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IGNITION SYSTEM FOR PULVERIZED COAL BURNERS

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3 Sheets-Sheet 1

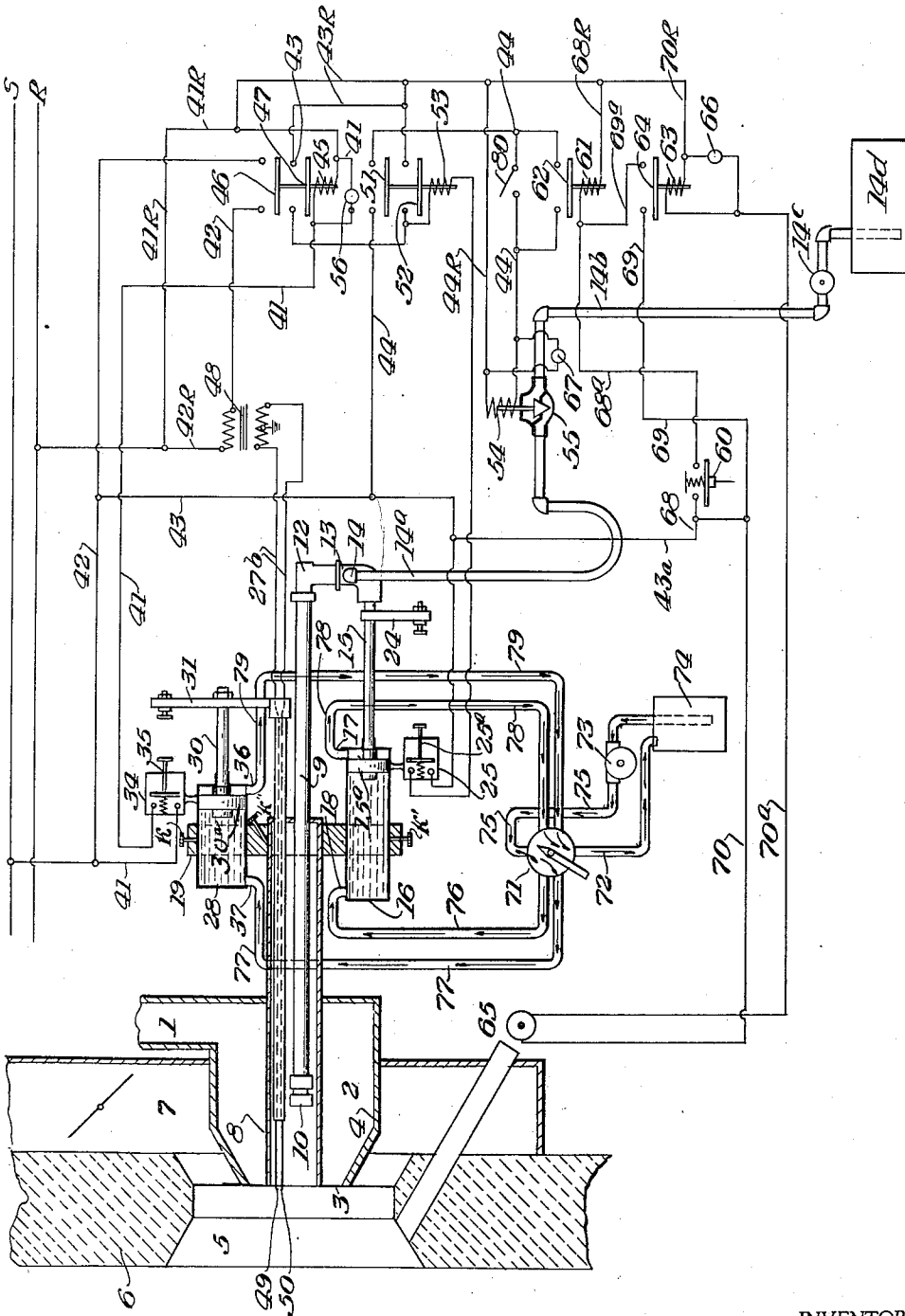


Fig. 1.

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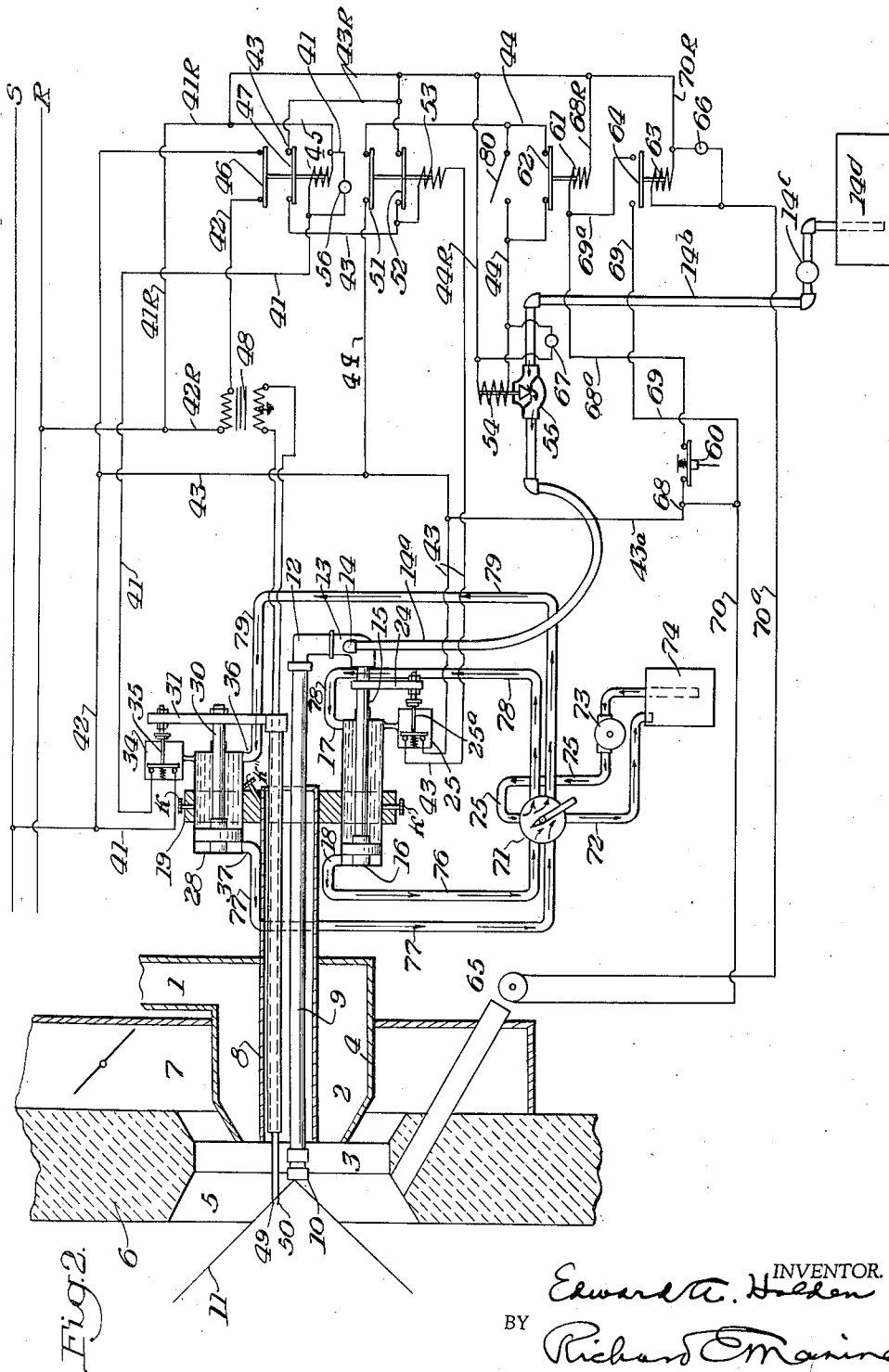
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3 Sheets-Sheet 2



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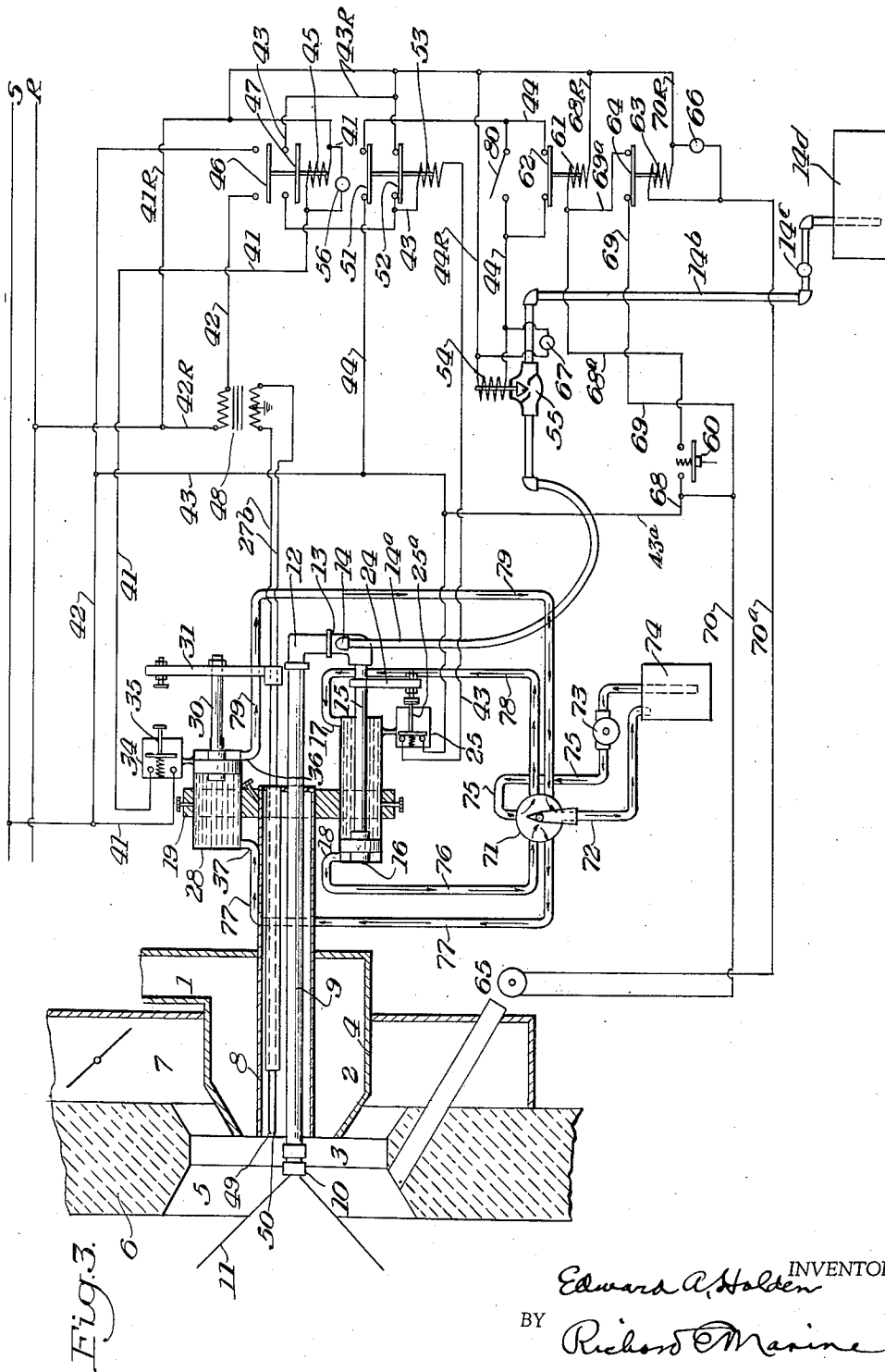
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UNITED STATES PATENT OFFICE

2,382,483

IGNITION SYSTEM FOR PULVERIZED
COAL BURNERS

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This invention relates to the use of a retractable electric sparking device and an oil, gas or similar burner used in combination to effect the ignition of a stream of pulverized coal or similar fuel delivered through any of the various types of pulverized coal burners or the like. This ignition is conveniently accomplished by a combination of electrical and mechanical means operated by distant control. The movements of the electrodes and of the oil or gas burners while correlated are independent of each other and allow, first, ignition of the ignition fuel by the sparking device; second, the withdrawal of the electrodes of the sparking device from the hot ignition flame zone after the ignition fuel is lighted and third, the withdrawal of the ignition fuel burner from the hot pulverized coal zone after coal ignition has taken place and the coal flame is stabilized. Other essential functions are more fully herein-after described.

The object of the invention is to provide a simple, reliable and interlocking device for the safe, rapid and convenient ignition of pulverized coal or similar fuel in furnaces of various types, particularly for re-igniting coal streams when ignition has been lost.

Since the pulverized coal is burned in suspension, only a few seconds supply of fuel is in the furnace at any one time and on loss of ignition, either through failure of the mills pulverizing the coal, of the supply of coal to the mills or due to unfavorable furnace conditions, there instantly follows a complete loss of heat liberation in the furnace and with steam boilers, for example, by cessation of steam generation. The resulting loss of pressure in steam used for power or process or public utility work may result in serious interruption of plant operation and heavy financial loss. It is therefore essential that ignition be reestablished as promptly as possible.

Various means are used at the present time to accomplish this, the principal ones being hand manipulated torches which may be either oil soaked waste on the end of a steel rod, kerosene oil torch operated by compressed air or gas from a pipe. All of these methods involve the loss of time required to get the torch to the individual coal burners, frequently in the larger installations, up long iron ladders to firing platforms, light the torch itself, insert it in the individual coal burner and wait while the mill is started and coal ignition is established, to be followed by the withdrawal and storage of the torch.

In many plants firemen are forbidden to light

pulverized coal burners in a furnace from the first one in order to prevent possible disastrous explosions. In this case there is a further delay while the torch is transferred to the other burners, mills for those burners started and coal ignition established in each.

By using the equipment hereinafter described, it is possible for the operator from a central position, preferably at the combustion control and instrument board now commonly used in large plants, to simultaneously, or in rapid succession, ignite as many coal burners as may be required within a few seconds, irrespective of their location, with entire safety to the operating personnel and the furnaces, and using only the limited operating force commonly found in modern combustion controlled plants.

To illustrate the principles involved, an oil burner of the mechanical atomizing type is shown but other types of oil atomizers or gas under pressure may be used by slight modification of the apparatus detail. A number of different pulverized coal burners are in commercial use, all having in common, however, some method of delivering a stream of finely pulverized coal, picked up by a stream of air passing through the mill and carried through piping to an opening in the furnace wall and discharged into the furnace in such relation to a stream of secondary air as to provide thorough intermixture of the air and fuel. The coal may be fired horizontally through a circular air register, vertically downward through a rectangular opening in an arch, or between water wall tubes or through any of the numerous other type burners in use.

For the functioning of this invention, it is only necessary to arrange the igniting flame so that some part of the pulverized coal stream in any of the various types of burners will pass through the ignition flame or close enough to it to ignite the coal.

With the above and other objects in view, the invention consists in a novel combination of parts and details of construction more fully disclosed and pointed out in the specifications and claims.

For the purpose of exemplification only, one of the many commonly used types of coal burners is shown, being of the circular air register type. A mechanical oil atomizer is shown as typical of a fluid burner.

Referring to the accompanying drawings forming a part of the specifications in which like numerals designate like parts in all the views:

Fig. 1 is a diagrammatic view, partly in section, showing the ignition system with both the

sparkling device and the ignition burner in their retracted or off positions;

Fig. 2 is a similar view showing both the device and the ignition burner in their projected or operative positions; and

Fig. 3 is a similar view showing the sparking device retracted after it has effected the ignition of the ignition burner fuel but with the ignition burner still projected to complete the ignition of the furnace fuel.

The same reference characters are used to designate the same parts in all views.

The figures all show by way of example a central longitudinal section of the register type of coal burner commonly used. Coal which has been pulverized in mills not shown, is carried by a stream of primary air through a coal pipe 1 and a passage 2 through burner pipe 4 and discharged in a stream of fine coal dust through opening 3 into the furnace throat opening 5 formed by a refractory ring 6. Secondary air for combustion is supplied through duct 7.

A so called "ignition tube" 8 is commonly located longitudinally along the center line of these coal burners. In this tube is shown an oil gun 9 having at its furnace end 10 an oil atomizer of the mechanical or pressure type which discharges a very fine oil spray, usually in the form of a hollow cone 11, into the furnace opening 5 and across the path of the pulverized coal when it issues from the opening 3 in coal burner pipe.

The liquid fuel burner may be any one of many forms, and any readily combustible liquids, such as oil, may be used. Gas may also be used with a suitable burner tip at the furnace end of the fuel pipe 9.

The gun 9 is here shown supplied with fuel through an elbow 12 mounted on a support 13, a flexible pipe 14a, a control valve 55, actuatable by coil 54, a connecting pipe 14b and a pump 14c connected to a reservoir as indicated at 14d.

The gun 9 is carried by plunger 15 carrying a piston 15a in a cylinder 16 which has pipe connections 17 and 18 at opposite ends of the cylinder to which flexible pipes 76 and 78 alternately deliver and carry away fluid under pressure following operation of control valve 71, as later described.

Referring to Fig. 1, application of pressure in cylinder 16 to connection 18 through flexible pipe 76 and connection of the opposite end to the drain by connection 17 and flexible pipe 78 will either retract or hold in retracted position the oil gun 9 as shown, in which position it is out of the hot pulverized coal fire zone. Conversely in Fig. 2 application of pressure to connection 17 and discharge through the opposite end connection 18 will advance the gun 9 into firing position as shown.

The electrodes 27b for igniting the oil spray are similarly mounted and may be located either in the same ignition tube as the oil gun 9 or they may be introduced through an auxiliary tube as will be necessary to adapt the equipment to existing types of pulverized coal burners. These burners vary as to the size of ignition tube used and in other respects. The methods of operation, however, are substantially the same. For purpose of explanation only, the gun and the electrodes are both here shown in the ignition tube.

The electrodes 27b are carried by the plunger 30 carrying a piston 30a in a double acting cylin-

der 28 and admission of pressure through connection 37 and discharge through 36 retracts or holds in the retracted position the electrodes 27b, as shown in Figs. 1 and 3. Conversely, application of pressure to connection 36 and discharge through connection 37 will advance the electrodes 27b so that spark between their terminals 49, 50 will ignite the oil spray as shown in Fig. 2.

To facilitate the adjustment of the electrodes 27b and the ignition spray 11 relative to each other and to the coal stream, a carrier 19 is provided, said carrier being supported on the tube 8 in which the ignition burner and electrodes are located. Said tube is shown as passing through a central aperture in said carrier. The carrier is shown as also provided with oppositely disposed side apertures through which the cylinders 16 and 28, respectively, pass and in which they are supported. The single cylinder carrier 19, or if the burner and electrodes are located in separate tubes both cylinder carriers are slidably adjustable longitudinally along the tube or tubes. The cylinders 16 and 28 are themselves slidably adjustable longitudinally relative to each other in the carrier or carriers to permit adjustment of the electrodes relative to the ignition burner to facilitate ignition of the ignition fuel, which when ignited is employed in turn to ignite the fuel of the main fuel burner. To permit adjustment of the ignition flame relative to the main fuel burner the cylinders 16 and 28 are moved as a unit by proper adjustment of the carrier 19, which supports them, along the tube 8. When the adjustments have been made the cylinders 16 and 28 and carrier 19, or carriers, are preferably secured in adjusted position by suitable conventional means, such as set screws K, K', K'', respectively. The above adjustments are permitted by reason of the flexibility of the feed pipes 76, 77, 78 and 79.

To operate the plunger 15 carrying the oil gun 9 and the plunger 30 carrying the electrodes 27b, any fluid such as oil or water or compressed air may be used. Assuming, for the purpose of explanation, a liquid is used, it is pumped by a pump 73 from a suitable reservoir 74 under pressure through pipe 75 to the control valve 71. This control valve has three operating positions and these positions and the resulting flow of liquid and the resulting positions of plungers 15 and 30 are shown in Figs. 1, 2 and 3 respectively. Pipe 75 supplies liquid under pressure and pipe 72 connects to the drain in all positions.

Referring to Fig. 1, the first position of the control valve is shown. Liquid is supplied under pressure through flexible pipes 76 and 77 to the inner ends of cylinders 16 and 28 and drained from the outer ends through flexible pipes 78 and 79 retracting both plungers.

Referring to Fig. 2, the second position of the control valve is shown. Liquid under pressure then is supplied through flexible pipes 78 and 79 to the outer ends of both cylinders and drained through 76 and 77, advancing both plungers.

Referring to Fig. 3, the third position of the control valve is shown. Liquid under pressure is being supplied to the inner end of cylinder 28 through flexible pipe 77 and drained from the opposite end through flexible pipe 79, retracting the electrodes 27b while simultaneously, pressure is maintained on the outer end of cylinder 16 through flexible pipe 78, the inner end

being still connected to the drain through 76. The ignition burner is thus held in firing position where it can continue to maintain an oil flame until the pulverized coal is ignited. The electrodes are meanwhile held out of the hot zone of the ignition flame.

To coordinate and synchronize the movement of the ignition burner and the electrodes, and to safeguard lighting off both the oil and pulverized coal, both of which are, under certain conditions, capable of producing serious explosions in the furnace, as well as to maintain the apparatus in working condition and in constant readiness for use, the electrical equipment as hereinafter described is provided.

Electric current is obtained from any satisfactory source. To establish the electric spark and also control the flow of fuel to the ignition burner, a combination of contact switches, relays and other electrical devices are provided.

Referring to Figs. 1 and 2. The spark between electrode points 49, 50 is established as follows: Spring contact switch 34 is mounted on or near cylinder 28 in such position that the inward movement of the arm 31 carried by the plunger 30, will close the switch, allowing current from supply line 41 to flow to and through relay coil 45, closing both relay switches 46 and 47 as shown in Fig. 2. The closure of switch 46 permits current to pass from supply line S, through 41, 42 to the primary of transformer 48, returning through 41R. The transformer secondary, being thus energized, causes sparks to pass between the terminals 49, 50 at the outer ends of the electrodes 27b.

At the same time, the control valve 71 being in the second position, the ignition burner plunger 15 is moving forward from the position shown in Fig. 1 to that shown in Fig. 2. A contact switch 25, located relative to the cylinder 16 in a manner similar to that already described for cylinder 28, is closed by pressure of arm 24 on plunger 25a. Circuit from supply line 43 is thus closed to relay coil 53, but current will not flow unless relay switch 47 has already been closed by relay coil 45. In other words, the oil cannot be turned on even though the gun 9 is in firing position, until the electrodes are in position and the spark current established. If, however, switch 47 has been closed by coil 45, current from line 43 will pass through coil 53 which will be energized and switches 51 and 52 will be closed. If the by-pass switch 80 is also closed, current will then flow from line 44 across switch 51 to solenoid 54, opening oil supply valve 55 and also lighting signal lamp 67, showing oil pressure is on the ignition burner line.

If the electrodes reach firing position first and spark current is turned on by closing of switch 34, the fuel valve 55 will open when the atomizer gun 9 reaches firing position and closes switch 25. If, however, the atomizer gun 9 reaches its firing position first, the oil valve cannot open until the electrodes are in firing position, closing switch 34, establishing spark current and simultaneously closing switch 52, providing path for current through relay 53 as previously explained. This insures against spraying unlighted oil into the furnace.

The ignition flame having been ignited by the electric spark, it is now necessary to retract the electrodes to prevent their destruction by the heat from the ignition flame. It is, however, desired to leave the ignition flame burning until

such time as the pulverized coal is lighted off, which may be immediately or some time later.

The control valve 71 is therefore moved into its third position, Fig. 3. The electrodes are retracted as previously explained and the resulting release of pressure of plunger arm 31 on spring contact switch 34, immediately opens switch 34 and deenergizes relay coil 45, which in turn opens switches 46 and 47 and discontinues the spark at 49, 50.

It will be noted that the above described opening of switch 47 opens the circuit from the relay coil 53 through said switch to line 43R. However, the previous closing of switch 52 by relay coil 53 provided a path in parallel with that through relay switch 47 for maintaining current from line 43 across switch 52 to keep coil 53 energized after switch 47 is opened. Since the relay 53 will keep the switch 51 closed as long as the coil is energized, current from line 44 will continue to flow across switch 51 to the fuel valve 54, 55, keeping it open and supplying fuel to the ignition burner until the current through coil 53 is interrupted by retraction of ignition burner and resulting opening of contact switch 25.

When the pulverized coal is turned on, it may ignite promptly from the ignition flame, but may be unstable for a time and the ignition flame may then be kept in service as long as desired. When ready to discontinue it, the control valve is turned back to the first position, Fig. 1. The pressure is thereby applied to the inner end of cylinder 16 and relieved from its outer end and the gun is retracted. As a result of the initial movement, the contact switch 25 is opened, as previously described, permitting the fuel valve 54, 55 to close. The pressure is meanwhile maintained on the inner end of cylinder 28 and the electrodes remain in their retracted position which they assumed from previous movement of control valve to second position, as previously described.

It will be noted that if the oil gun be partly retracted, opening contact switch 25 and cutting off current to the solenoid fuel valve 54, 55 and the gun is then returned to firing position, closing switch 25, the oil will not turn on until the electrodes are advanced and spark current established as previously explained. This provides against spraying unignited oil into the furnace, creating an explosion hazard.

In order to safeguard the operation still further, especially useful in such installations where the location of the observation doors is such that the operator cannot see whether the oil spray has actually ignited and continued to burn, an electric eye 65 may be used, switch 80 being left open.

Referring to Figs. 1 and 2, a momentary switch 60 is manually operated and may be of the push button type. A relay coil 61 is used to operate switch 62 in line 44. A relay coil 63 is used to operate switch 64. An electric eye 65 is directed at the flame, either ignition or coal. Signal lights 66 and 67 are provided to show that lines in which they are located are energized—connecting lines 68, 68a, 69, 70 and 70a are provided for the purposes hereinafter described.

The operation is as follows: After the operator has put the control 71 in the second position, Fig. 2, the spark current is established by the closing of relay 45 and the relay 53 is also closed, closing the circuit of line 44 as far as the relay switch 62, which will be open. The operator now closes the momentary switch 60 manually, allowing current from 43a to flow through lines 68 and

68a through coil 61, energizing that relay and passing through line 68R to the return line R.

When relay 61 is thus energized, switch 62 is thereby closed and current in line 44 opens solenoid valve 54, 55, the signal lamp 67 is lighted and oil flows to the atomizer. If the spray ignites, then the electric eye 65 is actuated to permit current from 43a to flow through lines 70 and 70a energizing relay 63 and lighting signal lamp 66. When relay 63 is energized it closes switch 64 establishing the circuit 69, 64, 69a in parallel with that through momentary switch 60. When the operator releases the momentary switch 60 after a suitable interval, if the spray has not been ignited, the electric eye switch will not have closed circuit 70, 70a, 70R, the switch 64 will not have closed, the signal light 66 will not have lighted. The current being cut off from relay coil 61 by the opening of the momentary switch 60, the line 44 is opened by switch 62 and the solenoid valve 54, 55 shuts off the oil.

If, however, the spray has lighted, the electric eye switch will have closed the circuit through line 70, 70a and 70R and relays 63 and 61 will continue to be energized after the momentary switch has been opened by the operator and the solenoid valve 54, 55 will remain open supplying oil to the atomizer until either the control valve is operated to retract the gun 9 or the flame goes out. In the first case, that of retraction of gun 9, the current to the solenoid valve 54, 55 is cut off at relay switch 51 as previously described. In the second case, that of flame failure, the current to the solenoid valve 54, 55 is cut off at relay switch 62 by action of the electric eye 65 which will open circuit 70, 70a, deenergizing relays 63 and 61.

It is obvious that those skilled in the art may vary the details of construction as well as the arrangement of the parts without departing from the spirit of the invention. I, therefore, do not wish to be limited to the above disclosure except as may be required by the claims.

I claim:

1. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; means for advancing said two means to their respective operative positions and for retracting said last mentioned means to a position out of range of the burner and ignition flames and for independently retracting said first mentioned means to a position out of range of the burner flame; control means for operating said retracting means; and means for operating said control means from a central point.

2. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; means for advancing said two means to their respective operative positions and for retracting said last mentioned means to a position out of range of the burner and ignition flames and for independently retracting said first mentioned means to a position out of range of the burner flame; and means for adjusting said first two means relative to each

other and also for independently adjusting said first two means as a unit relative to said burner.

3. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; means for advancing said two means to their respective operative positions and for retracting said last mentioned means to a position out of range of the burner and ignition flames and for independently retracting said first mentioned means to a position out of range of the burner flame; and means for adjusting said first two means relative to each other.

4. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; and means for advancing said two means to their respective operative positions and for retracting said last mentioned means to a position out of range of the burner and ignition flames and for independently retracting said first mentioned means to a position out of range of the burner flame.

5. The combination defined in claim 4 in which there is provided means for preventing discharge of ignition fuel unless said means for discharging said fuel is in normal operating position.

6. The combination defined in claim 4 in which there is provided means for preventing flow of ignition fuel before said means for igniting it is in operation.

7. The combination defined in claim 4 in which there is provided means for shutting off flow of ignition fuel on loss of ignition; said means comprising an electric eye in the path of radiant energy transmitted from burner fuel combustion.

8. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; and means at all times under control of the operator for advancing or retracting said ignition fuel discharging means and for independently advancing or retracting said means for igniting the ignition fuel.

9. In an ignition system for a fuel burner, in combination; mechanism for igniting the burner fuel comprising means movable to operative position to discharge ignition fuel to ignite the burner fuel; means movable to operative position to ignite said ignition fuel; means at all times under control of the operator for advancing or retracting said ignition fuel discharging means and for independently advancing or retracting said means for igniting the ignition fuel; and means for preventing the flow of ignition fuel until said means for igniting it is in operation.

10. The combination defined in claim 4 in which there is provided means for preventing flow of ignition fuel until said means for igniting it is in extended position.

11. The combination defined in claim 4 in which there is provided means for shutting off flow of ignition fuel on loss of ignition.

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