Oct. 25, 1966 P. J. ECKELBERRY ETAL 3,280,884

BURNER CONTROL APPARATUS

Filed Feb. 3, 1966 2 Sheets-Sheet 1

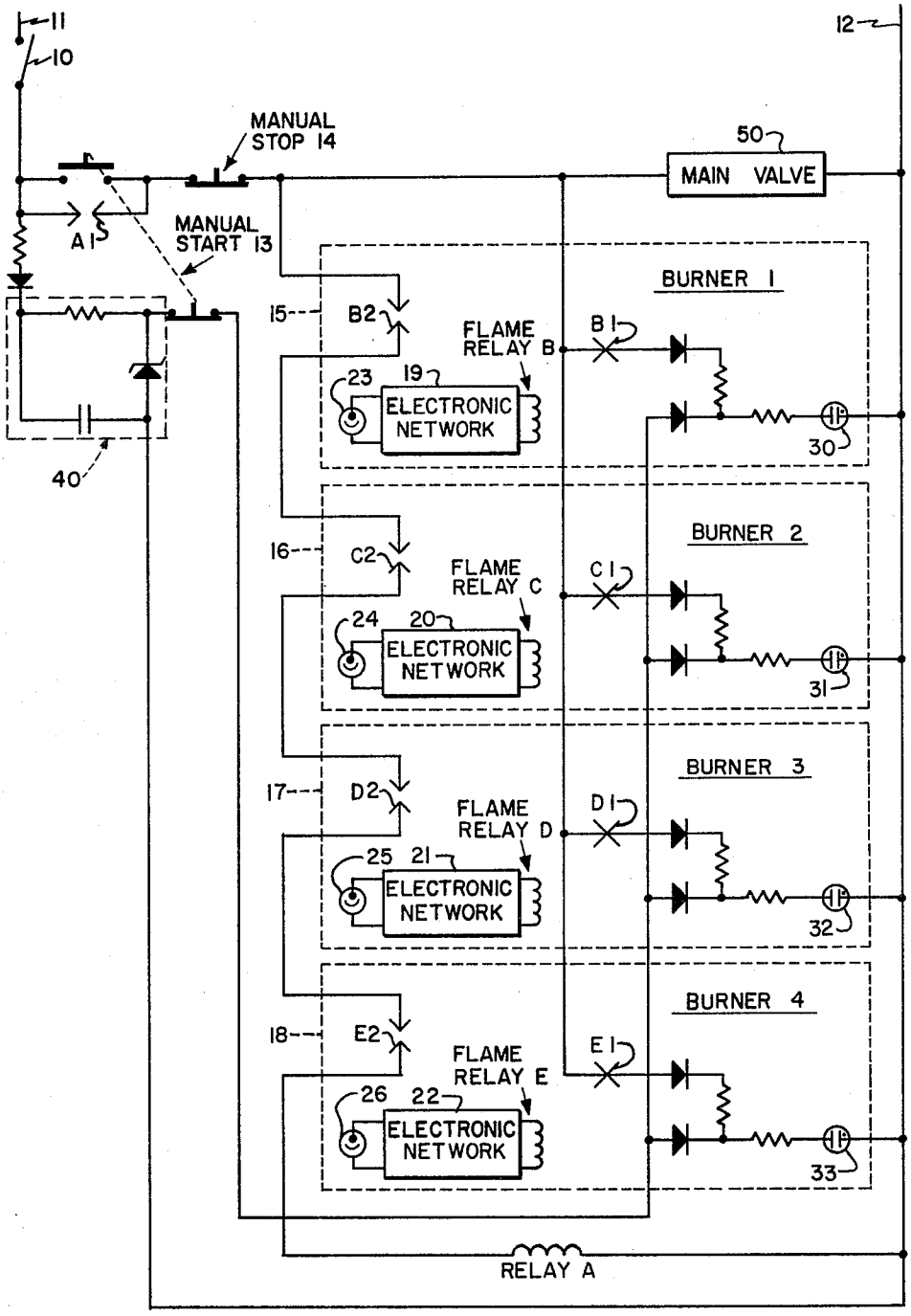


FIG. 1

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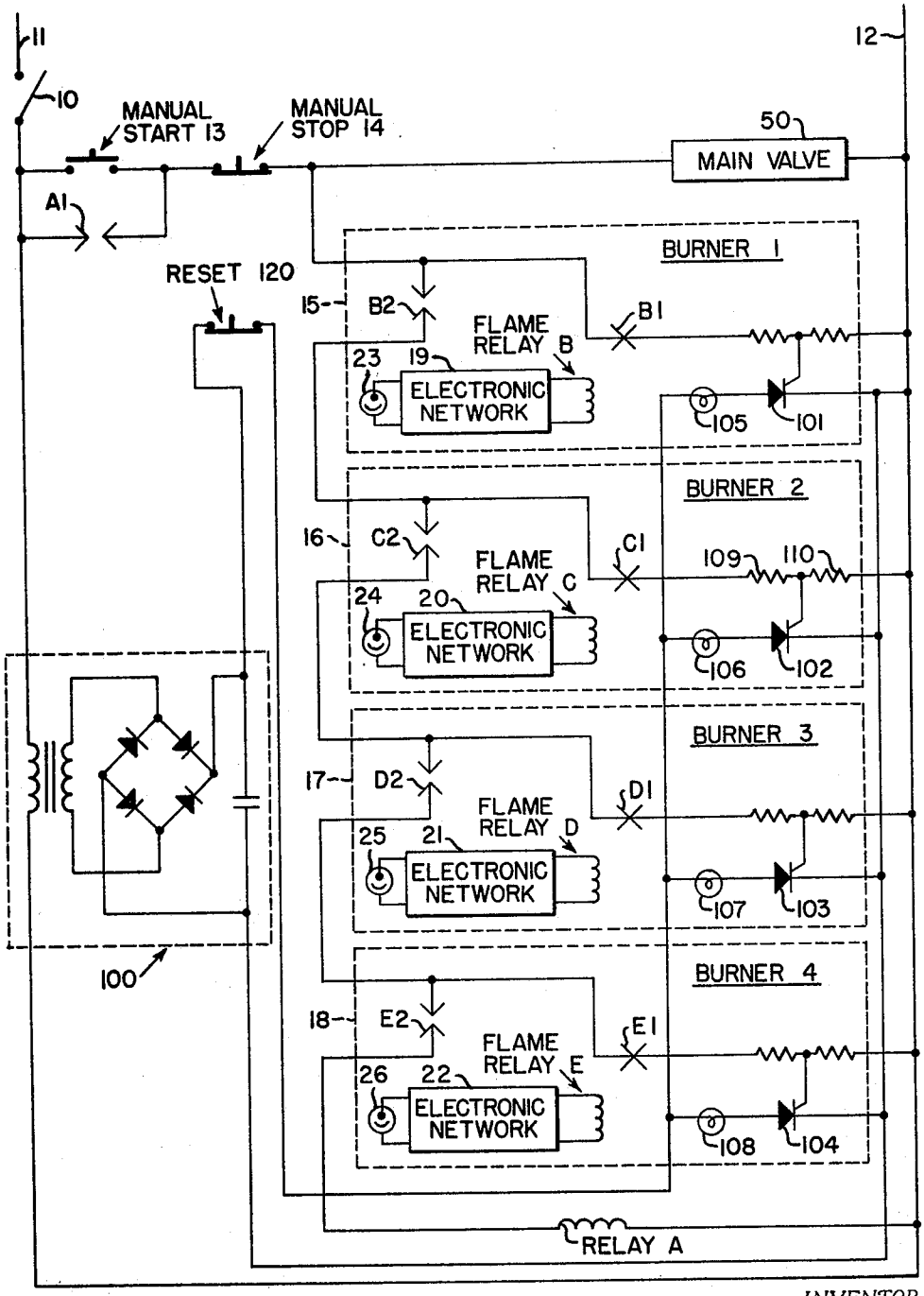


FIG. 2

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BURNER CONTROL APPARATUS

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10 Claims. (Cl. 158—28)

This application is a continuation-in-part of our co-pending application Serial No. 485,274, filed September 7, 1965, now abandoned.

Our invention is concerned with an improved multiple burner control apparatus which incorporates a plurality of failure indicating means to indicate which individual fuel burner of the multiple fuel burner installation has the burner to experience a flame failure and cause a shut-down of the remaining burners.

We are aware of prior art of this general nature, for example, the Lester N. Bolmgren Patent 3,150,709, assigned to the assignee of the present invention. Our invention is concerned with a specific arrangement which makes use of existing structure to energize the flame failure indicating means of our invention and does not require additional switch contacts or the like.

Specifically, a multiple burner system includes means whereby a manual start switch controller is moved to a closed position to facilitate the establishment of flame at all of the individual burners. Each of the individual burners is provided with its own flame detecting means which changes from a "no-flame" condition to a "flame" condition upon the establishment of flame at its particular burner. When all of the flame detecting means are in the "flame" position a maintaining circuit is established such that the manual controller can be released. Thus far, we have described the basic operation of a torch-lighting multiple fuel burner installation, a unison pilot-lighting multiple fuel burner installation, and a sequential pilot-lighting multiple fuel burner installation.

The structure of our invention provides a plurality of flame failure indicating means having a starting voltage and a sustaining voltage, for example, neon bulbs which have a high igniting voltage a lower sustaining voltage, or silicon controlled rectifiers (SCRs) which have an igniting voltage, and when ignited are sustained from an anode-cathode sustaining voltage. The indicating means are connected to a source of sustaining voltage through a normally closed manual switch. Thus, with a flame present at all of the fuel burners, the flame failure indicating means has only a sustaining voltage applied thereto and is not energized. Each of the flame failure indicating means is also connected to a source of starting voltage through the above mentioned maintaining circuit such that a starting pulse of voltage is applied to that corresponding one of the flame failure indicating means which is associated with the fuel burner to first experience a flame failure. As the remaining flame detectors subsequently assume a "no-flame" condition, due to a game failure at one of them, a starting pulse of voltage is not applied to the remaining flame failure indicating means since at this time the maintaining circuit is open.

FIGURES 1 and 2 are schematic showings of two embodiments of our invention.

FIGURE 1

FIGURE 1 shows a torch-lighting installation. Referring to this figure, reference numeral **10** designates an

on-off switch, shown in the off condition, which is adapted to connect a schematic representation of a multiple fuel burner installation incorporating our invention to a pair of power line conductors **11** and **12**. Reference numerals **13** and **14** designate a manual start controller and a manual stop controller respectively. Controllers **13** and **14** are of the momentary contact type, whereas switch **10** is a maintained contact type. The manual start controller includes a normally open switch and a normally closed switch. The manual stop controller includes a normally closed switch.

Reference numerals **15**, **16**, **17** and **18** designate individual fuel burners identified as burners **1**, **2**, **3** and **4**. The individual fuel burners each include a flame detecting means (**19**, **20**, **21** and **22**) having an input in the form of a photoelectric cell (**23**, **24**, **25** and **26**) adapted to be subjected to flame at its burner and having an output in the form of flame relays (B, C, D and E).

The flame relays are shown in the "no-flame" or denergized condition. Each of the flame relays includes a normally closed switch and a normally open switch. These switches are identified by the letter representing the flame relay and by the number **1** to identify the normally closed switch and the number **2** to identify the normally open switch.

The normally open switches of the flame relays are connected in series to the winding of a relay A, relay A having a normally open switch A1 which is connected in parallel with the normally open switch of the manual start controller.

The normally closed switch of each of the flame relays is connected to the one of the flame failure indicating means (**30** ,**31**, **32** and **33**), which is associated with its individual fuel burner. The circuit established by the normally closed switch of the flame relay is such as to apply a starting or igniting voltage to its indicating means, these means **30–33** being shown as neon bulbs in the preferred form of our invention. With the apparatus shown in FIGURE 1 the normally open switch of the manual start actuator **13** and switch A1, the maintaining circuit means, are in the open position; therefore neon bulbs **30–33** are not ignited. Reference numeral **40** identifies a source of lower sustaining voltage for the neon bulbs **30–33**. This source of sustaining voltage is connected to each of the individual neon bulbs through the normally closed switch of start controller **13**, which controller is in its release position.

Considering the operation of our apparatus, if the on-off switch **10** is placed in the "on" condition, the sustaining voltage source **40** is immediately energized. A sustaining voltage is applied to neon bulbs **30–33**; however, these bulbs are not ignited by this voltage.

If manual start controller **13** is now actuated to the start position, sustaining voltage source **40** is removed from neon bulbs **30–33** and a main fuel valve **50** is energized through manual stop controller **14**. The apparatus as shown in FIGURE 1 is a torch-lighting multiple burner system and with the main valve open the individual fuel burners **1–4** are manually torch ignited. Upon a flame being established at each of the burners, flame relays B–E are energized and assume the "flame" position. Energization of all of these flame relays energizes relay A to close switch A1 and allow release of manual start controller **13**. At this time the normally closed switches of the flame relays are in an open "flame" condition.

If one of the burners subsequently experiences a flame

failure, that particular flame relay, for example flame relay C, assumes the "no-flame" position and its normally closed switch is closed to apply a start voltage pulse to its neon bulb, neon bulb **31**. Also, the normally open switch of this flame relay opens to de-energize relay A, opening switch A1 and de-energizing main valve **50**. Shortly thereafter flame is extinguished at the remaining fuel burners and the remaining flame relays assume the "no-flame" position. However, a start voltage pulse is not applied to the remaining neon bulbs by virtue of the face that both the normally open switch of manual start controller **13** and switch A1 are in an open condition. Therefore, the neon bulb associated with the first burner to experience a flame failure is maintained in an ignited condition by means of sustaining voltage source **40**.

As we have mentioned, our invention may be applied to unison pilot-lighting systems and to sequential pilot-lighting systems. If either of these systems is utilized with our invention the normally closed switches of the flame relays are likewise used to energize the ignition means of the pilot burner of each individual fuel burner. Furthermore, in a unison system the pilot valve of each individual fuel burner is connected in place of main valve **50**, the main valve now being controlled by a second normally open switch relay A. In a sequential pilot-lighting system, the main valve is again controlled by a second normally open switch of relay A, and the ignition means and pilot valve of each individual fuel burner is energized upon the flame relay of the prior fuel burner unit assuming the "flame" condition.

We have chosen to show only a torch-lighting system since it is the simplest showing of our invention.

FIGURE 2

In FIGURE 2 we disclose a modification of our invention wherein the flame failure indicating means comprises a silicon controlled rectifier (SCR) which has initiating voltage applied to the gate thereof and which has a sustaining voltage applied to the anode thereof. Reference numeral **100** identifies a source of sustaining voltage for SCRs **101**, **102**, **103** and **104**. Reference numerals **105**, **106**, **107** and **108** identify lamps or bulbs which are connected in circuit with the anode-cathode circuit of the SCRs. As with FIGURE 1, the manual start switch, in the actuated positions, opens a switch to disconnect the source of sustaining voltage **100** from the anode-cathode circuit of the SCRs, thus causing the conductive SCRs to become nonconductive.

Conduction of the SCRs, upon flame failure, is controlled, as with FIGURE 1, from a source of starting voltage and a plurality of circuit means, each circuit means including a separate one of the flame detecting means. The flame detecting means in the "no-flame" position causes switches B1, C1, D1 and E1 to be closed. When one of these switches closes, a resistance network is connected in parallel with main valve **50** and the source of starting voltage is connected to the gate-cathode circuit of its respective SCR.

For example, if a flame failure is experienced in burner **2**, switch C1 closes to connect resistors **109** and **110** through switch B2 and in parallel with main valve **50**. The resulting voltage developed across resistor **110** is applied to the gate-cathode circuit of SCR **102** and this SCR fires. Firing of this SCR causes indicator lamp **106** to be energized.

Also, the absence of flame at burner **2** causes switch C2 to open, de-energizing the valve, de-energizing relay A, and opening switch A1. When switches B1, D1 and E1 subsequently close, no source of starting voltage is applied to SCRs **102**, **103**, and **104**. Thus lamp **106** remains energized as a "memory" of the fact that burner **2** was the first to experience a flame failure.

FIGURE 2 discloses a feature of our invention whereby the indicating means may be utilized on initial startup to indicate that an attempt is being made to ignite a particular burner. On startup the manual start switch **13** is closed to apply a source of starting voltage to SCR **101**, causing it to fire. When flame is established at burner **1**, flame relay B is energized and switch B2 closes. A source of starting voltage is then applied to SCR **102** through a circuit including switch C1. Thus, the indicating means which is energized, on startup, indicates the burner which is at that time attempting to ignite. After all burners are ignited, reset switch **120** is momentarily depressed to open circuit the source of sustaining voltage to de-energize all of the indicating means, leaving them to function as above described relative to a subsequent flame failure at one of the burners.

We claim as our invention:

1. An apparatus comprising a multiple fuel burner installation having a main valve and a plurality of individual fuel burners each of which includes a flame detecting means having a "flame" condition and a "no-flame" condition, and in which a switch controller is effective when in the start position to facilitate the establishment of flame at the individual fuel burners, whereupon maintaining circuit means is established by the plurality of flame detecting means in the "flame" condition, the improvement comprising:

a plurality of electrically energizable flame failure indicating means, one for each of the individual fuel burners, said indicating means initially being responsive to a starting voltage and subsequently being responsive to a sustaining voltage,

a source of starting voltage,

a plurality of circuit means, each circuit means including the maintaining circuit means and each being controlled by a separate one of the flame detecting means when in the "no-flame" condition to connect only the corresponding one of said indicating means to said source of starting voltage,

a source of sustaining voltage,

and circuit means controlled by a normally closed switch connecting said source of sustaining voltage to said plurality of indicating means.

2. Apparatus as defined in claim **1** wherein said plurality of flame failure indicating means are a plurality of neon bulbs.

3. Apparatus as defined in claim **2** wherein said source of sustaining voltage is of a magnitude which is below the igniting voltage and above the extinction voltage of said neon bulbs, and wherein said source of starting voltage is of a magnitude which is above the igniting voltage of said neon bulbs.

4. Apparatus as defined in claim **1** wherein said plurality of flame failure indicating means are a plurality of silicon controlled rectifiers.

5. Apparatus as defined in claim **4** wherein said source of sustaining voltage is connected to the anode-to-cathode circuit of said controlled rectifiers and wherein said circuit means connects said source of starting voltage to the gate-to-cathode circuit of said controlled rectifiers.

6. Apparatus as defined in claim **5** wherein a manual switch controller is effective when in the start position to facilitate the establishment of flame at the individual fuel burners, wherein the maintaining circuit means includes a normally open relay switch connected in parallel with the manual switch controller, and wherein a relay winding controlling said relay switch is energized by a series circuit including the plurality of flame detecting means in the "flame" condition.

7. Apparatus as defined in claim **1** wherein the switch controller is a manual switch, wherein the maintaining circuit means includes a normally open relay switch connected in parallel with the switch controller, and wherein the relay winding controlling said relay switch is energized by a series circuit including the plurality of flame detecting means in the "flame" condition.

8. Apparatus as defined in claim **7** wherein the switch controller when in the released position closes said nor-

mally closed switch which connects the source of sustaining voltage to the plurality of indicating means.

9. Apparatus as defined in claim **7** wherein said plurality of flame failure indicating means are a plurality of neon bulbs.

10. Apparatus as defined in claim **1** wherein the switch controller, when in said start position, is effective in cooperation with the flame detecting means of one of the individual burners, when in the "no-flame" condition, to connect its indicating means to said source of starting voltage; and upon the establishment of flame at said one burners, said flame detecting means, now in said "flame" condition is effective in cooperation with the flame detecting means of another of the individual burners, when in the "no-flame" condition, to connect its indicating means to said source of starting voltage.

No references cited.

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