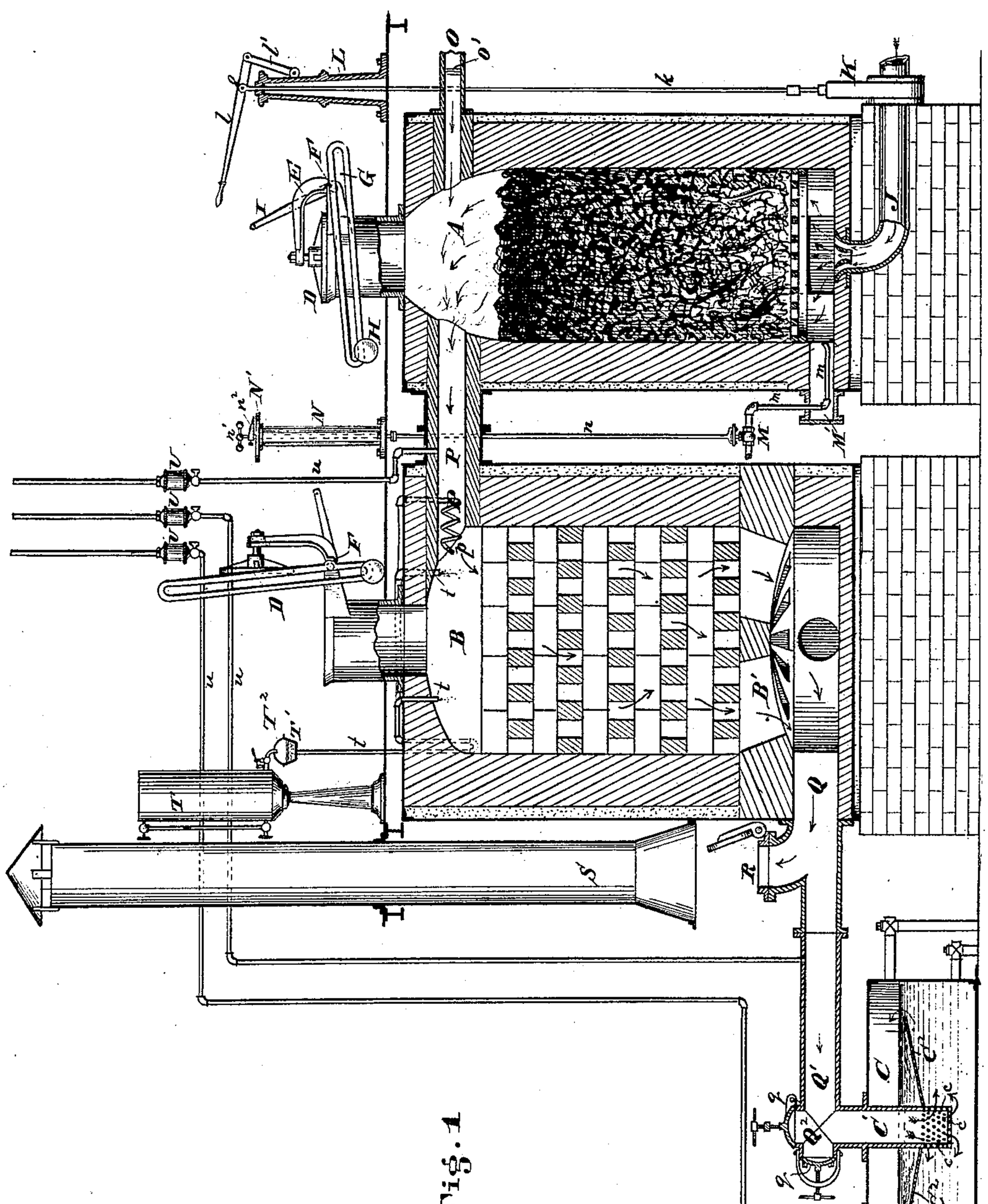

Fig. 1

Attest:

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By their atty

(No Model.) 2 Sheets—Sheet 2.

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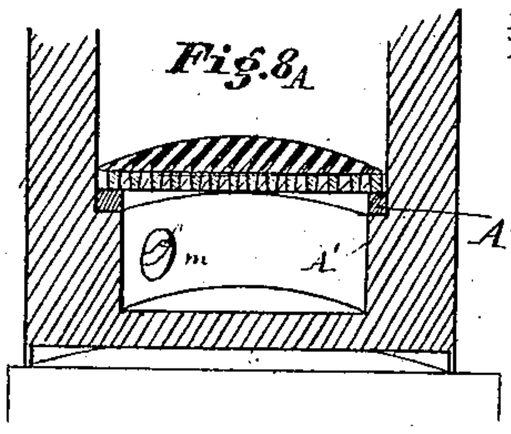
Fig. 8A



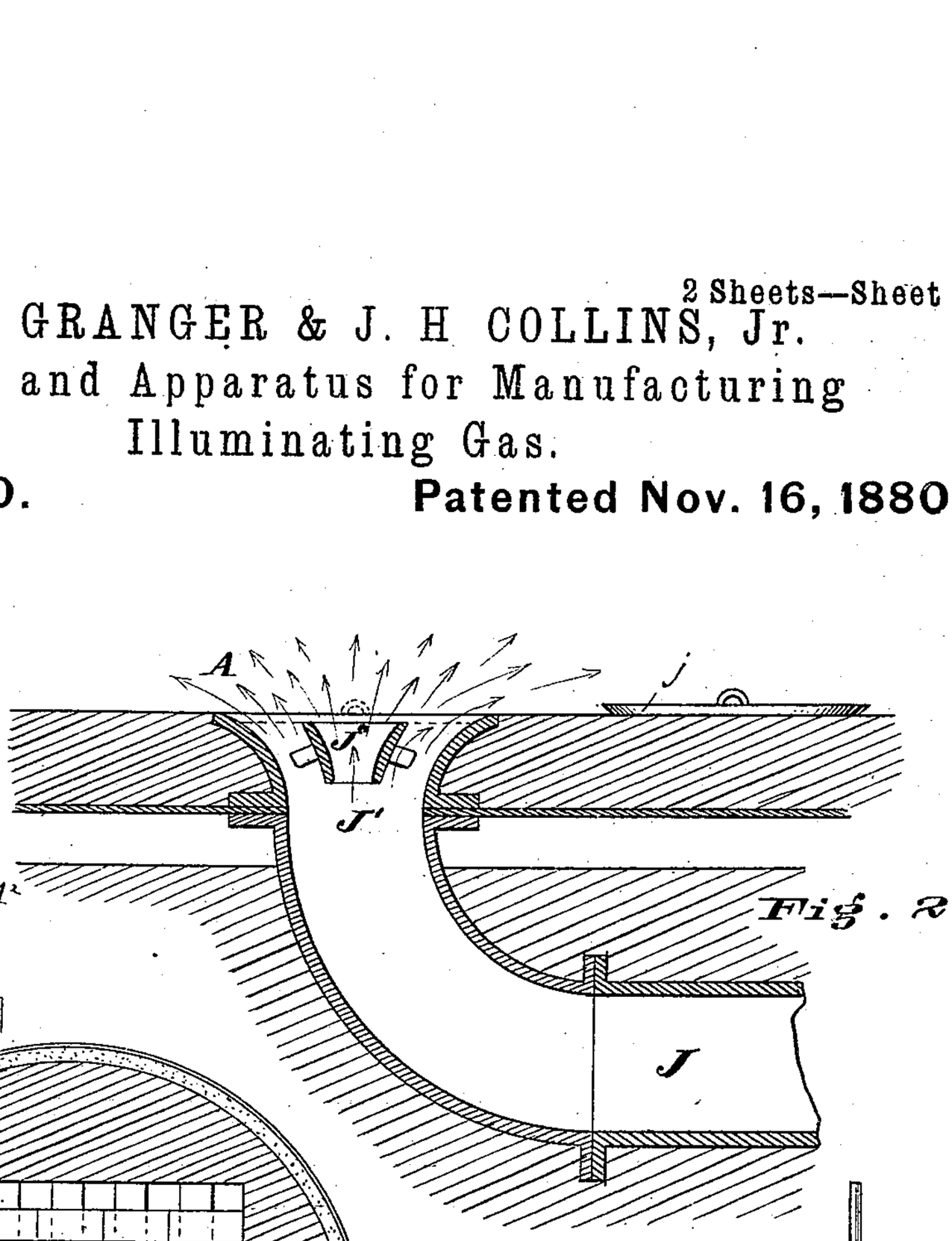


Fig. 2

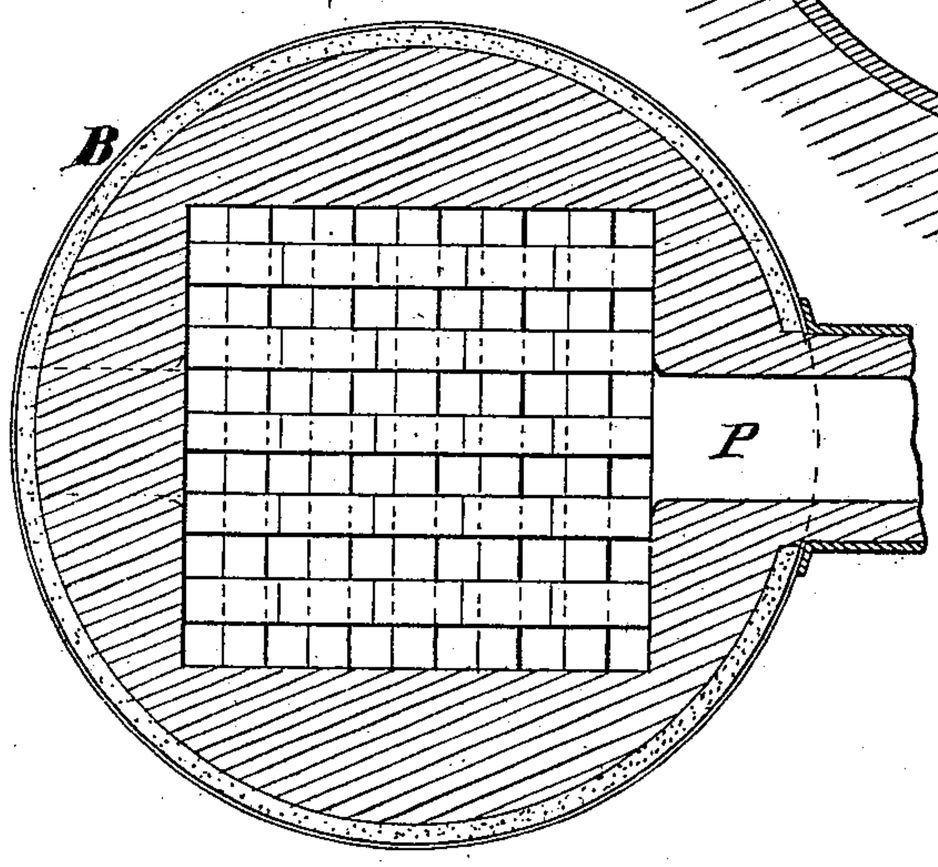


Fig. 3

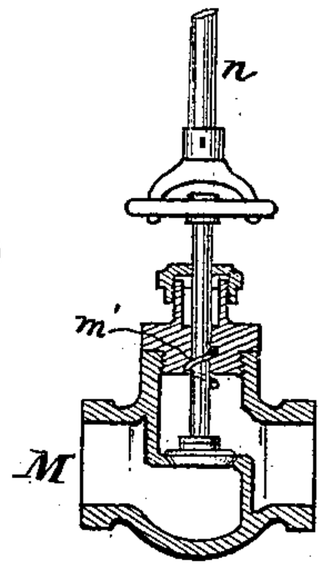


Fig. 6

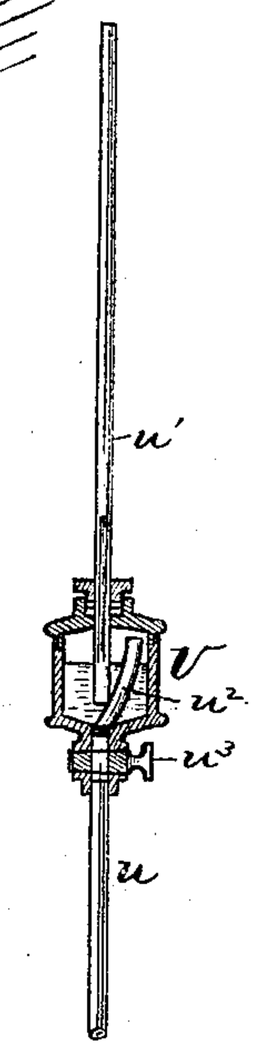
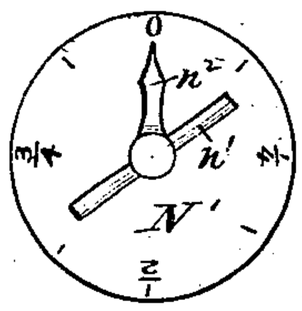


Fig. 5

Fig. 7



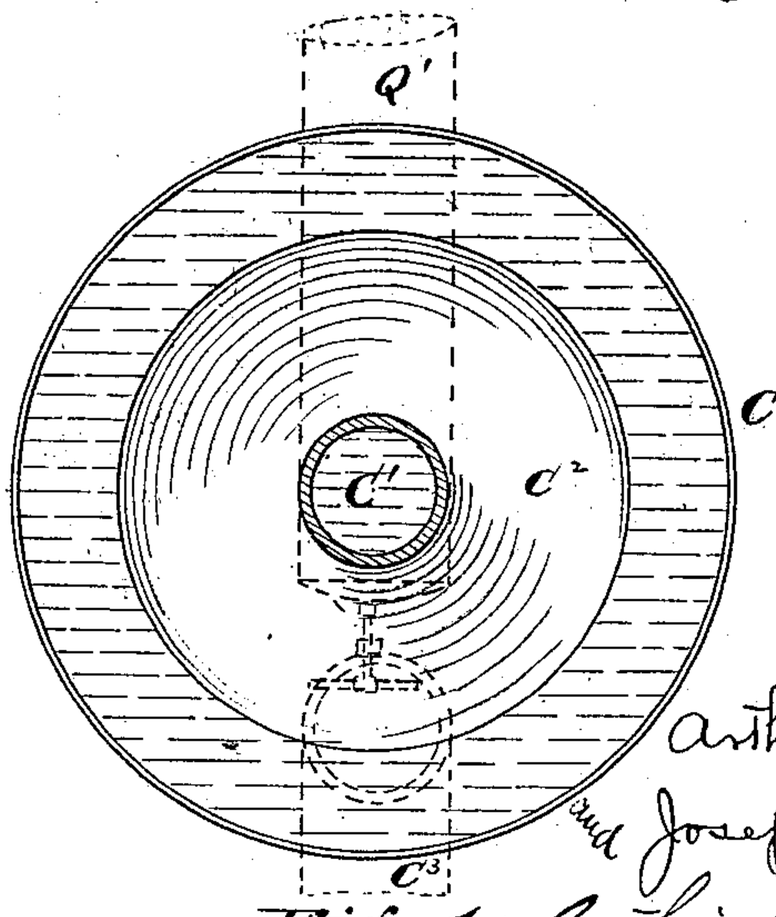


Fig. 4

Attests

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UNITED STATES PATENT OFFICE.

ARTHUR O. GRANGER AND JOSEPH H. COLLINS, JR., OF PHILADELPHIA, PA.

PROCESS OF AND APPARATUS FOR MANUFACTURING ILLUMINATING-GAS.

SPECIFICATION forming part of Letters Patent No. 234,400, dated November 16, 1880.

Application filed April 12, 1880. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR O. GRANGER and JOSEPH H. COLLINS, Jr., both of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Processes and Apparatus for Manufacturing Illuminating-Gas, of which the following is a specification.

Our improvements relate to that process and apparatus which are employed in the production of what is technically known as "water-gas;" and it consists in the operation and novel construction of various parts of the same, and which improvements are fully and clearly described in the following specification, shown in the accompanying drawings, and referred to in the appended claims.

The process of producing gas from steam, incandescent carbon, and fluid hydrocarbon, broadly, is old, and many forms of apparatus for producing such gas are also old; but our invention relates to many improvements upon such old forms, whereby the apparatus is under more perfect control, can be built at a less expense, and the gas made more economically and purer in composition.

There are many forms of apparatus for producing water-gas and carbureting it, some of which are shown in patents to Frost, Strong, and Hunter; but we do not claim anything set forth in those patents. Neither do we claim the processes set forth in those patents.

In the drawings, Figure 1 is a vertical section of the entire works. Fig. 2 is a section of the generator-blast-pipe nozzle. Fig. 3 is a cross-section of the superheater. Fig. 4 is a sectional plan of the washer. Fig. 5 is a sectional elevation of one of the pressure-gages. Fig. 6 is a section of the steam-valve which admits steam to the generator. Fig. 7 is a plan of the steam-valve operating and regulating mechanism. Fig. 8 is a sectional perspective view, showing the method of supporting the grate-bars.

Corresponding letters of reference indicate like parts of the apparatus.

A is the generator, B the superheater, and C the washer. The generator and also the superheater are provided at their respective tops with valves D, free to rotate upon a stem, which is bolted to an arm, E, secured to a rocking shaft, F, carrying upon either end the inclined guide G and arm I, respectively, and working in bearings attached to the valve-seat. Free to slide upon the guide G is a weight, H, which in practice is preferably suspended upon a small wheel or roller. To open the valve D the arm I is pulled back, changing the incline of the guide G, whereupon the weight H runs to the opposite side of the rocking shaft F and helps to raise the valve D by gravity, and at the time when the lever or arm I has the least power.

The generator is furnished with grate-bars and an air-tight door, which extends above and below such grate-bars. The grate-bars are supported upon a wrought-iron ring, A^2, which, in turn, is supported by fire-brick A', which constitutes the narrowing of the generator at the bottom. This is clearly shown in Fig. 8. Formerly this iron ring was supported upon an expensive iron carriage, and it was impossible to clean the ash-pit; but with our construction there is not the slightest trouble in any way.

Entering the ash-pit under the grate-bars is the blast-nozzle J, of peculiar construction. Heretofore it has been customary to blow the air through a horizontal pipe under the grate-bars, as would be indicated by tube M'; but in that case the air was forced across the ash-pit against the wall on the opposite side, expending its force and supplying more oxygen to the fire at that side than anywhere else, which was a decided objection, inasmuch as coal burned unevenly, packed and caked on one side, and allowing the steam greater chance to escape without decomposition. With the old method the lower portions of the bed of coal were reduced to ashes before the coal on top was red hot, this latter being necessary in order to vaporize the fluid hydrocarbon, and frequently the superheater was hot enough, but the generator-coal not being red hot on top, time was lost in bringing it up to that condition, and the lower portions of coal were wasted away, whereas in our method the condition of the coal on top is of no great importance, as we vaporize the oil either in the top of the superheater or in the vaporizer in the connecting-flue; and by reason of the bed of coal being brought to the incandescent state quicker with

our method of blast the coal remains more solid, and so holds a larger quantity of heat than when by a slower combustion it is partially reduced to ashes. We, will, however, with our method, more perfectly decompose the steam, and as a result we will have for the same amount of coal and steam a larger volume of gas and produced in a shorter space of time. By bringing the blast-pipe under the generator grate-bars in the middle, and then providing such pipes with the bell-mouths J′ and a smaller one, J², within the former, the air is forced up and spread evenly, and with equal force, all over the grate-surface, producing even combustion and lessening the chances of the steam being undecomposed. When cleaning the generator-fire a plate or cover, *j*, is placed over the nozzle to prevent its being choked up with ashes and cinders. This last pipe J is provided with a valve, K, which is worked by the lever *l* upon the working-platform at the top. This lever *l* is hinged to a hollow standard, L, by link *l′*, and is connected to the valve K by the rod *k*. Opening into the generator under the grate-bars is a tube, M′, which contains the end of the steam-pipe *m*. We particularly require that the nozzle of the steam-pipe *m* shall be directed up toward the grate-bars, because if the steam is blown upon the red-hot carbon it is instantly decomposed and gas immediately produced. Heretofore it has been the habit to blow the steam into the horizontal blast-pipe at the bottom and then allow it to find its way into the generator, and in which case much of it was condensed by contact with the cold pipe and fire-brick, &c., about the bottom of the generator, and no gas is produced until about four minutes have passed from the beginning of the steam admittance, whereas with our construction little or no steam is condensed and gas is instantly produced. Should the nozzle of this pipe *m* be worn the cap to the tube M′ can be taken off and the end changed.

The steam-pipe *m* is provided with a valve, M, of peculiar construction. This valve has its valve-stem provided with a screw-thread, *m′*, of such a pitch that one complete revolution entirely opens the valve. This is very important, inasmuch as it is necessary to know how much steam is admitted to the generator for conversion into gas. To operate this valve we provide a hollow standard, N, upon the working-platform at the top, furnished with a disk, N′, divided upon its upper surface and near its periphery into degrees or angles, Fig. 7. Passing up through this standard is a rod, *n*, which is in connection with the valve M and carrying just above the disk N′ a pointer, *n²*, and a handle, *n′*. By turning the handle and pointer at the top it is immediately known how wide the valve is open. Entering the top of the generator A, and above the level of the coal, is a blast-pipe, O, provided with the necessary valve, which is not shown. The object of this pipe O will be hereinafter explained.

Connecting the superheater B with the generator A is a fire-brick-lined tube, P. The superheater B is preferably, on account of cheap construction, cylindrical in shape outside, but is so lined that a square prismatic opening extends vertically through it to the arch at the bottom. The object of making this opening square or rectangular in shape is that the ordinary fire-brick can be used for the entire lining instead of the expensive specially-made curved bricks heretofore used. The arch B′ at the bottom is horizontal on the top, whereby greater strength is obtained, and the loose brick above will have a level foundation.

It has been the practice heretofore to make the arches in superheaters curved both on top and bottom.

The bottom is provided with a cleaning-door. Opening from this superheater B, under the arch B′, is an exit-flue, Q, which has two branches, one of which terminates in a valve, R, of similar construction to those already described. Situated over this valve R, but not in contact with it, is a smoke-stack, S. In general practice this valve was inclosed within the stack, and it was impossible to prevent the valve from burning and warping by the intense heat it was of necessity subjected to, and the consequence was that when the valve was closed and the gas produced there was great loss from leakage. It was also very difficult to get at the valve to make repairs. By the construction shown all this is entirely obviated. A construction somewhat similar to this is shown in a patent to Rowland.

Pipe Q′ leads to the cross Q², which is used for cleaning purposes. It is composed of two hinged doors, *q q*, which are kept tightly closed by loops and screws, as shown in Fig. 1. Crosses with cleaning-doors have been used before. From this cross descends the tube C′ into the water contained in the washer C. The bottom of the tube C′ is closed, and is provided with small perforations, *c*. Surrounding the pipe or tube C′, just above the perforation *c*, extending out and inclined slightly upward, is the cylindrical plate C². By these means the gas is caused to descend below the water-level, and is thus finely divided up and brought into thorough contact with the water, whereby it is effectively washed. The washed gas escapes from the cylindrical washer by the tube C³. A washer somewhat similar to this was patented to Miller; but we do not claim anything shown by him.

Situated above the superheater B is the oil-tank T, which is provided with a glass gage to indicate the quantity of oil contained therein. From this tank the oil is drawn into trough T′, from which it is allowed to drop into the superheater by pipes *t*, and becomes volatilized. It is best to introduce the fluid hydrocarbons in the superheater for the reason that they will flow more freely. In the old method of putting them in the top of the generator, drop-

ping onto the coal, it is, during the first half of the run, very difficult, and, indeed, impossible, to get in the proper amount, because the large volume of hydrogen rushing up through the coal drives back the oil, and it is only during the last half of the run, when the fire is cooled off and the volume of hydrogen is much less, that the oil will flow freely, and it then has to be forced in in large quantities, so as to make the gas extremely rich, trusting to the rich gas of the latter part of the run or heat mixing or diffusing in the holder, and so producing a gas of average candle-power. In our method the oil is introduced in a chamber in which the current is downward, and so the proper amount can flow in during all parts of the run, and so saving the waste due to putting in an excess in the last part, as in the old way, and securing a gas of even candle-power from first to last. In our method the tendency is for the gas to draw the oil after it instead of stopping its flow, as in the old method. Over the top of the trough T′ is a glass case or covering, T^2, preventing any oil which may be evaporated from the said trough escaping into the atmosphere of the room, and which is so objectionable with the open troughs now in common use.

If desired, the fluid hydrocarbons may be admitted into a coil or vaporizer, *p*, from which they issue as a vapor.

In connection with the foregoing apparatus we also provide pressure-gages U, which are shown in Fig. 5. They consist in a hollow cylinder, air-tight, provided at the top with glass tubes *n′*, which extend nearly to the bottom inside, and at the bottom they are provided with a valve, u^3, and pipe *u*, in connection with pipes P, Q′, and C′. In connection with the pipe *u* is a small pipe, u^2, which extends nearly to the top of the gage inside. The gage is then nearly filled with water or other liquid, Fig. 5. From this construction it is evident that if any pressure occurs anywhere about the works it is instantly made apparent by the water being forced up the glass tubes.

It was formerly necessary to screw down the doors or valves D; but with our special construction they are sufficiently weighted, and in case of an explosion, which often occurs, they act as explosive doors. Before opening the door or valve D for the purpose of throwing coal into the generator, steam or blast, if either are open, are shut off from *m* and J, and air is blown through pipe O to blow out all explosive gases from the generator.

In the Lowe apparatus now in use the products of combustion pass from the generator at the top down a flue and enter the superheater at the bottom, where air is admitted to burn the gases to bring the superheater to a high temperature. By this it is readily seen that the gases produced in the generator were greatly cooled before they reached the superheater, and consequently about ten minutes elapse before the gases become sufficiently hot for combustion with the oxygen of the air-blast, and frequently a red-hot bar has to be inserted to ignite the gases, whereas with our construction the connection between the superheater and generator is made at the top and is short, and the air to burn the gases produced in the generator for the purpose of heating the superheater is admitted by the pipe O just at the point where there is the greatest amount of heat, and so instant combustion is assured and loss of time obviated. Also, the superheaters, as usually constructed, are small in diameter and very high, and the gases pass upward through them quickly and without much effect, whereas by our construction of a superheater of large diameter and of the same height as the generator, and causing the gases to descend, they spread over the entire interior and bring it to a high temperature in a very short space of time and do their greatest work.

The process of working is as follows: The valves M and D D being closed, air is forced in by the pipes J and O, bringing the coal to a state of incandescence and burning the escaping gases in the generator and above the coal. The flame and products from the combustion of these gases pass through the superheater, raising its temperature, and escape by valve R and chimney S. When the coal in generator A is brought to incandescence the blast from O and J is shut off and valve R closed and valve M opened, and the steam, preferably superheated, from the nozzle of steam-pipe *m* is instantly decomposed by the incandescent carbon, the resulting gases being hydrogen and carbonic oxide, which pass through flue P into the superheater, where they meet volatilized fluid hydrocarbons, which now drip from the pipe *t*. The gas so produced passes down through the superheater, where it becomes a fixed gas, and then through flues Q, Q′, and C′ into the water in the washer C, and finally passes through pipe C^3 to the scrubbers, and then to the holders.

Having now described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The herein-described process for manufacturing illuminating-gas, consisting in the following steps: raising to incandescence a bed of carbonaceous material by a blast of air in the primary generator, producing carbonic oxide; then burning this carbonic oxide by air above the bed of incandescent carbonaceous material and in the primary generator; then causing the products of combustion to pass into a superheater and descend under slight pressure, spreading into every available heating-space and raising said superheater to a high temperature; then decomposing steam by the incandescent carbonaceous material in the primary generator, producing water or heating gas; then carbureting such gas by fluid hydrocarbons in its passage from the primary generator to the body of the super-

heater, and finally fixing the gas by passing it through the highly-heated superheater, substantially as and for the purpose specified.

2. The combination of the generator A, provided with blast-nozzle J J′, blast-pipe O, steam-pipe *m*, exit-flue P, with superheater B, provided at the top with hydrocarbon-tube *t* and at the bottom with outlet-flue Q, valve R, flue Q′, cross Q^2, and with washer C, provided with vertical tube C′, perforated at the bottom *c*, and a conical disk, C^2, substantially as and for the purpose specified.

3. The combination of generator A, blast-nozzle J J′, steam-pipe *m*, blast-pipe O, provided with a valve, O′, and exit-flue P, on the same level, and an automatic explosive door, D, constructed substantially as and for the purpose specified.

4. A charging and explosive valve composed of the following parts in combination: valve or disk D, attached to and supported by an arm, E, secured to a rock-shaft, F, provided on one end with an arm, I, and on the other with a guide, G, upon which a weight, H, is supported and free to move thereon, all being attached to and working upon a valve-seat, substantially as and for the purpose specified.

5. Generator A, provided with means to admit blast under the grate-bars, in combination with automatic explosive valve D, blast-pipe O, provided with valve O′ and exit-flue P on the same level and exactly opposite each other, substantially as and for the purpose specified.

6. Generator A, superheater B, both provided with automatic explosive valves or doors D, in combination with flue P, blast-pipe O on the same level, exit-flue Q, and hydrocarbon-pipe *t* at the top of the superheater and in front of the flue P, substantially as and for the purpose specified.

7. Superheater B, provided at the top with automatic explosive door D and flue P, and at the bottom with exit-flue Q, the cross-section of the superheater being circular outside and square inside, substantially as and for the purpose specified.

8. Generator A, in combination with blast-nozzle J J′, situated under the middle of the grate-bars, blast-pipe O, flue P, square superheater B, exit-flue Q, and valve R, substantially as and for the purpose specified.

9. Blast-nozzle provided with a bell-mouth, J′, and containing within such bell-mouth a second or smaller bell-mouth, J″, for the purpose of spreading the air evenly over the grate-area, substantially as and for the purpose specified.

10. The blast-nozzle J, composed of two bell-mouths, one situated within the other, valve K, valve-rod *k*, lever *l*, link *l′*, and standard L, in combination with generator A, substantially as and for the purpose specified.

11. Oil-tank T, provided with a glass gage, in combination with glass trough T′, glass cover T^2, and tube *t*, substantially as and for the purpose specified.

In testimony of which invention we hereunto set our hands.

A. O. GRANGER.
JNO. H. COLLINS, JR.

Witnesses:
GEO. L. BAUM,
C. CUYLER GREGORY.