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C. A. A. BAZILLE

REGULATING THE OPERATION OF A GAS PRODUCER

Filed March 20, 1939

Serial No. 263,042

2 Sheets-Sheet 1

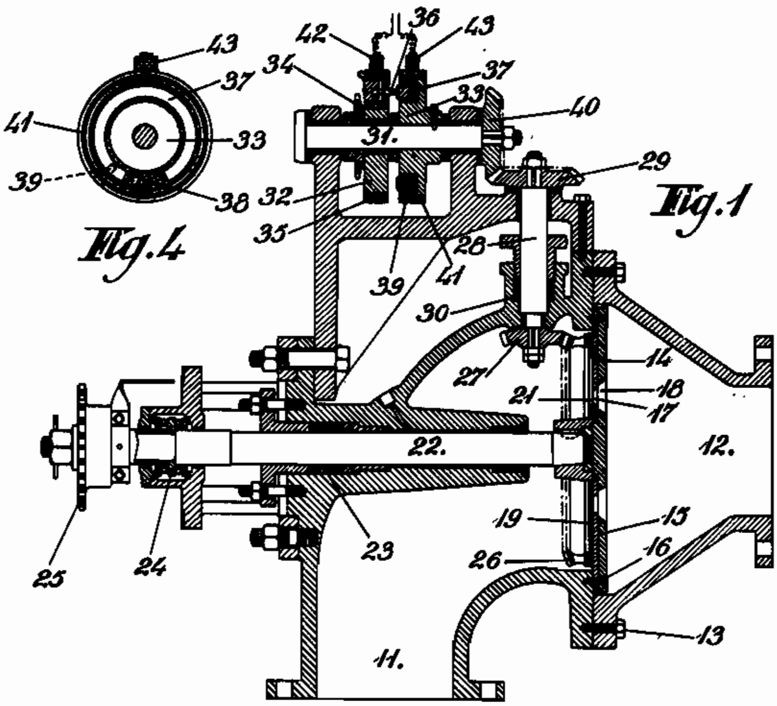
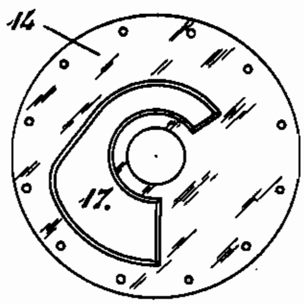


Fig.4

Fig.1

Fig.2



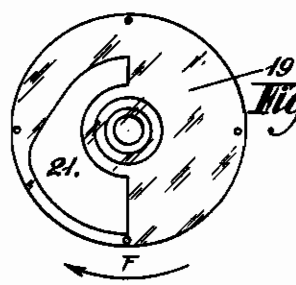
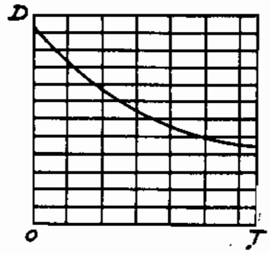


Fig.3

Fig.5



INVENTOR

C. A. A. BAZILLE

By

Young, Emery & Thompson

ATTYS.

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Fig. 7

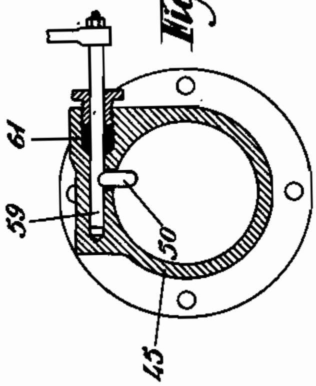
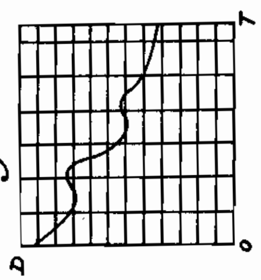
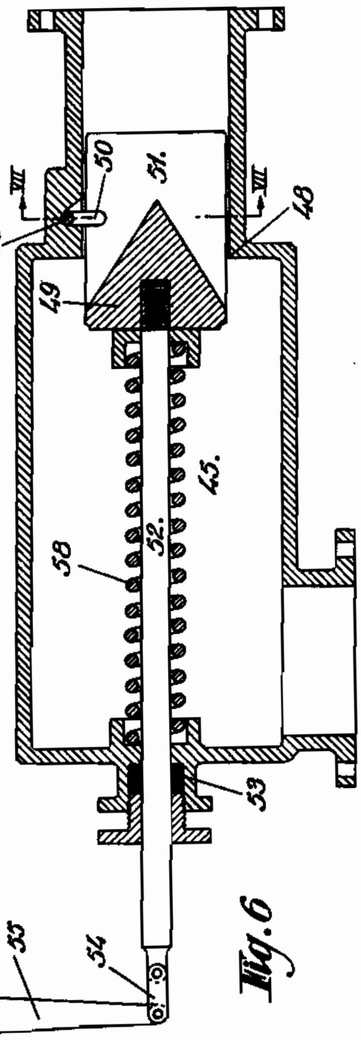


Fig. 8





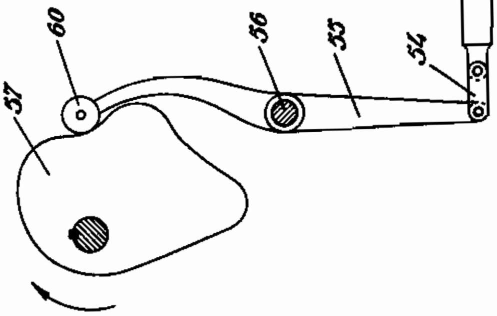


Fig. 6

INVENTOR

C. A. A. BAZILLE

BY

Young, Emery & Thompson

ATTYS.

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ALIEN PROPERTY CUSTODIAN

REGULATING THE OPERATION OF A GAS PRODUCER

Cyrille Alfred Alexis Bazille, Gennevilliers, France; vested in the Alien Property Custodian

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In the utilisation of gas producers with a view to producing "water gas" it is usual to proceed, preferably automatically, by regular cycles each comprising two successive phases: air blowing and injection of water vapour.

The first phase has the effect of bringing a mass of coke contained in the gas producer to the temperature most suitable for ensuring the decomposition of the water vapour injected during the second phase, and consequently the desired production of water gas.

However, the reaction of the water vapour on the coke is endothermic, so that during the course of the vapour injection phase the temperature of the coke constantly decreases; as the reaction is reversible, it becomes more complete in proportion as the temperature is increased; consequently, the proportion of decomposed vapour decreases also from the beginning to the end of the injection phase.

Moreover, the rapidity of decomposition of the water vapour depends upon numerous other factors: cooling of the mass of coke by conductivity of the walls of the gas producer or by the carrying away of heat by the non-decomposed vapour, the length of time the water vapour and the incandescent coke are in contact with one another, the speed of displacement of the water vapour and of the gases in the interstices of the mass of coke, and relative proportions of the constituents of the mixture of water vapour and gas.

In order to obtain optimum results, the most favourable duration for one complete cycle, for example three minutes, and the necessary distribution of the two phases, air blowing and injection of vapour, in the cycle, for example one minute of blowing for two minutes of injection, have hitherto been determined for each gas producer by calculation or by numerous tests.

In all cases, the rate of the injection of water vapour has been maintained constant from the beginning until the end of the injection phase regardless of the time sequence adopted.

The object of the present invention is further to improve the working of a gas producer by ensuring, during the period of the vapour injection, a decreasing rate of delivery either continuously or in phases, or finally in successive pulsations.

In all cases, the mean vapour delivery at the beginning of the injection phase is much greater than the delivery at the end.

This process of regulating the injection of vapour improves the conditions of operation of the gas producer, because for the same weight of injected vapour, there is obtained either a richer gas or a greater quantity of gas per cycle, that is to say, a substantial increase in the production.

The possibility of one or more pulsations in the law of variation of the delivery has the effect of creating each time a sudden increase in the velocity of flow of the gases, and consequently of causing the breakage of the stationary gaseous film, which, as experience has shown, tends to form about each piece of coke and forms an obstacle to the decomposition of the water vapour.

The regulating process according to the invention may be automatically effected by means of a closing member arranged on the steam delivery conduit and mechanically actuated in such a manner that its movable part leaves free an inlet area which decreases during the course of the injection phase in accordance with the law fixed for the delivery to be effected at each instant.

In a first embodiment, such a closing device may be constituted by a fixed diaphragm having suitable apertures against which there is applied a movable diaphragm, also apertured, which rotates continuously; the inlet area is constituted by those parts of the apertures of the two diaphragms which lie in coincident positions.

In a modification, the closing member is constituted by a form of profiled valve having an axial lift and controlled by a continuously actuated cam of suitable profile.

Suitable safety systems are combined with these devices for the purpose of stopping the operation of the gas producer if the closing member is accidentally held fast.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a longitudinal section through a first constructional form of the regulating arrangement according to the invention;

Figure 2 is a front view of the fixed diaphragm;

Figure 3 is a front view of the movable diaphragm;

Figure 4 is a view of a safety member of the arrangement;

Figure 5 is a graph representing the inlet area during the course of operation;

Figure 6 is a longitudinal section through a modification of the arrangement;

Figure 7 is a cross-section along the line VII—VII of Figure 6;

Figure 8 is the graph representing the inlet area during the course of the operation of this modification.

The arrangement shown in Figures 1 to 4 comprises an inlet branch 11 and an outlet branch 12 intended to be interposed between any two elements of the conduit delivering the vapour to the gas producer (not shown).

The two branches are connected by screws 13 and at the joint the inlet branch 11 contains a fixed diaphragm 14 covered by a diaphragm-supporting plate 15. This plate, which is secured by screws 16, plays a purely mechanical part and serves to reinforce the diaphragm 14, which is thin and may thus be constructed with great precision.

As is shown in Figure 2, the fixed diaphragm has an aperture 17 of generally arcuate form, the width of which, considered radially, continuously decreases. The diaphragm-supporting plate 15 is also apertured, but its aperture 18 is systematically larger than the aperture 17 of the diaphragm, so that it in no way influences the operation.

Against the fixed diaphragm 14 is applied an apertured movable diaphragm 19 (Figure 3) comprising an arcuate aperture 21 of the same general form as the aperture 17 of the fixed diaphragm 14 but having a smaller angular extent than that of the fixed diaphragm. In the example shown, the aperture 17 extends over about ⅔ of a circumference, while the aperture 21 of the movable diaphragm extends only over half of a circumference.

The movable diaphragm 17 is carried on the extremity of a rod 22 which extends by means of a stuffing box 23 through the wall of the inlet branch 11. The rod 22, which is retained by a ball thrust bearing 24, carries at its outer extremity a sprocket wheel 25 over which there passes a transmission chain (not shown) extending from a suitable continuously rotating driving member, owing to which the movable diaphragm 19 effects at constant speed one complete revolution per cycle of operation of the gas producer.

In order to ensure the safety of the installation there is provided on the movable diaphragm 19 a toothed rim 29 in engagement with a bevel wheel 27, the shaft 28 of which extends through the wall of the branch 11 at right angles and through a stuffing box 30 and carries at its outer end a pinion 29 in engagement with a second pinion 40 driving a shaft 31 on which a plate 33 is rigidly mounted.

On the shaft 31 is mounted, so as to turn loosely thereon, another plate 32 connected to a toothed wheel 34 over which there passes a chain (not shown) actuated by the general driving member of the arrangement at a speed of one complete revolution per cycle of operation of the gas producer.

The plate 32 comprises on its periphery a metal ring 35 electrically insulated, but connected nevertheless to a brush 38 provided with a spring and bearing against an arcuate contact member 37 (Figure 4), which is carried in suitably insulated fashion by the plate 33. The contact member 37 does not extend over a complete circumference and has an insulated gap 36 between its two extremities.

However, the said contact member 37 is electrically connected by a screw 39 to an insulated metal ring 41 surrounding the plate 33.

Two fixed brushes 42 and 43 are connected in an electric circuit so as to be in permanent contact with the rings 35 and 41, said circuit comprising the winding of a relay, the armature of which is adapted to ensure the placing of the gas producer "in suspension", that is to say out of operation. Such a relay is at present commonly employed in installations for the automatic control of gas producers and does not require to be particularly described.

The arrangement described in the foregoing operates in the following manner.

During the course of the first phase of one cycle (air blowing), the ordinary vapour injecting valve (not shown) is completely closed and the regulating arrangement is inoperative; however, the movable diaphragm 19 is turned in the direction of the arrow F (Figure 3). At the end of this phase of operation of the gas producer, the air blowing is stopped and the vapour admission valve is fully opened; at this precise moment, the two apertures 21 and 17 are in coincident positions and a maximum inlet area is offered by the arrangement to the vapour.

However, the movable diaphragm 19 is still turning in the direction of the arrow F and covers a wide part of the aperture 17, while it frees a narrower part. The inlet section therefore diminishes progressively until the diaphragm 19 has carried out about half a revolution.

From this moment, the inlet area remains substantially constant, since the diaphragm frees on one side approximately the same inlet area as it covers on the other side. Finally, after two-thirds of a revolution the vapour admission valve closes in the ordinary way and the injection of vapour ceases. A further cycle of operation then commences.

Figure 5 shows a curve prepared by plotting along the ordinates the inlet areas (or steam deliveries D) and along the abscissae the periods of fractions of cycles.

This curve has an exponential form turning its concavity towards the top. It will be understood that by replacing the two diaphragms by others having apertures of different form from those shown in Figures 2 and 3, a curve of different appearance would be obtained, from which it may be seen that the arrangement permits of regulating the injection of vapour in accordance with any desired law.

If by accident the movable diaphragm 19 stops, for example owing the breakage of the chain by which it is actuated, the plate 33 remains stationary, while the plate 32 continues to rotate.

As a result, the brush 36 is soon removed from contact with the contact member 37, the electric circuit is broken and the safety relay responds and suspends the operating of the gas producer.

The modification shown in Figures 6 and 7 comprises a tubular body interposed between two elements of the delivery conduit for the injection vapour. The tubular body 45 forms the seat 48 of a valve 49 of conical form, which is provided with guide blades 51.

The valve 49 is carried on the extremity of a rod 52 which traverses the tubular body 45 at right angles through a stuffing box 53 and which is connected by a link 54 to a rocker 55 pivoting about a fixed axis 56.

The other extremity of the rocker 55 is provided with a roller 60 in permanent contact with a cam 57 continuously rotating at the rate of one revolution per cycle of operation of the gas producer. A spring 56 surrounding the rod 52 of the valve tends constantly to return the valve to its seat as far as is permitted by the contour of the cam 57.

Transversely to the tubular body 45 is disposed a finger 50 intended to be encountered by the valve 48 when this valve bears completely against its seat, which may occur in the event of accidental breakage of a part; such for example as the link **54**.

The finger **50** is carried by a transverse rod **59** extending from the body **45** through a stuffing box **61** and actuating outside this body an electric switch which controls the circuit of the safety relay of the installation.

This modification of the arrangement operates in the following manner:

At the end of the air blowing phase, the highest rise of the cam **57** is disposed below the roller **60**, so that in spite of the spring **59** the valve **49** is in its position of maximum opening.

At this moment, the steam admission valve is opened and the injection into the gas producer commences at a high rate.

However, the cam **57** in rotating first allows the valve **49** to approach its seat **48**, but another rise of the cam **57** is soon presented and the valve **49** is again opened but less than in its initial opening.

The closing movement of the valve **49** then recommences and atfer the passing of a further rise of the cam the inlet area freed by the valve progressively decreases until the end of the cycle.

Since the inlet areas and consequently the steam deliveries have accurately followed the displacements of the conical valve **49**, it follows that the injection of vapour has been effected in accordance with a law of both declining and pulsatory character, such as that represented by the curve in Figure 8.

Each pulsation corresponds to the presence of a rise on the cam **57** and it will be understood that it is sufficient to select a suitable profile for this cam in order to obtain any desired law of variation of delivery for the injection of the vapour into the gas producer.

Should a part be accidentally broken, the spring **58** forces the valve **49** on to its seat, whereby the finger **50** is forced back and causes the safety relay to respond.

It is obvious that the invention is not limited to the two examples of application which are described in the foregoing and that it is possible, without departing from the general scope of the invention, to utilise other forms of closing members for carrying out the regulating process according to the invention.

CYRILLE ALFRED ALEXIS BAZILLE.