April 9, 1940. E. E. POTTER ET AL 2,196,802

ELECTRICAL CONTROL APPARATUS FOR STOKERS AND THE LIKE

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FIG. 1

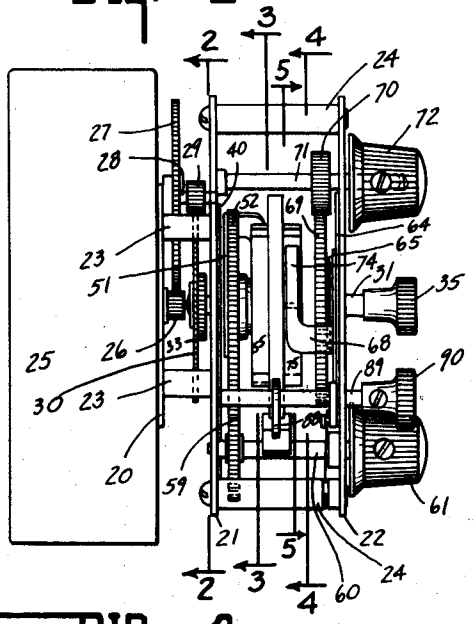


FIG. 2

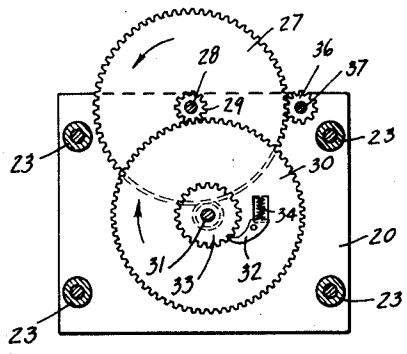


FIG. 3

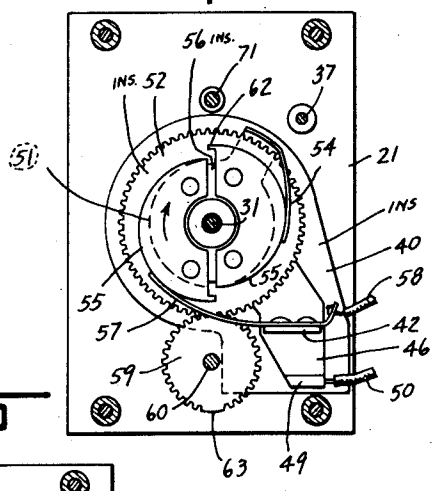


FIG. 4

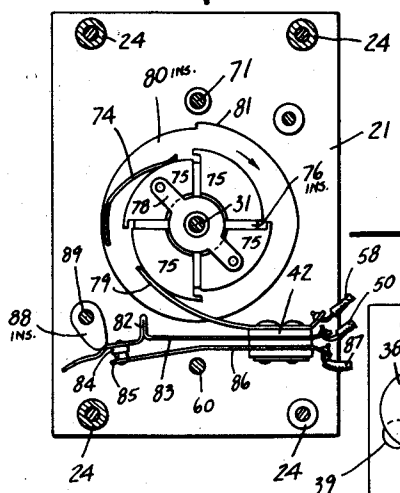
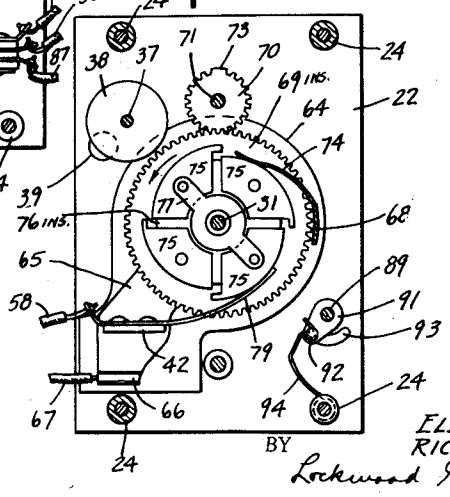


FIG. 5



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FIG. 6

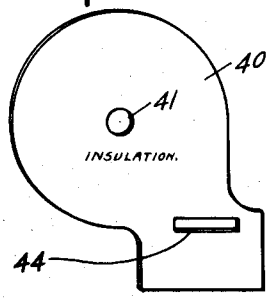


FIG. 7

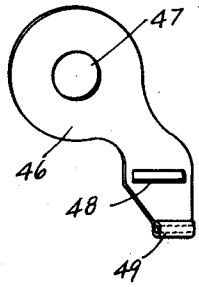


FIG. 8

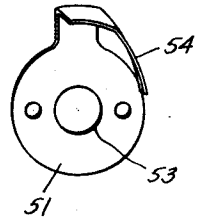


FIG. 9

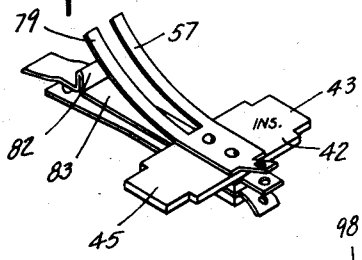


FIG. 10

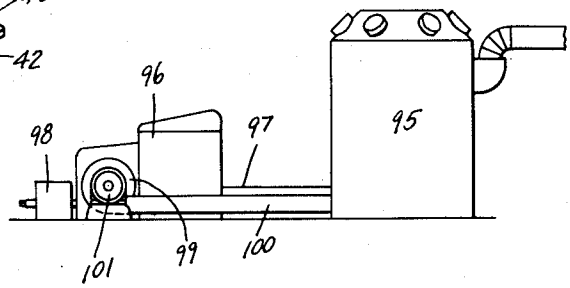
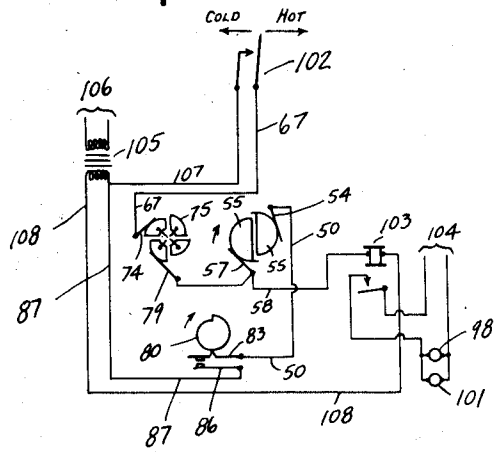


FIG. 11



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ELECTRICAL CONTROL APPARATUS FOR STOKERS AND THE LIKE

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Application April 18, 1938, Serial No. 202,664

1 Claim. (Cl. 236—46)

This invention relates to an electrical control apparatus for stokers and the like.

One object of the invention is to provide apparatus by means of which the duration and frequency of fuel feeding periods may be simply and easily controlled.

This and other objects are accomplished by the combinations of elements described in the following specification and claim and illustrated in the accompanying drawings.

Fig. 1 is a side elevational view of a time controlled switching unit which forms an important part of the invention. Figs. 2, 3, 4 and 5 are elevational views in section taken on the correspondingly indicated lines of Fig. 1. Figs. 6, 7, 8 and 9 are perspective views of individual parts of the switch unit shown in Fig. 1. Fig. 10 is a partially diagrammatical view of a stoker installation to which the invention may be applied. Fig. 11 is a diagram of wiring connections by means of which the invention may be applied.

The principal switching unit for use with the invention is shown in Fig. 1. The framework thereof consists of three plates 20, 21 and 22 secured together by spacers 23 and 24 and suitable screw fastenings. To the plate 20, there is attached a casing 25 enclosing a clock mechanism of any desired type, the details of which are not pertinent to the present invention. Said clock is preferably electrically operated but may be of the spring type if desired. A pinion 26 is driven at a uniform speed by the clock and meshes with a gear 27 mounted upon a shaft 28 journaled in the plates 20 and 21. The shaft 28 carries a pinion 29 meshing with a gear 30 freely mounted on a central shaft 31 which is journaled in the plates 21 and 22. Said gear carries a pawl 32 normally retained in engagement with a gear 33 by means of a spring 34. The gear 33 is secured to the shaft 31. The gears 27 and 30 are driven by the clock in the direction of the arrows in Fig. 2 and thus permit the clock to rotate the shaft 31 through the pawl 32. Said shaft may be turned by hand however in the same direction by means of a knob 35 since the pawl 32 will then slip past the teeth of gear 33.

A pinion 36 meshes with the gear 27 and is mounted on a shaft 37 journaled on the plates 20 and 22. Said shaft carries a disc 38 visible through an opening 39 in the plate 22. Said disc indicates by its movement that the clock mechanism is in operation.

On the inner surface of the plate 21 there is placed an insulation member 40, (Figs. 3 and 6). Said member is held in a stationary position by shaft 31 which passes through a central opening 41 therein and by a block 42 of insulation material which has a tenon 43 (Fig. 9) engaging an opening 44 in the member 40 and engaging a suitable mortise in the plate 21. The opposite end of the block 42 has a similar tenon 45 engaging a mortise in the plate 22 and is thus held securely in position.

Engaging the inner surface of the insulation member 40 there is an electrical contact member 46 (Figs. 3 and 7), which has a central opening 47 surrounding the shaft 31 and sufficiently large to prevent electrical contact therewith. Said member is secured in position by the tenon 43 passing through a mortise 48 therein and is provided with a terminal 49 for the connection of a conductor 50.

A contact member 51 (Fig. 8) engages the contact member 46 and is secured to the surface of a gear 52 formed of insulating material and freely mounted on the shaft 31. Said contact member has a central opening 53 sufficiently large to prevent electrical contact with the shaft 31 and is provided with a finger 54 extending around the edge of the gear 52 and adapted to engage the surface of a pair of segmental contact members 55. The contact members 55 are mounted upon an insulating member 56 secured to the shaft 31 and rotatable thereby in the direction of the arrow in Fig. 3. A finger 57 likewise engages the contact segments 55 and is mounted upon the insulation block 42 and is provided with a suitable terminal for the connection of a conductor 58. A gear 59 meshes with the gear 52 and is mounted on a shaft 60 journaled on plates 21 and 22. A knob 61 is carried by the shaft 60 and is manually movable to rotate the gear 52 and thus change the position of the finger 54 with relation to the contact segments 55.

It will be noted that the segments 55 are eccentrically mounted and each has a lip 62 extending substantially to the edge of the other, but out of electrical contact therewith. The fingers 54 and 57 are formed of resilient material and are sufficiently flexed to move quickly from the lip of one segment to the other segment when said lip passes the ends of the fingers. In the position of the parts shown in Fig. 3, the finger 57 engages one of the contact segments 55 and the finger 54 engages the other. In this position, no electrical connection is established between said fingers and between the conductors 50 and 58 connected thereto. When shaft 31 has been rotated sufficiently for finger 57 to shift to the same contact segment as finger 54, an electrical con-

nection is established between conductors 50 and 58. This connection endures until shaft 31 is rotated sufficiently for finger 54 to move from one segment to the other. Since there are two of the segments 55, the connection is established twice during each revolution of shaft 31.

The fingers 54 and 57 and the segments 55 constitute an electric switch which is periodically operated by rotation of the shaft 31 with a frequency of twice the frequency of rotation of the shaft. The duration of the periods during which the switch is closed may be varied by changing the position of finger 54 by means of the knob 61. The gear 59 is provided with a blank portion 63 which limits the movement thereof and limits the range of adjustment of said finger. Because of the eccentricity of the contact segments and the provision of the lips 62, the movement of the fingers from one segment to the other is accomplished by a snap action which reduces arcing to a minimum and permits extremely accurate timing.

Resting against the inner surface of the plate 22 there is an insulation member 64 similar in shape to the member 40 (Fig. 6) and held in position by the shaft 31 and the tenon 45 on the insulation block 42. Engaging the insulation member 64 there is a contact member 65 similar in shape to the contact member 46 (Fig. 7) and having a terminal portion 66 to which a conductor 67 may be connected. A contact member 68 similar in form to the contact member 51 (Fig. 8) engages the contact member 65 and is secured to the face of a gear 69 formed of insulating material and freely mounted on the shaft 31. The gear 69 may be rotated by means of a gear 70 meshing therewith and mounted on a shaft 71. Said shaft is provided with a knob 72 for manual adjustment and the gear 70 is provided with a blank portion 73 which limits the range of said adjustment. The contact member 68 is provided with a spring finger 74 adapted to engage a plurality of eccentrically mounted contact segments 75. Said segments are carried by an insulation member 76 secured to the shaft 31 and are rotatable thereby in the direction of the arrows in Figs. 4 and 5. In said figures, the contact segments 75 are shown as four in number, opposite segments being connected electrically by conducting members 77 and 78 on opposite sides thereof. Thus, each opposing pair of segments may be considered as constituting a single contact member. A spring finger 79 formed integrally with the finger 57 also engages the segments 75.

By means of this construction an electrical connection is completed between the fingers 74 and 79 and between the conductors 67 and 58 connected thereto when the fingers 74 and 79 engage opposite segments 75. Said connection is broken when said fingers engage adjacent segments as shown in Figs. 4 and 5. The connection is normally completed each time finger 79 slips from one contact segment to the next and is broken when finger 74 does likewise. Said fingers and contact segments, therefore, comprise an electric switch periodically operated by rotation of the shaft 31 with a frequency four times the frequency of rotation of said shaft. The duration of the periods during which the switch is closed may be varied by varying the postion of the finger 74 by means of the knob 72. The positions of the contact segments 55 and 75 with relation to each other are such that the closed periods of the 54—55—57 switch begin substantially simultaneously with certain of the closed periods of the 74—75—79 switch.

Secured to the shaft 31 there is a cam 80 having a portion 81 of greater radius than the remainder thereof. Said cam is adapted to engage a humped portion 82 of a contact leaf 83 which is secured to the underside of the insulation block 42 and provided with a terminal to which the conductor 50 is connected. The contact leaf 83 carries a contact point 84 adapted to engage a similar point 85 carried by a contact leaf 86 which is secured beneath the leaf 83 and suitably insulated therefrom. Said leaf is provided with a terminal to which a conductor 87 may be attached. A finger 88 of insulating material is mounted on a shaft 89 journaled on the plates 21 and 22 and provided with a knob 90. Said finger, in the position shown in Fig. 4, engages the leaf 83 and maintains the points 84 and 85 in contact. The shaft 89 also carries an arm 91 having a pin 92 operating in an arcuate slot 93 in the plate 22. An overcenter spring 94 engages said pin and is secured to one of the spacers 24 and serves to maintain said pin in whichever end of the opening 93 it may be set. When said pin is moved by the knob 90 to the opposite end of the opening 93, the finger 88 is moved to the left in Fig. 4 and permits separation of the points 84 and 85. With the parts in that position, the cam 81 may engage the humped portion of the leaf 83 to press said points together. The cam is so shaped that this occurs once in each revolution of the shaft 31 and occurs during the time that the fingers 54 and 57 are both in engagement with one of the contact segments 55. However, when said fingers engage the other of said contact segments, the cam 81 will be out of engagement with the leaf 83 and the points 84 and 85 will be separated. The leaves 83 and 86 and their associated contact points thus constitute an electric switch which may be periodically operated by the rotation of the shaft 31 with a frequency equal to the frequency of rotation of said shaft. The closed period of said switch coincides at least in part with one of the closed periods of the switch 54—55—57. By manual operation of the knob 90, however, the switch 83—86 may be set in the closed position irrespective of the position of shaft 31.

In Fig. 10 there is shown a furnace 95, a fuel hopper 96, a fuel conduit 97 and a motor 98, included in a common form of stoker installation in which fuel is fed from the hopper 96 through conduit 97 to the retort of the furnace 95 by means of a screw or other conveying means whenever motor 98 is operated. There is also shown a blower 99 adapted to supply air for combustion to the furnace through a conduit 100. Said blower is driven by a motor 101. A preferred form of wiring for the control of the motors 98 and 101 is shown in Fig. 11 in which there is included the high frequency switch 74—75—79, the intermediate frequency switch 54—55—57 and the low frequency switch 83—86 previously described as a part of the switching unit of Fig. 1. There is also included in Fig. 11 a thermostatic switch 102 adapted to close its circuit when the temperature affecting the associated thermostat is below a predetermined degree and to open its circuit when said temperature is above said degree. Said switch may be of any suitable commercial type. A motor operating relay 103 when energized supplies power from a pair of power mains 104 to operate the motors 98 and 101. A transformer 105 which may be connected to any

suitable source of alternating current such as mains 106 supplies current at a suitable low voltage for the operation of the control circuits for the relay 103. The first of said control circuits includes a conductor 107 connected to the transformer secondary, the thermostatic switch 102, conductor 67, the high frequency switch 74—75—79, conductor 58, relay 103 and a conductor 108 connected to the opposite terminal of the transformer secondary. The second control circuit includes conductor 87 connected to the transformer secondary, the low frequency switch 83—87, conductor 59, the intermediate frequency switch 54—55—57, conductor 58, relay 103 and conductor 108.

In the operation of the invention the thermostatic switch is operated in the usual manner in response to the temperature of one of the rooms to be heated. When said temperature indicates a need for heat, said switch is closed and the first control circuit is periodically completed by the operation of the high frequency switch 74—75—79. The completion of the circuit energizes relay 103 which in turn completes the circuits to motors 98 and 101 to supply fuel and draft to the furnace. The frequency of the fuel and draft periods then depends upon the frequency of operation of the high frequency switch and the duration thereof depends upon the adjustment of finger 74.

When the thermostatic switch shows no need for heat, the second control circuit is completed periodically to operate relay 103 and motors 98 and 101 with sufficient frequency to maintain a fire in the furnace. The required frequency and duration of such operations depends upon the nature of the fuel, the design of the furnace and the ratio of the rates of supply of fuel and air. For that reason the apparatus provides a choice of two frequencies together with a single adjustment which controls the duration at either frequency. When the lower frequency is required, the knob 90 is operated to move arm 88 to the left in Fig. 4, leaving the low frequency switch 83—86 free for time controlled operation by the cam 81. Since said switch is then closed only during alternate closure periods of the intermediate frequency switch 54—55—57, the second control circuit is completed only once per revolution of shaft 31. The duration of the closure period of the low frequency switch is preferably greater than the greatest duration of the closed period of the intermediate frequency switch. Therefore, the duration of each feeding period depends only upon the adjustment of the intermediate frequency switch by its knob 61.

When the higher frequency of the two is required for the hold fire operation, knob 90 is set to move arm 88 to the position shown in Fig. 4, thus closing the low frequency switch 83—86 and rendering the same ineffective to control the frequency of fuel feed. The feeding periods then occur at the intermediate frequency and the duration of said periods again depends only on the setting of the knob 61.

Preferably the switching unit of Fig. 1 is enclosed in a suitable casing (not shown) from which the shafts carrying knobs 35, 61, 72 and 90 protrude. Suitable index marks on the knobs and calibration marks on the casing may be provided to indicate the settings of the several adjustments.

From the foregoing specification it will be apparent that the invention provides means whereby the duration of fuel feeding periods may be accurately controlled within wide limits by simple and convenient manipulation. Likewise, there is provided a readily operable means for choosing the frequency of the hold fire operations with a single means of controlling the duration thereof independent of the frequency.

The details of the invention may be varied within wide limits by those skilled in the art without departing from the scope thereof as defined by the appended claim.

The invention claimed is:

Electrical control apparatus for a stoker having a motor driven fuel feeding mechanism including three time controlled switches having high, intermediate and low frequencies of operation with respect to each other, a thermostatic switch, electric circuits associated with the high frequency switch and the thermostatic switch and operating said motor when said thermostatic switch indicates a need for heat to feed fuel during predetermined periods occurring with the frequency of operation of said high frequency switch, electric circuits associated with the intermediate and low frequency switches and independent of the thermostatic switch and normally operating said motor to feed fuel during hold fire periods the duration of which is controlled by the intermediate frequency switch and the frequency of which is controlled by the low frequency switch, manually operated means for adjusting the intermediate frequency switch to vary said duration and manually operated means for rendering said low frequency switch ineffective to control said circuit whereby the frequency of said periods is controlled by the intermediate frequency switch.

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