PUBLISHED

MAY 25, 1943.

BY A. P. C.

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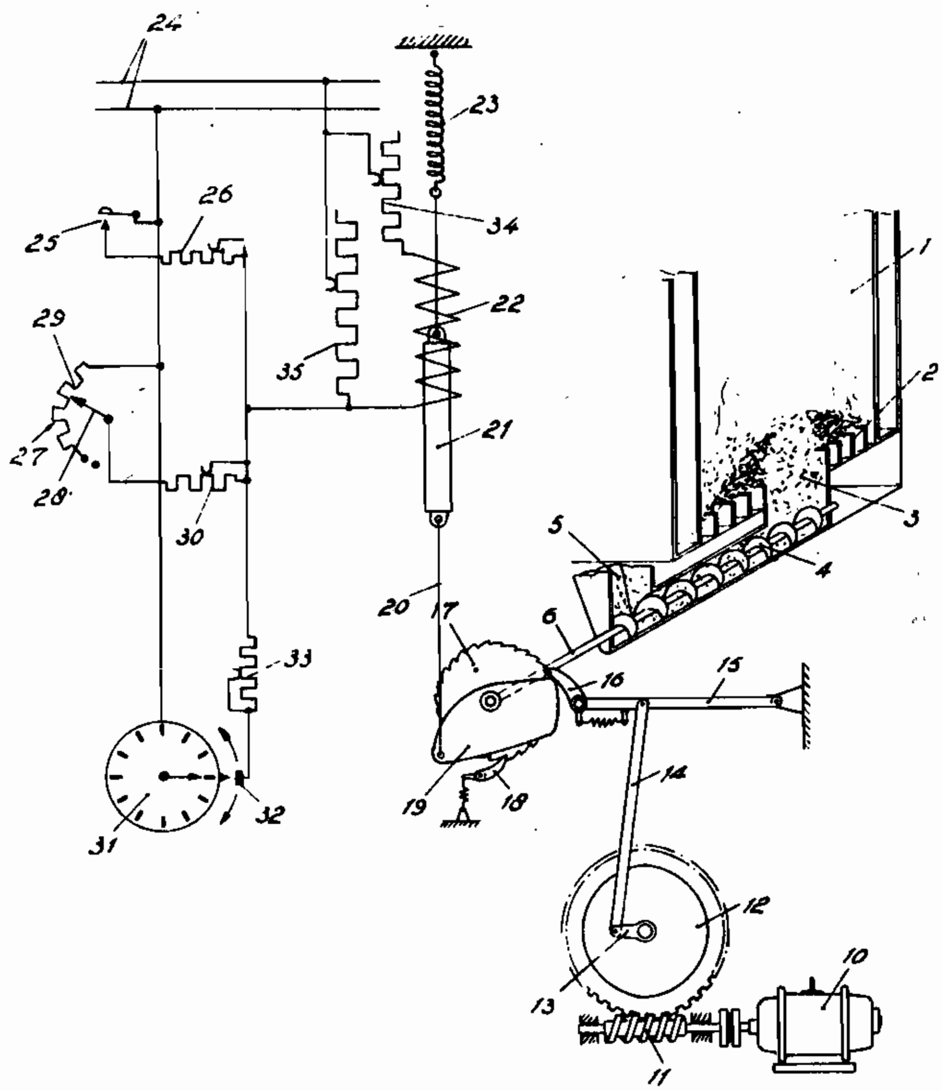
Filed Dec. 6, 1941

Serial No. 421,940



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Serial No. 421,940

ALIEN PROPERTY CUSTODIAN

HEAT PRODUCING AND CONSUMING SYSTEMS

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Application filed December 6, 1941

The invention relates to a heat producing and consuming system comprising a heat producer, a plurality of heat consumers having a non-uniform heat consumption and means for controlling the heat production per unit of time.

It is an object of the invention to improve particularly the means for the control of the heat production which ought to be dependent on the heat consumption.

It is a further object of the invention to enable a heat producing and consuming system to be controlled efficiently, the heat production always being exactly in accordance with the heat consumption, no loss nor shortage of heat occurring when the heat consumption changes.

The invention aims at placing at the disposition of every single heat consumer a certain fraction of the total heat producing capacity, said fraction being exactly determined in its extent in accordance with the highest demand for heat by the consumer in question.

Another object of the invention is to control the system by regulating the capacity of the fire, preferably beforehand, so as to have the change of said capacity already started when a change in heat consumption is expected in future, and the change in heat production will be completed when the change in heat consumption really occurs.

Usual control systems of the kind referred to as a rule operated in dependency on one main factor, such as a steam or water temperature, a steam pressure, a room temperature, an outer temperature, the rate of cooling down of a building etc. There were provided sometimes more than one observation or controlling member it is true (e. g. in the case of a heating system for a building, an outer thermostat recording the cooling action of the outer air and in addition thereto a room thermostat recording a temperature), but also in this event one is acting in dependence on the other, e. g. in such a manner that the room thermostat is arranged to exert influence on the artificial heating and thus on the times of working of the outer thermostat, so that actually the outer thermostat only effects the controlling action.

Furthermore it was known to have the capacity of a heating device increased or decreased by means of adjusting or setting by hand when an increase or decrease in heat consumption was expected. This is found e. g. in the case of steam heated cooking vessels when a cooking vessel is put into or out of action. Also in plants where the output of energy usually changes at a certain time (such as in electrical works) it is usual to have the capacity of the fire already changed at an earlier moment. In this case there is a certain range of control between a lowest and a highest value of the fire capacity which is used arbitrarily by increasing or decreasing the existing capacity on behalf of all consumers together. Control becomes however very inexact in this way.

Furthermore it is necessary to also take into consideration other consumers belonging to the same heat production system, such as a water heating system, a kitchen etc., which may also show changes in heat consumption.

The invention aims at a control of the fire capacity which is automatically exact as to quantity, particularly in the case of more than one consumer. This is obtained in that control is effected in dependence on controlling impulses from or on behalf of each of the consumers, each of such impulses operating within a control range corresponding with a predetermined fraction of the possible change in fire capacity between a minimum and a maximum value, the said fraction corresponding with the consumption available for and admitted to the consumer in question, whereas all impulse influences are superimposed, i. e. are added to one another.

As a rule controlling systems are only sensitive to the consequences of a change in, or the appearance or disappearance of external, i. e. outer factors indicating a future change in heat consumption (e. g. a change in the outer temperature, reaching a certain time when cooking shall begin etc.). This means that control only takes place when the balance between heat production and consumption as existing or as aimed at as yet, does not already exist (repressive control). The thermostat at the steam or water temperature records the decrease in temperature in a steam cooking or hot water plant, after heating of a further cooking vessel or the delivery of hot bathing water has already started, which of course is too late. In the same way a room thermostat records too late that the outer temperature has fallen or that the velocity of the wind has increased. As long as the heating system due to the exerted controlling impulse, has not reached the higher temperature level which is necessary for the increased delivery of heat, the temperature of the heated room is too low.

Therefore according to the invention control is effected direct, that means, factors which have influence on the fire capacity in first instance are controlled, such as the rate of flow of the supply of fuel or combustion air, the surface of the grid and the like. Furthermore control is exerted preventively so as to have the change in the heat production in accordance with heat consumption, completed at the time the latter change occurs. If e. g. in the case of central heating the outer temperature decreases, the invention aims at such a control, that if the decreasing outer temperature will exert its influence in half an hour, the capacity of the fire has to be decreased during this time to the desired extent, and that exactly.

Apart from the control according to the invention other control systems (momentary controls) may be maintained. The room thermostat may e. g. continue to vary the (newly set) surface temperature of the heating radiators, or in the case of intermittently operating systems (oil burners) the said thermostat may continue to control switching in and switching off the heat production. Such control is then "secondary".

The annexed drawings illustrate a single embodiment of the invention and that very diagrammatically.

This embodiment concerns the control of a heating system comprising a so-called underfeed-furnace consuming solid fuel.

The boiler 1 is only shown in part and that in cross section. The figure shows the grid 2 and the centrally arranged fuel supply aperture 3 through which from below coal is forced through the grid 2 into the burning fuel layer. The coal supply is effected by a conveying screw 4 fed from a hopper 5. This hopper may actually constitute the bunker space or in turn may be connected to a conveying system feeding the fuel from a distant coal supply.

The conveying screw 4 is operated by a shaft 6 which generally is arranged to be driven at a very low, but for all that regulable speed. The principle of a driving system of this kind is shown in the drawing.

The driving motor 10 operates a worm screw 11 engaging a worm wheel 12. A crank or eccentric 13 on the shaft of the worm wheel 12 drives, through the medium of a connecting rod 14, a swing arm 15 having at one end a pawl 16 secured thereto. This pawl is arranged to cooperate with a ratchet wheel 17 secured to the shaft 6. A second pawl 18 prevents the ratchet wheel 17 to rotate in opposite direction.

Preferably two pawls 16 will be provided, so that such pawls operate alternately so as to impart to the shaft 6 a more continuous movement. In addition the axis of the crank or eccentric 13 may be arranged co-axially with the ratchet wheel 17 and the shaft 16 to render the construction more compact. In general the driving means will moreover be arranged at some distance from the shaft 6, in other words, the ratchet wheel 17 will be connected to the shaft 6 by a chain or the like transmitting means.

The speed control of the shaft 6 is obtained by varying the throw of the pawl 16 at each operation as is usual in devices of this kind. The drawing shows for this purpose a kind of screen 19 rotatably mounted on the axis of the ratchet wheel 17 and operating to prevent the pawl 16 from entering into engagement with the ratchet teeth during a predetermined, variable stretch of its throw. In this manner the number of ratchet tooth-pitches, through which the ratchet wheel 17 is rotated at each throw of the pawl 16 and therefore at each revolution of the worm wheel 12, is determined.

The above regulating system, now serves to adjust the said screen 19, this being effected through the medium of a rod 20 operated by a servo-motor. The latter is diagrammatically represented in the drawing by an electromagnet comprising a core 21 and a coil 22. The core 21 is suspended from a spring 23. Dependent on the current intensity in the coil 22, the core 21 is more or less raised causing thereby the screen 19 to be adjusted proportionally, for regulating the coal supply to the boiler correspondingly. The current is supplied to the coil 22 from the mains 24. Each heat consumer is arranged to close the circuit through the coil and that in a certain manner over a resistance, so that each heat consumer effects a predetermined current intensity in the coil 22, such current intensities in the case of simultaneous operation of a plurality of heat consumers being superimposed, so that the variations of the fire capacity exactly and proportionally correspond with the variations occurring in the heat consumption.

As an example of heat consumers may e. g. be mentioned:

1. A heat consumer adapted to be put into operation by the operator at any moment with a predetermined fixed capacity, e. g. a cooking boiler,

2. The heating of a building under the control of an outside thermostat,

3. A heat consumer, which permits of an augmentation or reduction of the heat production capacity with a certain amount and at a predetermined moment under the control of a clockwork.

For the first consumer there is provided a simple switch 25 for instance a push button switch. The current, at the closing of the circuit, is supplied to the coil 22 through a variable resistance 26, so that a certain current intensity is set up in the coil 22. If, for instance, a cooking boiler is to be switched on, the cook presses the button 25. The core 21 is pulled up so far, that the capacity of the fire in the boiler 1 is increased to such an extent, that the heat consumption of the cooking boiler is just met.

The heating of the building (second example) is controlled by an outside thermostat 27 responsive to the cooling down of the building. The control is effected by an arm 28 connected in a second circuit and cooperating therein with a resistance 29. As the outer temperature rises, the arm 26 swings anti-clockwise, causing the resistance in said second circuit to be augmented. This causes the current intensity to be decreased resulting in a proportional lowering of the core 21 and a corresponding proportional reduction of the capacity of the fire. It will be understood that in this second circuit there is also provided a fixed but adjustable resistance 30 on behalf of the adjustment of the regulating system.

The third circuit with which current may be supplied to the coil 22 contains a clock switch 31. Assuming the contact 32 of such clock switch, which is adjustable through 360°, to be set for three o'clock, as shown in the drawing. At that time a current of predetermined intensity will be supplied to the coil 22 through said third circuit via the clock-hand and the contact 32 causing the core 21 to be raised a certain amount, the capacity of the fire increasing proportionally. 33 again indicates an adjustable but for the rest fixed resistance.

From the above it will be understood that each heat consumer switches on or off, resp. controls its own portion of the entire fire capacity and that several capacity portions are superimposed automatically.

It will, of course, be preferable to still add to the coil **22** itself, an adjusting resistance, for regulating the range of throw of the core **21**. In addition thereto and in parallel with the coil **22** there is provided a variable resistance **35** which is operated when the rate of control of the fire capacity by the regulating system has to be altered as for instance when the quality of the fuel changes.

The various regulating circuits may further contain retarding elements. When, for instance, the outside thermostat **27** observes the necessity of an increase of fire capacity, such increase may not be necessary until after, say, half an hour, as the influence of the fall in the outer temperature will only then be noticeable. Such retardation may, for instance, be obtained by means of a clock switch.

In practice a more complicated electric system will be used than that shown in the drawing. For instance, for the outside thermostat a potentiometer circuit may be used for transmitting the indication. Moreover relays will be inserted enabling the weak control impulses to be converted into strong control impulses. The eventual adjustment of the screen **19** will have to be effected by an actual motor which in turn is controlled by a position adjusting cylinder with a time switch by which, dependent on the control impulses received, the cylinder is rotated at every time through a certain number of steps in one direction or the other. The electric solutions of this problem, however, lie without the scope of the present invention.

In addition to the primary and preventively operating regulating system as shown, secondary regulating devices may be maintained. The CO_2 content of the flue gases, for instance, may continue to control the flue damper. In addition thereto, however, the steam pressure, a room temperature, a water temperature etc. may continue to exert their influence on the capacity of the fire.

The servo-motor systems and their control may also be pneumatically, hydraulically or mechanically operated instead of electrically.

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