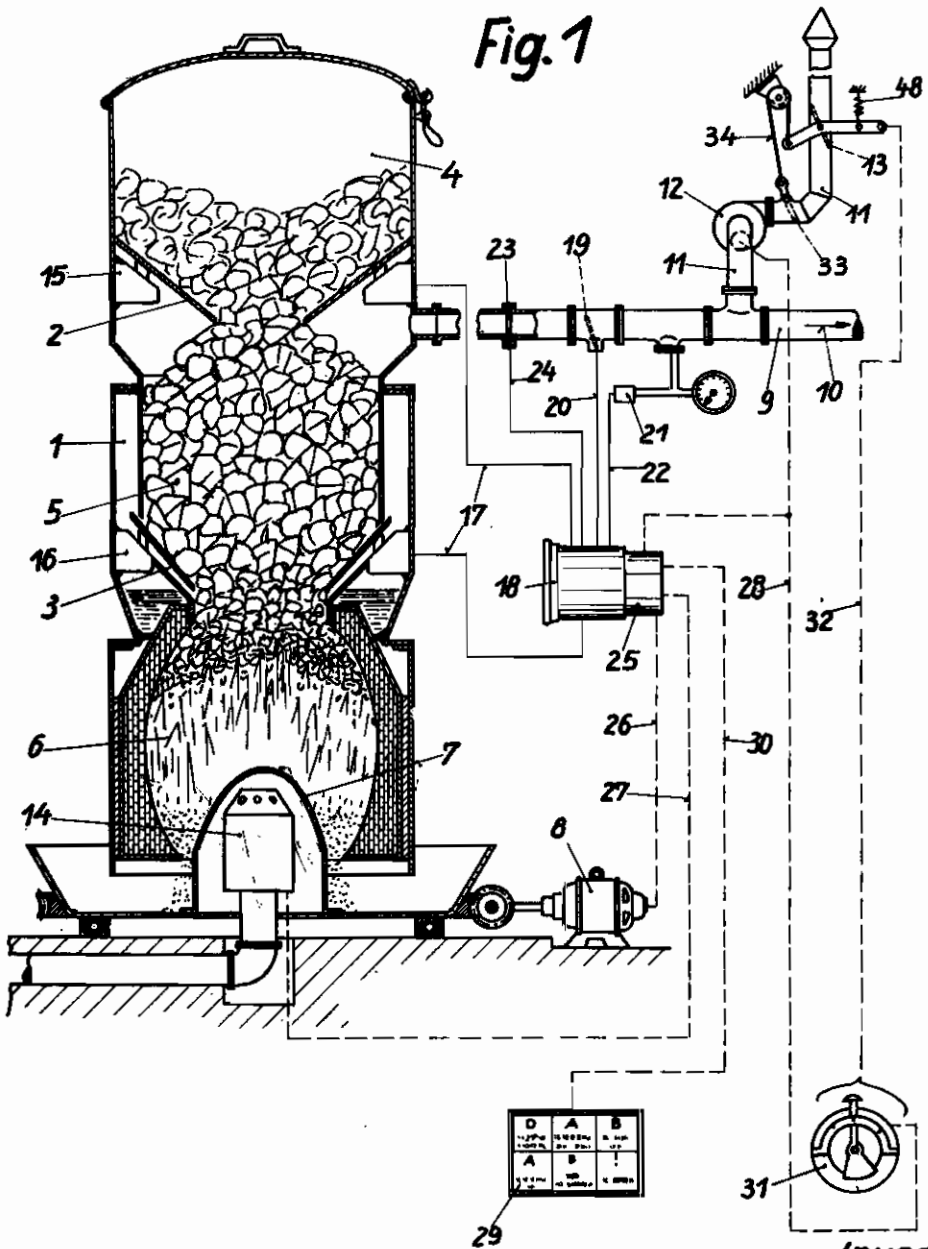
PUBLISHED
APRIL 27, 1943.
BY A. P. C.

E. LELL
METHOD AND DEVICE FOR REGULATING THE OPERATION OF GAS GENERATORS
Filed March 25, 1941

Serial No.
385,193
3 Sheets-Sheet 1

Fig. 1



Inventor
E. Lell

By
Glascock Downing & Seebold
Attorneys.

PUBLISHED
APRIL 27, 1943.
BY A. P. C.

E. LELL
METHOD AND DEVICE FOR REGULATING THE OPERATION OF GAS GENERATORS
Filed March 25, 1941

Serial No.
385,193
3 Sheets-Sheet 2

Fig.2

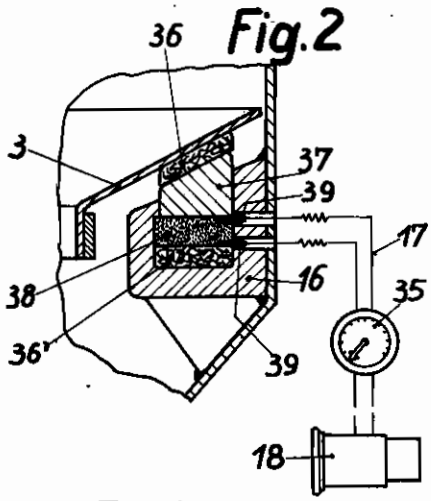


Fig.4

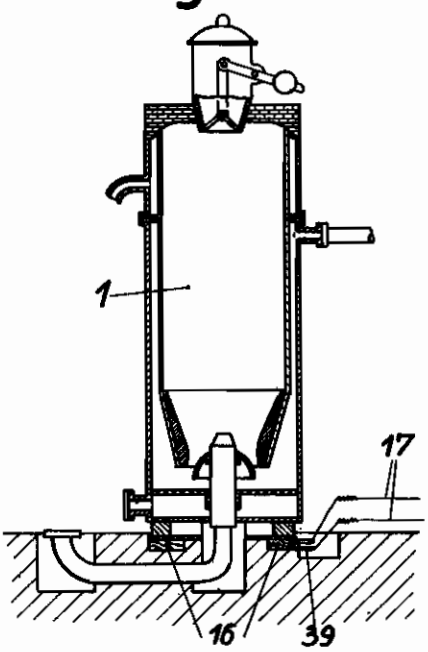


Fig.3

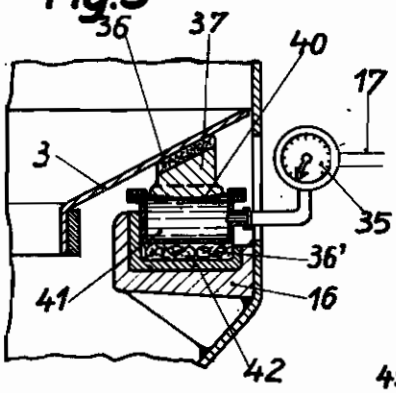


Fig.5

Inventor
E. Lell

By Glascock, Downing & Seebold
Attorneys.

PUBLISHED
APRIL 27, 1943.
BY A. P. C.

E. LELL
METHOD AND DEVICE FOR REGULATING THE OPERATION OF GAS GENERATORS
Filed March 25, 1941

Serial No.
385,193
3 Sheets-Sheet 3

Fig.6

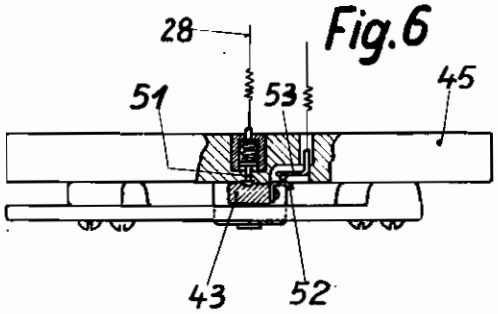


Fig.7

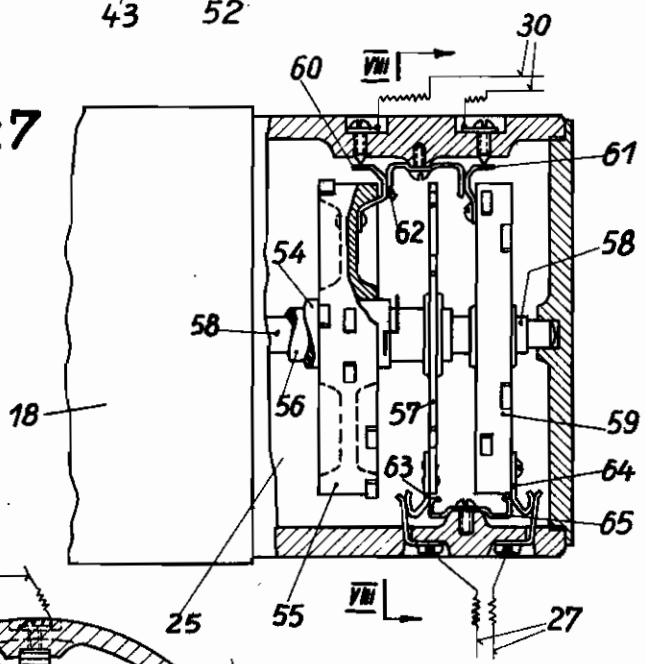
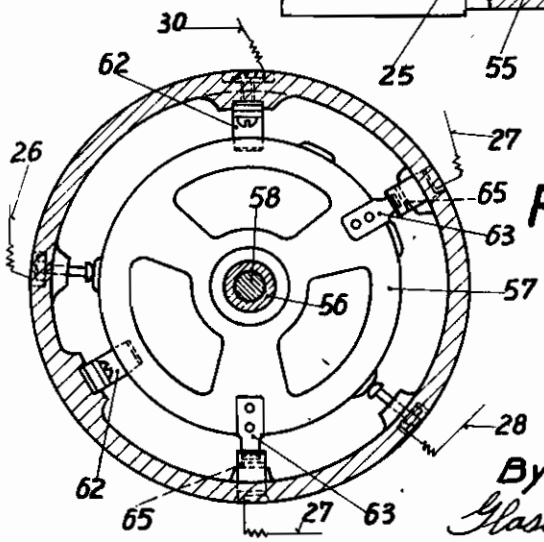


Fig.8



Inventor
E. Lell

By: Glascock Downing & Seebold
Attorneys.

Published Apr. 27, 1943 Serial No. 385,193

ALIEN PROPERTY CUSTODIAN

METHOD AND DEVICE FOR REGULATING THE OPERATION OF GAS GENERATORS

Eugen Lell, Berlin-Weissensee, Germany; vested in the Alien Property Custodian

Application filed March 25, 1941

This invention relates to a method for regulating the operation of gas generators, as well as to a plurality of constructional forms of a device for carrying out that method. The invention is important especially for gas generators operating with a strongly fluctuating or greatly varying load. I am aware of the fact that there have already been suggested automatic regulation devices for gas generators in which the amount of the added steam depends upon the amount of the gas withdrawn by the apparatuses consuming it, but also in the case of automatic regulation of the supply of the steam there remain for the attendant, especially in the case of disturbances of the service, so many possibilities as to a change in the service conditions that the control also of such gas generator plants must be carried out in a very careful manner, since there exists, in fact, also the possibility that even highly skilled attendants make mistakes merely from the reason that the actual interior state of the service and the cause of an eventualty existing disturbance cannot by itself be perceived from the exterior of the plant.

Now, it is the object of the present invention to accommodate to the utmost the control and the regulation of gas generators to the actual state and condition existing at any given point or period of time without paying regard to merely felt assumptions and to make the control and the regulation dependent on several magnitudes enlightening the attendant as to the situation. Such magnitudes affording the requisite information either already singly or with certainty in certain combinations are the following:

(1) The temperature within the generator, or in the gas outlet pipe respectively.

(2) The pressure ratios in the passages, through which the air, or the gas respectively, is streaming, especially (*a*) the pressure below atmospheric pressure in the gas pipe as regards suction gas generators, (*b*) the fall of the pressure below atmospheric pressure as regards pressure gas generators, (c) changes in the difference between the air pressure below the grate and the gas pressure in the gas outlet pipe.

(3) The amount of the gasiform agent in correspondence with the load on the generator, measured, for instance, by the speed of the flow.

(4) Fuel admisson to the generator,

(5) Proportion of the gas not flowing to the gas consuming devices in order to maintain the service in the case of small load.

(6) Composition of the gas produced.

It is possible to carry out the operation of the generator in the proximity of its most economical service magnitudes by proper determining the proportion of several of said magnitudes, but as the number of the combination of the several service conditions concerned is so large that their proper recognition and combination in order to obtain the proper view of the actual state necessitates wearisome considerations which the attendant is not able to carry out, the present invention comprises also devices in which from the beginning of the gas production several feelers provided for several of the above-mentioned service states or conditions act upon an indication or regulation implement common to them and being able to show the redress or effect automatically the measures requisite in the respective case.

It is, of course, also possible that, independent of the indication and regulation effected by several different magnitudes as above mentioned, intermediate service states may occur which need be controlled by only one of said magnitudes, for instance, the temperature. The additional impulses may co-act with the main regulation of the boundary impulses by which the arising of states or conditions not proper to the service are indicated, but the respective impulses can likewise act singly or successively upon several auxiliary aggregates exerting an influence upon the operation of the generator.

For carrying out the invention particularly successfully it is important to make use of such impulse feelers which are continuously subject to the action of the state or condition to be regulated. The invention comprises, therefore, also suitable constructional forms of such feelers, especially such for ascertaining the amount of the material admitted and being as independent as possible from shocks or short duration in the case of shakes, and being, furthermore, able to make the indication without the action of a practically perceivable value of the weighing amount, that is to say, the amount of the fuel admitted.

The invention is illustrated diagrammatically and by way of examples on the accompanying drawings on which Figure 1 shows in its lefthand half a vertical section through a gas generator for use in connection with the invention, and in its righthand part a diagram, the members of which will be fully dealt with hereinafter. Figure 2 shows, chiefly in vertical section, a regulation feeler for the ascertainment of the weight of the charge supplied into the generator according to the piezo-electric principle. Figure 3 shows, likewise chiefly in vertical section, a regulation feeler for ascertaining the weight of the charge supplied into the generator according to the hydraulic principle. Figure 4 is a vertical section through a modified constructional form of a regulation feeler for ascertaining the weight of the charge. Figures 5 and 6 show a device, partly in side-view (Fig. 5) and partly in section (Fig. 6) the section being seen in the direction of the arrow VI of Fig. 5) for combining manual regulation with automatical one. Figure 7 shows,

chiefly in section, an implement for combining several impulses with one another. And Figure 8 shows a longitudinal section in the line VIII—VIII of Fig. 7.

Referring to Fig. 1, 1 denotes the generator which is subdivided into three superposed compartments by means of hopper-like sheet-metal members 2 and 3. The uppermost compartment 4 serves as normal store-room, the compartment 5 therebelow as a reserve store room, and the compartment 6 is the fire chamber in which the fuel is maintained in the necessary glowing state as long as the service lasts. 7 denotes a rotatory grate which is rotated in a regulable manner by means of an electromotor 8 or the like. The gas is withdrawn through the pipe 9 in the direction indicated by the arrow 10. From this pipe is branched off a pipe 11 into which are inserted a blower 12 and a throttle flap 13, and which may terminate either into the atmosphere or into a store receptacle. Air and steam are supplied to the generator through a nozzle 14 which may be provided with means for varying the proportion of these components relatively to one another before they stream through the openings of the grate.

The hopper-like sheet-metal members 2 and 3 are supported upon pressure or weight feelers 15 and 16 by which pressure impulses are transmitted over conduits 17 to a central regulation device 18 receiving impulses also from a temperature feeler 19 arranged in the gas outlet pipe 9, the transmission being effected by conduits 20; furthermore, said device 18 receives impulses also from a pressure feeler 21 over a conduit 22, and, finally, also from a throttling place 23 over a conduit 24. The impulses act upon members housed in the central regulation device and being able to assume therein several positions corresponding to the values of the respective impulses. 25 denotes an intermediate receiver forming a part of the said device 18 and being connected up by conduits 26, 27, 28 (indicated in Fig. 1 by dotted lines) to the grate-rotating motor 8 (conduit 26), the adjusting means provided in the nozzle 14 (conduit 27), and the blower 12 (conduit 28). Besides these members (motor, nozzle, blower) further means or devices (not shown in Fig. 1) suited for supplying the generator automatically with fuel may effect this action either directly or by the intermediary of the central regulation device 18 and may act over the conduit 30 also upon a signalling table 29 arranged in the direction of view of the attendant. In the same direction and in a position in which the attendant can conveniently operate it is provided a manually operable control device 31 with the aid of which the position of the throttle flap 13 can be determined by the intermediary of a rope 32 or the like. This flap is, furthermore, controlled in a certain of its position by means of a flap 33 arranged between the flap 13 and the blower 12 and being connected with the flap 13 by means of a double-armed lever connected at one end with the flap 33 by means of a rope or the like 34 and being subjected at its other end to the action of a helical spring 48, as shown in the upper right-hand corner of Fig. 1.

The manner of operation of this plant is as follows:

The several regulation impulses arriving from the pressure or the weight feelers 15 and 16, the temperature feeler 20, the throttling member 23 and the pressure feeler 21 are received by the regulation devide 18 by which thereupon the various control commands are communicated to the regulation members to be controlled by the intermediary of the intermediate transmitter 25.

As regards normally repeatedly occurring service conditions, such as small leads and loads therebelow and thereabove, either merely the temperature or, preferably, the temperature in co-operation with the pressure in the gas pipe and with the quantity of the gas passing therethrough will suffice. The impulses and the control influences may be indicated, for instance in such a manner as stated on the Table I here following:

TABLE I

Service states

(*a*) Temperature	Low	High.
(*b*) Pressure below atmospheric pressure in the suction pipe.	Small	Greater than normal.
(*c*) Quantity of gas passing through.	do	Large.
(*d*) Admission	Normal	Over-charged.

Diagnosis

Regulating steps to be carried out:		
(1) Addition of steam	None at all or only at the rim.	Increasing eventually especially at the rim.
(2) Addition of air	Eventually to the middle of the grate.	To be throttled.
(3) Blower in the branch branch pipe.	May be inserted	
(4) Rotary grate	Slow	Quicker.

Besides the normal service states, also special or exceptional cases and disturbances can be automatically ascertained with certainty with the aid of a combined valuation of the several measuring results, and it is also possible either to provide for automatic redress or to inform the attendant of the kind of the disturbance and the redress thereof by a signal. The most frequently occurring disturbances, such as "burning through", "slackening" and "obstructed conduits" arestated in the Table II here following:

TABLE II

Service states

(*a*) Temperature	Very high (quickly rising).	High	Low slowly falling).
(*b*) Partial vacuum in the suction pipe.	Very low	do	High.
(*c*) Amount of fluid passing.	Normal	Normal	Normal.
(*d*) Admission	Small	do	

Diagnosis.

Burning through	slackening.	Obstructed pipes	
Regulating steps:			
(1) Addition of steam.		At first suddenly strong addition of steam, thereafter throttling, eventually several times.	Cleaner and pipes. cleaning
(2) Addition of air.		Throttling in the case of a large addition of steam.	
(3) Blower in branch pipe.		(Eventually).	
(4) Rotary grate.	Quicker.	Quicker.	
Admission	Charging freshly		
Stocking	Yes	Strongly stocking.	

Besides the service states *a*—*d* mentioned in the preceding two tables it is possible to measure also other service states, for instance the moisture of the gas or the composition thereof. This

latter measurement may be effected by a continuous analysis of the gas, and the knowledge of the moisture of the gas could afford, for instance, another datum for the state of the slackening.

As far as automatic redress in the cases mentioned is possible corresponding control impulses may be given through the supply conduits 26, 27 and 28, and in other cases, but also in those mentioned, signal indications shall be given upon the signalling table 29 on which a transparent field concerned in the respective case is rendered prominent, for instance, by illumination, the diagnosis and the redressing contrivances being stated on that field.

A plurality of constructional forms of feeler devices designed for the purposes stated, as well as certain details pertaining thereto, are illustrated in the Figs. 2–8.

Referring to Fig. 2, this device is designed for ascertaining the admission and operates according to the pietro-electric principle. The projections 2 or 3 transmit over insulating cushions consisting, for instance, of rubber, and further by the intermediary of a pressure stamp 37 the pressure to which they are subjected upon a crystal 38 supported in the bracket 18 upon a further insulating layer 36'. The charge generated in the crystal in dependency of the pressure acts through the conduit 17 upon the central regulation device 18, but may also be read directly at the indication implement 35. The amplifying relays and indication devices known in connection with the piezo-electric measurement of pressure have been omitted in the drawing in that they do not form parts of the invention.

In Fig. 3 is shown a constructional form of a hydraulic weight feler in which a pressure stamp acts upon a diaphragm 40 subjecting a liquid space 41 to a hydraulic pressure corresponding to the admission weight bearing upon the projection 35; that pressure can be read at the implement 35 and can act upon the central regulation device 18 through the conduit 17. In order to screen the heat the space 41 is provided with an insulating lining 42.

The two weight feelers described in the preceding paragraphs present the advantage that they are able to operate without the projections being obliged to cover a way of any practically important length in the case of the amounts of fuel bearing upon them causing an alteration of the result of the measurement, as might be the case if, which is possible, springs are employed as active counter-forces.

The arrangement of several projections 2 and 3 in different heights and, in correspondence therewith, of several groups of weight feelers 16, or 15 respectively, renders it possible to give, after a strong relief of the upper feelers 15, only simple regulation or indication impulses in the sense of fresh charging, and only if also the lower feelers 16 are too strongly relieved another urgent remote signal or even to stop the motor in a positive manner prior to it being destroyed by flames breaking through.

In Fig. 4 is illustrated the arrangement of weight feelers 16 at a generator with downwardly progressing combustion, the arrangement being in this example such that the weight feelers indicate and transmit the total weight of the generator, including its charge, through the conduit 17. With this arrangement the ways admitted for ascertaining the result of the measurement cannot be permitted to be too long.

In Figs. 5 and 6 is shown how the blower 12 (Fig. 1) inserted into the branch pipe 11 can be on the one hand manually operated and on the other hand be operated in dependency of the regulator. The manually operable readjusting device 31 is equipped with a lever 43, as well as with a sector-shaped disk 44 rigidly connected with said lever and being turnably supported in front of a disk 45. A rope 32 fastened at one end to the sector-shaped disk 44 passes over rolls 46 and 46' to a lever 47 firmly connected with the throttle flap 13 and subjected to the action of a tensile spring 48 tending to hold the throttle flap in closed state. When the disk 44 is in the position shown in full lines in Fig. 5 the throttle flap is closed, but when it is turned into the position shown in dotted lines, said flap is open. The movement of the disk 44 is transmitted to the throttle flap by the intermediary of the rope 32 and the lever 47. There is on the disk 45 an abutment pin 49 for the arm 43 of the disk 44. When the disk 44 has so much been turned that said arm contacts with the pin 49 the throttle flap is nearly completely closed, there being, however, left a gap just sufficient for maintaining a natural draught by which the generator is kept in operation also if no gas is withdrawn from it by a gas consuming device.

There is on the disk 45 also an abutment or rest pin 50 likewise operating with the arm 43 of the disk 44 and engaging a cavity of this arm. When the arm 43 is in the position shown in full lines in Fig. 5 the throttle flap is subjected solely to the action of the spring 48 by which it is kept completely closed, but is can be opened by means of the flap 33 by the intermediary of the rope 34 counter to the pull of said spring. This takes place when, after the blower 12 has been automatically started (as is effected by the regulating device 25 in the case of the load being below normal) a current of gas worth mentioning arises in the conduit 11. The throttle flap closes, however, automatically as soon as the blower has been stopped.

There is, furthermore, on the disk 45 a rest pin 51, likewise engaging said cavity. When the arm 43 of the disk 44 is in this position (shown in dotted lines in Fig. 5, which is the firing-up position) the throttle flap 13 has been completely opened by the intermediary of the rope 32, and simultaneously therewith a sliding contact 52 (Fig. 6) contacts with a stationary contact 53 provided in the disk 45. When these members are in this position the blower is thereby manually started. When a firing-up time of sufficient length has elapsed the arm 43 is again moved into the position determined by the pin 50.

The arrangement of the members concerned may also be such that an automatic operation can take place. That takes place in this manner that the temperature feeler 19 sends into the conducting wire 28 an impulse by which on the one hand the blower 12 is switched off and on the other hand the rest pin 51 is withdrawn from the cavity of the arm 43, for instance, by means of a magnet, so that this arm or the segment-shaped disk 44 respectively, returns under the action of the spring 48 into the position determined by the pin 50. In this position the throttle flap is open and automatic regulation can take place.

In Figs. 7 and 8 is shown by way of example a constructional form of the intermediate transmitter 25 forming part of the central regulation device. In this example is assumed that three different impulses can be transmitted by the intermediary of three telescopically arranged

shafts 54, 56 and 58. The shaft 54 is connected with a contact disk 96 operated, for instance, by means of a device 21 actuated by a pressure impulse; the shaft 56 is connected with a disk 57 actuated by the flow measuring device 23, and the shaft 58 is connected with a contact disk 59 actuated by the temperature feeler 19. Contacts 60 provided upon the disk 55 and contacts 61 provided upon the disk 59 contact in certain distinct positions with the contact bridge 62 so that the conducting wire 30 connected up to the signal table 28 can cause the production of the proper corresponding indications on the signal table 29, calling, for instance, if the pressure is low and the temperature is high the attention of the attendant to the possibility of burning through.

Other contact springs 65 provided on the disk 57, and contact springs 64 provided upon the disk 59 can transmit impulses across the stationary contact bridge 85 to the conducting wire 27 as soon as they have arrived in such positions as correspond to the state at the time being. If, for instance, the temperature is correspondingly high and the amount of gas streaming through the delivery pipe is large there may be transmitted to the nozzle 14 an impulse by which it is enabled to counteract, in the case of the load having risen to overload, the arising of a supertemperature while increasing the supply of the steam and decreasing the supply of the air.

In the same manner as above described concerning the co-operation of two operating agents also three or even still more thereof may be combined with one another for instance by making the contacts establishing the connections movable and placing them upon a disk controlled by one of the operating agents concerned.

The regulator and the central regulation device can be designed not only for electric regulators, but also for mechanical or hydraulic ones designed according to principles known in connection with art of designing such regulators.

I wish it to be understood that the present invention is not restricted to any definite kind of fuel, and it can be utilised in connection with generators with downwardly, as well as with upwardly progressive combustion.

EUGEN LELL.