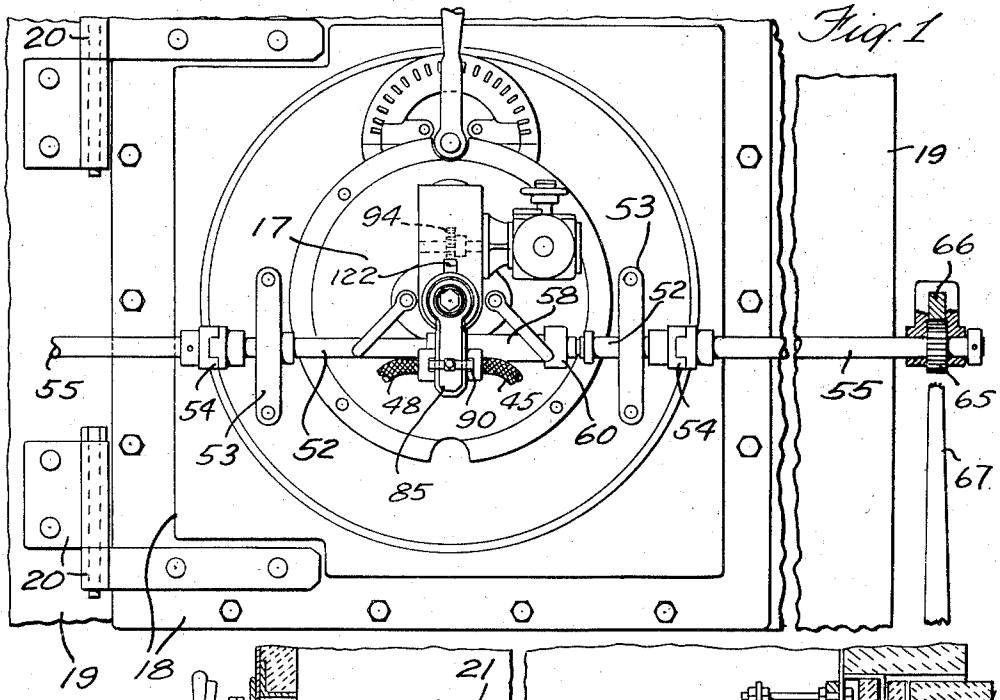
April 22, 1958 W. F. LANGE 2,831,535

FUEL BURNER

Filed Dec. 28, 1953 3 Sheets-Sheet 1

Fig. 1



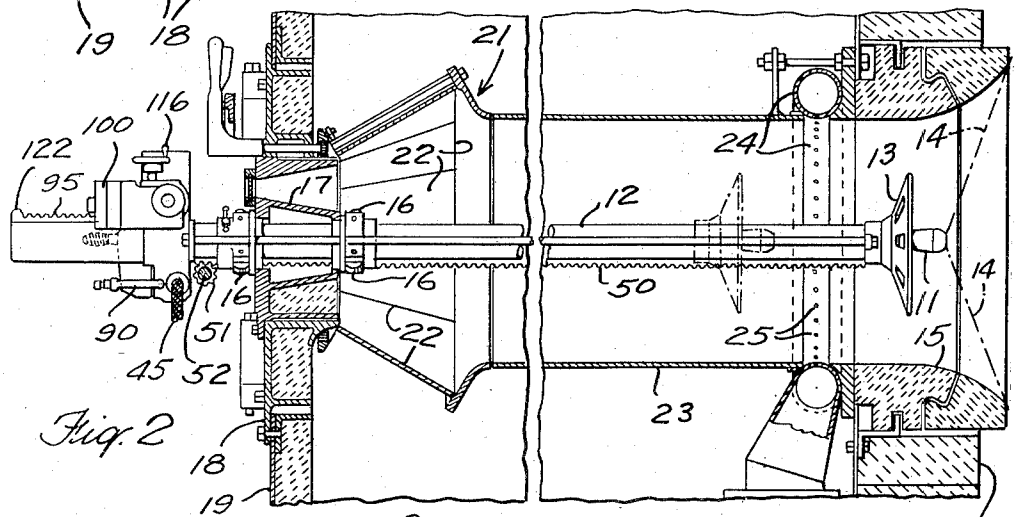


Fig. 2

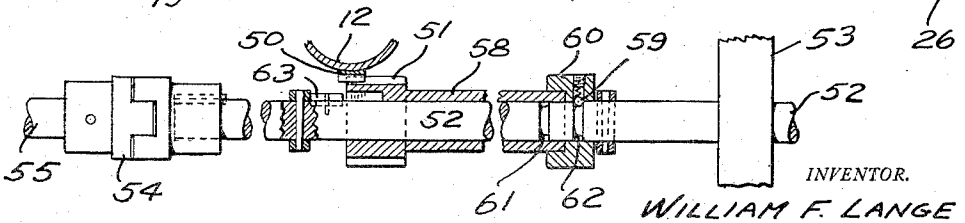


Fig. 3

INVENTOR.
WILLIAM F. LANGE

BY

ATTORNEY

April 22, 1958 W. F. LANGE 2,831,535

FUEL BURNER

Filed Dec. 28, 1953 3 Sheets-Sheet 2

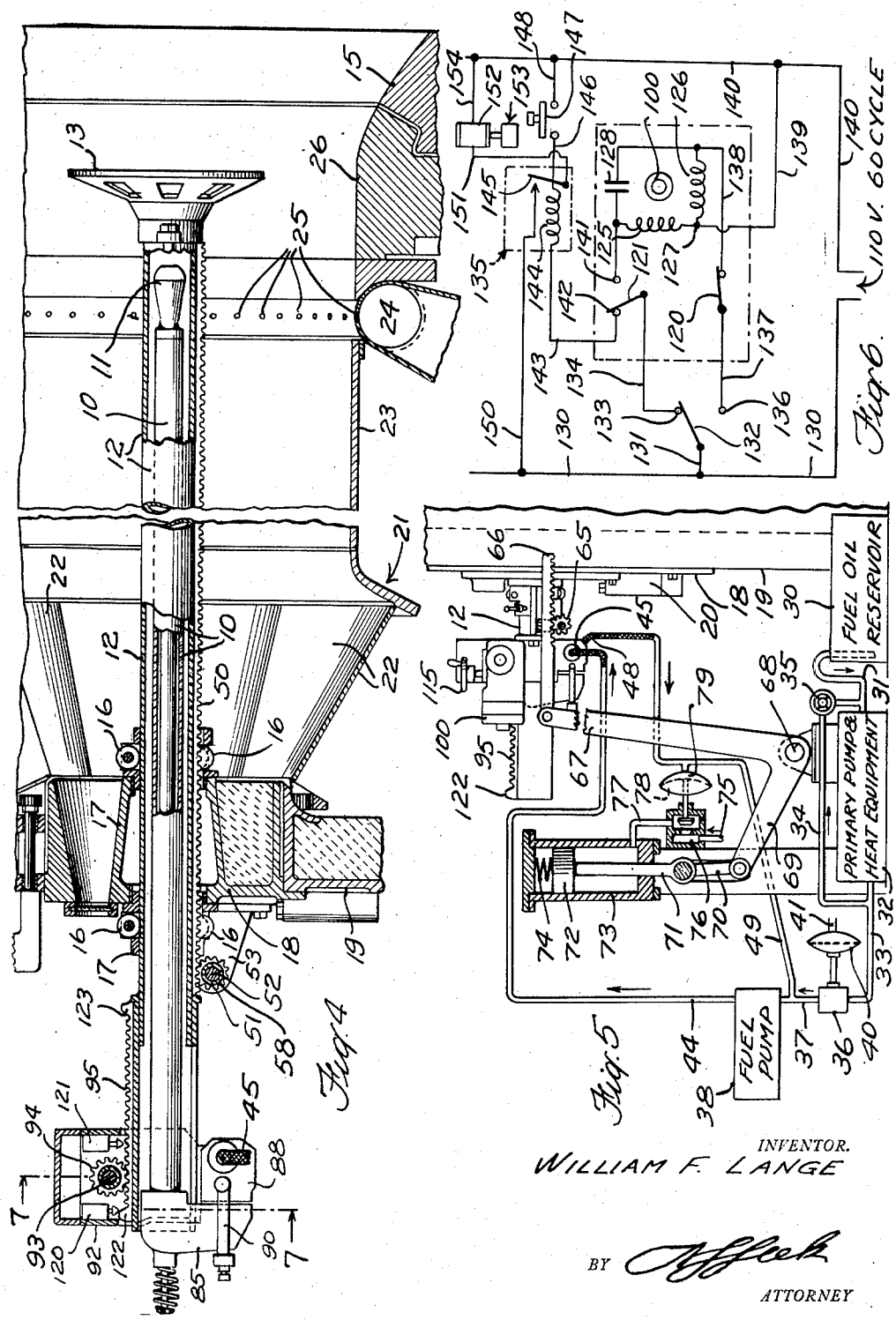


Fig. 4

Fig. 5

Fig. 6

INVENTOR.
WILLIAM F. LANGE

BY

ATTORNEY

April 22, 1958 W. F. LANGE 2,831,535

FUEL BURNER

Filed Dec. 28, 1953 3 Sheets-Sheet 3

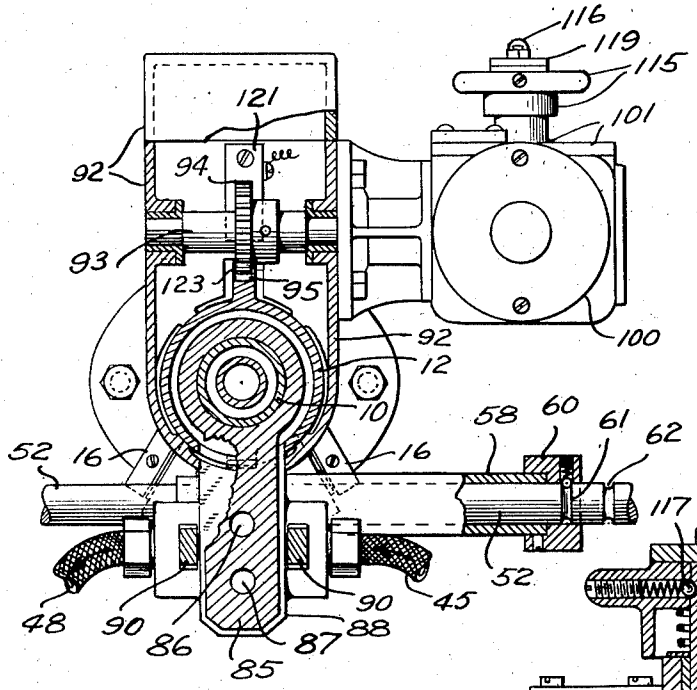


Fig. 7

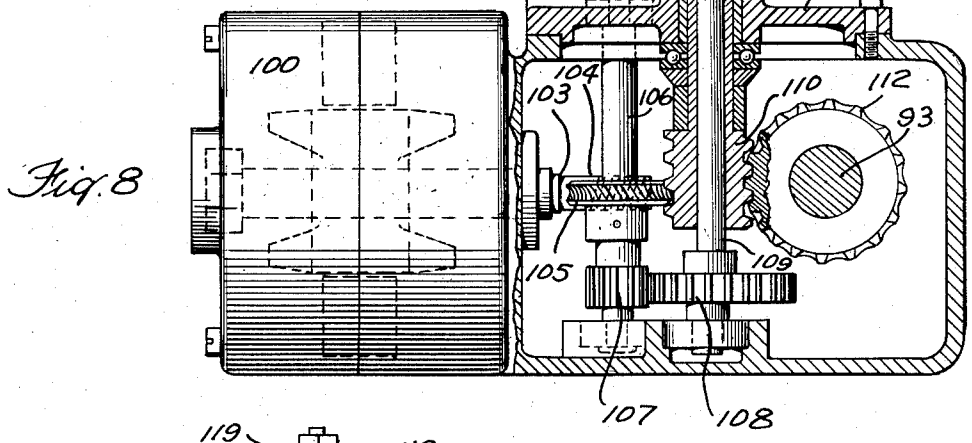


Fig. 8

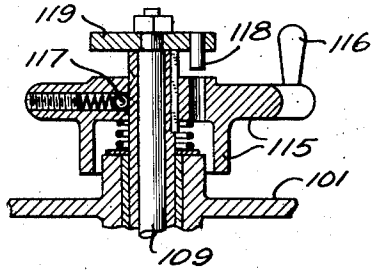


Fig. 9

INVENTOR.
WILLIAM F. LANGE

BY

ATTORNEY

United States Patent Office 2,831,535 Patented Apr. 22, 1958

2,831,535

FUEL BURNER

William F. Lange, Springdale, Conn., assignor to Peabody Engineering Corporation, New York, N. Y., a corporation of New York

Application December 28, 1953, Serial No. 400,627

13 Claims. (Cl. 158—76)

This invention relates to control mechanisms for burners for solid, gaseous or liquid fuel and more particularly for multiple fuel burners having center fired fuel units, and has for an object to provide means for protecting the center fired unit from the heat of the furnace when the unit is inactive.

Another object is to provide means operable both manually and automatically for retracting the center fired unit into an inoperative shielded position when it becomes inactive and for restoring such unit to its operative position with a minimum loss of time when it is again to be used for firing.

The invention is shown as embodied in a burner having a fuel atomizer barrel sliding within a diffuser pipe. The atomizer barrel and diffuser pipe are mounted as a unit for variable positioning so as to maintain the cone of flame tangent to the burner throat at various burner loads. In operating a bank of such burners it is frequently desirable to remove a unit from operation, for example when the boiler is operating under a light load. However, such unit must be maintained in condition for firing with a minimum of delay when an increase in load requires that additional burners be placed in operation.

It has heretofore been proposed to retract inactive units within the burner tube when not in use. Such retraction however is undesirable since considerable delay is involved in again advancing and locating the unit into its proper position for firing.

The present invention overcomes this objection by providing means for retracting the fuel atomizer barrel and tip a predetermined distance within the diffuser pipe while allowing the diffuser pipe to maintain its normal operating position within the burner tube. In the case of a bank of such burners with the center fired fuel units adjustable automatically in accordance with the flame angle, the diffuser pipe of the inactive burner remains connected to the adjusting mechanism and is maintained thereby in its normal operating position even when not firing. Hence when the atomizer tip is again advanced within the diffuser pipe to its normal position it is automatically brought into correct position for firing and can immediately take up its part of the load.

The nature of the invention will be better understood by referring to the following description, taken in connection with the accompanying drawings in which a specific embodiment thereof has been shown for purposes of illustration.

In the drawings:

Fig. 1 is a front elevation of a burner embodying the present invention showing the master control unit for adjusting the operating positions of the various center fired units;

Fig. 2 is a longitudinal section through the burner of Fig. 1 showing the normal operating position of the center fired unit with respect to the burner throat;

Fig. 3 is a detail view showing the coupling means for coupling the diffuser pipe to the master control shaft;

Fig. 4 is a sectional view similar to Fig. 1 but on a larger scale showing the atomizer tip retracted within the diffuser pipe;

Fig. 5 is a diagrammatic view showing the operating mechanism for the control shaft;

Fig. 6 is a schematic wiring diagram illustrating the electrical circuits involved;

Fig. 7 is a transverse section taken on the line 7—7 of Fig. 4, but on a larger scale showing details of the retraction mechanism;

Fig. 8 is a sectional view showing the gearing connecting the driving motor to the retraction mechanism; and

Fig. 9 is a view of a portion of the gearing showing the same in position for manual operation.

Referring to the drawings more in detail, the invention is shown as applied to a burner comprising an atomizer barrel **10** carrying an atomizer tip **11** and slidably disposed within a diffuser pipe **12** carrying a diffuser **13** and arranged to project a cone of flame **14** through the burner throat **15**. The diffuser pipe **12** is mounted for retraction on rollers **16** in a hub **17** carried by a front plate **18** which is hingedly mounted in a front wall **19** by hinges **20**.

The burner is shown as including an air register **21** having a set of peripheral air doors **22** which are adjustable and communicate with a burner tube **23** registering with the burner throat **15**. A ring fired fuel unit, such as a gas ring **24**, having discharge openings **25** is disposed around the burner throat **15** for use in conjunction with or instead of the center fired unit. The burner throat **15** is disposed in a wall **26** forming the front of the combustion chamber, which wall may contain a plurality of burners of the type above indicated.

In the form shown the burner is assumed to be of the wide range, variable return type, burning liquid fuel as shown in the Graham et al. Patent No. 1,824,952 and Olches Patent No. 2,290,350. This is shown in Fig. 5 as comprising in general an oil reservoir **30** from which oil is withdrawn through a pipe **31** and through a primary pump and heater **32** which is adapted to heat the oil to the desired temperature and to supply the same under pressure to a feed line **33**. Bypass **34**, controlled by a pressure regulator valve **35** is used to maintain a predetermined substantially constant pressure in the feed line **33**. The fuel from the feed line **33** passes through a control valve **36** and line **37** to the intake side of a fuel pump **38**. The opening of the fuel control valve **36** is controlled automatically by a suitable means shown as a diaphragm control **40** which is adapted to be connected by pipe **41** to the source of steam pressure so as to control the fuel supply through the valve **36** in accordance with variation in heat requirements.

The fuel pump **38** discharges through a line **44** and a flexible connection **45** to the supply duct of the atomizer barrel **10**. The return from the atomizer barrel **10** passes through a flexible connection **48** and a return line **49** to the pipe **37** on the intake or low pressure side of the pump **38**. The pump **38** is adapted to maintain a constant pressure differential between the high pressure line **44** and the return line **49**, as set forth in said Olches patent No. 2,290,350.

For control purposes the diffuser pipe **12** is provided with a rack **50** which extends along the entire length of the pipe **12** and is engaged by a pinion **51** mounted on a shaft **52** (Figs. 1 and 3). The shaft **52** is mounted in bearings **53** on the front plate **18** and is provided at its ends with coupling members **54** for coupling to a master control shaft **55** which extends across the front wall **19** of the furnace to control the position of the diffuser pipes of other burners so that the center fired fuel units of all or a selected group of burners are adjusted in unison.

Referring to Fig. 3 the pinion **51** is shown as mounted on a sleeve **58** which is slidable on the shaft **52** and is

latched in forward and retracted positions respectively by a spring-pressed ball 59 which is carried in a ring 60 attached to the sleeve 58 and engages one of a pair of annular positioning grooves 61 and 62 in the shaft 52. In its advanced position the sleeve 58 is keyed to the shaft 52 by means of a key 63. When the sleeve 58 is retracted to the position shown in Fig. 3 it is released from the key 63 and is free to rotate with respect to the shaft 52. The teeth on the pinion 51 are sufficiently long to remain in engagement with the rack 50 when the sleeve 58 is in disengaged position, so that the sleeve may again be coupled to the shaft when the shaft 52 is in the same relative position with respect to the diffuser pipe 12.

The shaft 55 is shown in Figs. 1 and 5 as carrying a pinion 65 which is operated by a rack 66 attached to an arm 67 of a bell crank lever whch is pivoted at 68 and is provided with a short arm 69 attached by a link 70 to a piston rod 71, which in turn is connected to a piston 72 sliding in a cylinder 73 and normally urged downwardly by a compression spring 74. The connections are such that movement of the piston 72 in the cylinder 73 through the linkages above described serves to actuate the shaft 52 so as to shift the various center fired units axially.

The position of the piston 72 is determined by the fluid pressure in the cylinder 73. Fluid is supplied from a pipe 75, which is connected to a suitable source of fluid under pressure, through a metering valve 76 and a pipe 77 to the cylinder 73. The metering valve 76 is so designed that fluid pressure in the cylinder 73 is varied as a function of the opening of said valve. The valve 76 is controlled by a diaphragm control 78 which is connected by a line 79 to the return line 49 from the burner so that the position of the diaphragm 78 and the opening of the valve 76 varies as a function of the fuel pressure in the return line 49, which in turn is a function of the burner operating capacity. The connection is such that an increased pressure in the return line 49 tends to close the metering valve 76 and thereby reduce the fluid pressure in the cylinder 73 which results in a lowering of the piston 72, thereby retracting the diffuser pipe 12.

The diffuser pipe 12 is shown in fully advanced position in Fig. 2 wherein the cone of flame 14 is tangent to the burner throat 15. This position corresponds to minimum load conditions and maximum flame angle. The retracted position of the fuel unit is indicated by dotted lines in Fig. 2. This is the minimum flame angle position and the cone is likewise tangent to the burner throat. The piston 72 is so connected as to shift the fuel unit between the two positions described and to position it in conformity with the flame angle corresponding to the various operating burner loads.

When a plurality of burners such as are shown and described herein are mounted in a bank of burners at least one of these burners is always maintained in operation with the fuel supplied thereto controlled independently of the other burners, and this burner through the mechanism shown and described in connection with Fig. 5, through the shaft 55 automatically controls the position of the diffuser pipes 12, of the various burners, within the combustion chamber in accordance with variations in heat requirements.

It is be be understood that the metering valve 76 may be operated by other elements of the system which vary as a function of the burner load, for example the pressure in the supply line 44, the quantity of fuel supplied, the steam pressure in the boiler, or the like. It is also to be understood that the particular form of mechanical linkage has been shown merely for purposes of illustration and that the shaft 52 may be actuated by other means, as for example, by a reversible motor which is controlled and positioned in accordance with the oil return pressure as above mentioned.

The atomizer barrel 10 is shown as attached at its end to a coupling member 85 having passages 86 and 87 for the supply and return of fuel to and from the atomizer barrel 10. The coupling member 85 is adapted to be coupled to a connector 88 to which the flexible connections 45 and 48 are attached. The connector 88 is secured to the coupling member 85 by a yoke 90.

The connector 88 is formed as a part of a housing 92 which is slidable on the diffuser pipe 12 and carries a shaft 93 to which is secured a gear 94 meshing with a rack 95 on the top of the diffuser pipe 12 to cause the housing 92, together with the parts attached thereto to ride along the rack 95 as the gear 94 is rotated.

The shaft 93 is driven by an electric motor 100 through a reducing gear train and manual clutch shown in Figs. 8 and 9 as enclosed in a housing 101 attached to and moving with the housing 92.

Referring to Figs. 8 and 9 the motor 100 is provided with a shaft 103 carrying a worm 104 meshing with a worm gear 105 on a vertical shaft 106. The shaft 106 carries a pinion 107 meshing with a gear 108 on a second vertical shaft 109. A worm gear 110 attached to a sleeve 111 which is rotatable on the shaft 109, meshes with a worm 112 on the shaft 93.

A hand wheel 115 having a handle 116 is keyed to slide on the sleeve 111 and is held in its upper position by a spring-pressed ball 117. In its upper position the handle wheel 115 engages a pin 118 carried by a disk 119 attached to the end of the second vertical shaft 109 so that in the position shown in Fig. 8 the sleeve 111 is coupled to the shaft 109 and the motor 100 is connected through the double worm gear shown to drive the shaft 93. In order to turn the shaft 93 manually the hand wheel 115 is depressed as shown in Fig. 9, to release the same from the pin 118 thereby release the sleeve 111 from the shaft 109 and from the worm gears 104 and 105. The sleeve 111 is then free to be turned by the handle 116 to turn the shaft 93 through the worm 110 and worm gear 112.

The housing 92 carries a pair of limit switches 120 and 121 which are actuated by cam surfaces 122 and 123 respectively at the two ends of the rack 95.

Referring to the wiring diagram of Fig. 6 the motor 100 is shown as of the split phase reversing type having a pair of field windings 125 and 126 interconnected at 127 and having their free ends joined by a condenser 128 in the usual manner. A power line 130 is connected by a lead 131 to a double throw switch 132 having a contact 133 connected to a line 134 to the double throw limit switch 121 and having a contact 136 connected by a lead 137 to the limit switch 120. The limit switch 120 is connected by a lead 138 to one end of the winding 126. The junction 127 of the windings 125 and 126 is connected by a lead 139 to the other side 140 of the power line.

The double throw limit switch 121 has a contact 141 connected to the winding 125 and a second contact 142 connected by a lead 143 to the coil 144 of a relay 135 having contacts 145, thence by lead 146 to a fuel switch 147, thence by a lead 148 to the power line 140. The fuel switch 147 may be a manual or a remote controlled switch to be closed for oil firing and may be adapted to open automatically when the oil firing circuit is broken, for example when the burner is retracted.

Contacts 145 of the relay 135 are connected by a lead 150 to the power line 130 and by a lead 151 to a solenoid 152 of a solenoid controlled fuel shut-off valve 153, thence by a lead 154 to the power line 140. The solenoid valve 153 is adapted to open and close the fuel supply.

In the operation of the electric circuit, when the switch 132 is in the position to close contact 133 as shown in the drawings and switch 121 is in position to close contact 142 the circuit is completed from the line 130 through switches 132, and 121 to relay coil 144. If the fuel switch 147 is closed the relay coil 144 is energized to close contacts 145 and thereby complete the circuit to energize the solenoid 152 and open the fuel

supply valve **153**. This is the normal position for oil firing and the switch **121** is actuated by the cam surface **123** to close the contact **142** as shown when the atomizer barrel is in fully advanced position. In this position the limit switch **120** is closed.

If now the tip is to be retracted the switch **132** is shifted to close contact **136**, thereby completing the circuit through the limit switch **120** to the winding **126** to drive the motor **100** in a direction to retract the atomizer barrel. As soon as the barrel starts to retract the limit switch **121** is automatically shifted to close contact **141** and open contact **142**, thereby deenergizing relay winding **144** and opening contacts **145** which interrupt the current supply through the solenoid **152** and cause the fuel valve **153** to close so that the tip **11** cannot fire when it is in retracted position.

When the housing **92** has been fully retracted by the motor **100** the limit switch **120** is opened, thereby deenergizing the motor and bringing the atomizer barrel to rest in retracted position.

Since the contact **141** of limit switch **120** has been closed by the retraction of the barrel the winding **125** may be energized by shifting the switch **132** to close the contact **133** so as to actuate the motor **100** in a direction to advance the barrel. However, the fuel supply valve **152** remains closed until the barrel has been fully advanced and the limit switch **121** actuated to open the motor circuit at contact **141** and close the circuit to the relay coil **144** through the manual switch **147**. The fuel valve **153** may then be opened to operate the atomizer by closing the control switch **147**.

When a plurality of burners such as shown and described herein are mounted in a bank of burners each burner is provided with a control mechanism, such as shown and described in connection with Fig. 6, in which each burner is provided with an individual manually operated control switch **132** and a solenoid actuated fuel control valve **153**.

In the case of failure of the motor circuit or if for other reasons the atomizer barrel may be retracted or advanced manually by actuation of the handle **116**.

While the diffuser pipe is automatically shifted in position in accordance with the return oil pressure as above described, it may be entirely withdrawn manually by releasing the coupling to the sleeve **58** as indicated in Fig. 3. The shaft **52** may also be disconnected from the shaft **55** by the couplings **54** when the front plate **18** is to be opened.

In connection with oil or gas fired units it is usually sufficient to retract the atomizer tip **11** a matter of 6 to 12 inches within the diffuser pipe when the center fired unit is converted to an inactive state. It is thus ready for instant return to service when desired.

Although a specific embodiment has been shown for purposes of illustration it is to be understood that various changes and modifications may be made therein as will be readily understood by those skilled in the art.

What is claimed is:

1. In a fuel burner, an air register having a hub, rollers mounted on said hub, a center-fired fuel unit having a tube slidably supported on said rollers and a fuel atomizer barrel slidably supported within said tube, means including a gear train for automatically positioning said fuel unit, drive means for operating said positioning means, releasable coupling means between said drive means and said positioning means to permit positioning of said fuel unit independently of said drive means when said drive means is released, said coupling means having means to restore the original relationship between said drive means and said positioning means when recoupled.

2. In a fuel burner, an air register having a hub, rollers mounted on said hub, a center-fired fuel unit having a tube slidably supported on said rollers and a fuel atomizer barrel within said tube, means including a gear train for automatically positioning said fuel unit, drive means for operating said positioning means, releasable coupling means between said drive means and said positioning means to permit positioning of said fuel unit independently of said drive means when said drive means is released, said coupling means having means to restore the original relationship between said drive means and said positioning means when recoupled.

3. In a fuel burner, an air register having a hub, rollers mounted on said hub, a center-fired fuel unit having a tube slidably supported on said rollers and a fuel atomizer barrel slidably supported within said tube, means including a gear train for automatically positioning said fuel unit, drive means for operating said positioning means, releasable coupling means between said drive means and said gear train to permit positioning of said fuel unit independently of said drive means when said drive means is released while maintaining said gear train engaged, said coupling means having means to restore the original relationship between said drive means and said positioning means when recoupled.

4. In a fuel burner, an air register having a hub, rollers mounted on said hub, a center-fired fuel unit having a tube slidably supported on said rollers and a fuel atomizer barrel slidably supported within said tube, means including a gear train for automatically positioning said fuel unit, drive means for operating said positioning means, releasable coupling means between said drive means and said gear train to permit positioning of said fuel unit independently of said drive means when said drive means is released while maintaining said gear train engaged, said coupling means having means to restore the original relationship between said drive means and said positioning means when recoupled, and adjusting means mounted on said tube for automatically adjusting said fuel atomizer barrel relative to said tube.

5. In a fuel burner, an air register having a hub, rollers mounted on said hub, a center-fired fuel unit having a tube slidably supported on said rollers and a fuel atomizer barrel slidably supported within said tube, means including a gear train for automatically positioning said fuel unit, drive means for operating said positioning means, releasable coupling means between said drive means and said gear train to permit positioning of said fuel unit independently of said drive means when said drive means is released while maintaining said gear train engaged, said coupling means having means to restore the original relationship between said drive means and said positioning means when recoupled, adjusting means mounted on said tube for automatically adjusting said fuel atomizer barrel relative to said tube, and a second drive means, including first and second reducing gear stages between said second drive means and said adjusting means, a second releasable clutch between said stages to disconnect said first reducing gear stage from said adjusting means, and means adapted for actuating said adjusting means through said second gear stage when said second clutch is released.

6. Means for advancing and retracting the burner tip of a center fired fuel burner, which is adapted to be secured to the end of an atomizer barrel slidably mounted in a diffuser tube, said means comprising a rack adapted to be mounted in fixed position on said tube, a housing adapted to be slidably mounted on the outer end of said tube for back and forth movement thereon, means by which said housing is adapted to be connected to said barrel, a pinion rotatably mounted in fixed position in said housing in mesh with said rack, means including a reversible motor adapted to be connected to a gear train to actuate said pinion to move said housing back and forth on said tube and thereby advance or retract said barrel in said tube, a releasable clutch to disconnect said motor from said pinion, and means adapted to operate said gear train for actuating said pinion when said clutch is released.

7. Means for advancing and retracting the burner tip of a center fired fuel burner, which is adapted to be secured to the end of an atomizer barrel slidably mounted in a diffuser tube, said means comprising a rack adapted to be mounted in fixed position on said tube, a housing adapted to be slidably mounted on the outer end of said tube for back and forth movement thereon, means by which said housing is adapted to be connected to said barrel, a pinion rotatably mounted in fixed position in said housing in mesh with said rack, means including first and second reducing gear stages and a reversible motor adapted to be connected to said reducing gear stages for actuating said pinion for moving said housing back and forth on said tube and thereby advance or retract said barrel in said tube, a releasable clutch between said stages to disconnect said first reducing gear stage from said pinion, and means adapted for actuating said pinion through said second reducing gear stage when said clutch is released.

8. Means for advancing and retracting the diffuser tube of a center fired fuel burner with an atomizer barrel slidably mounted therein, as a unit, said means comprising a rack adapted to be secured in fixed position on said tube, a control shaft adapted to extend across the front of said burner, a pinion mounted on said shaft in permanent mesh with said rack, and a releasable coupling means coupling said pinion to said shaft, said coupling means being operable to reconnect said pinion to said shaft only when said pinion is in a predetermined position with respect to said shaft, whereby the tube resumes its predetermined response to said control shaft when recoupled thereto; and means adapted for advancing and retracting said barrel in said tube independently of the movement of said tube.

9. Means for advancing and retracting the burner tip of a center fired fuel burner, which is adapted to be secured to the end of an atomizer barrel slidably mounted in a diffuser tube, said means comprising a rack adapted to be secured in fixed position on said tube, a control shaft adapted to extend across the front of said burner, a pinion mounted on said shaft in permanent mesh with said rack, and a releasable coupling means coupling said pinion to said shaft, said coupling means being operable to reconnect said pinion to said shaft only when said pinion is in a predetermined position with respect to said shaft, whereby the tube resumes its predetermined response to said control shaft when recoupled thereto.

10. Means for advancing and retracting an atomizer barrel slidably mounted in the diffuser tube of a center fired fuel burner, and for advancing and retracting said tube and barrel as a unit, said means comprising a reversible motor adapted to be connected to retract and advance said barrel with said tube, a gear train connected to said motor and adapted to be connected to said barrel, a releasable clutch to disconnect said gear train from said barrel, means adapted for retracting said barrel when said clutch is released, means by which said tube is adapted to be mounted from sliding movement to thereby advance and retract said tube and said atomizer barrel as a unit, a rack adapted to be secured in fixed position on said tube, a control shaft having a pinion mounted thereon in permanent mesh with said rack, and a releasable coupling means coupling said pinion to said shaft, said coupling means being operable to reconnect said pinion to said shaft only when said pinion is in a predetermined position with respect to said shaft, whereby the tube resumes its predetermined position with respect to said shaft, whereby the tube resumes its predetermined response to said control shaft when recoupled thereto.

11. A center fired fuel burner comprising a diffuser tube, means mounting said diffuser tube for advancement and retraction into and out of a combustion chamber, a rack secured to said diffuser tube in fixed position adjacent the outer end thereof, a housing straddling said rack and slidably mounted on said tube for back and forth movement thereon, a pinion gear rotatably mounted within said housing in mesh with said rack, means carried by said housing through which said pinion gear is adapted to be rotated in either direction to thereby slide said housing back and forth on said tube, an atomizer barrel reciprocally mounted within said diffuser tube, means by which said atomizer barrel is connected to said housing for back and forth movement therewith, a fuel supply line through which fuel is supplied to said atomizer barrel, and means operative to automatically cut off the supply of fuel to said atomizer barrel as said housing approaches the limit of its movement in an outward direction and to admit the supply of fuel to said atomizer barrel as said housing approaches the limit of its movement in an inward direction.

12. A center fired fuel burner as defined in claim 11 in which control means are provided by which said diffuser tube is automatically advanced and retracted, said control means including a rotatable shaft, a rack secured to said tube, a pinion gear mounted on said shaft in permanent mesh with said rack, and means by which said pinion is adapted to be connected to said shaft for rotation therewith and to be disconnected from said shaft for rotation independently of said shaft.

13. A center fired fuel burner comprising a diffuser tube, means mounting said diffuser tube for advancement and retraction into and out of a combustion chamber, a rack secured to said diffuser tube in fixed position adjacent the outer end thereof, a housing straddling said rack and slidably mounted on said tube for back and forth movement thereon, a pinion gear rotatably mounted within said housing in mesh with said rack, means carried by said housing through which said pinion gear is adapted to be rotated in either direction to thereby slide said housing back and forth on said tube, an atomizer barrel reciprocally mounted within said diffuser tube, means by which said atomizer barrel is connected to said housing for back and forth movement therewith, a fuel supply line through which fuel is supplied to said atomizer barrel, an automatically actuated fuel control valve interposed in said supply line, switch means mounted in said housing and operative to effect the opening of said control valve as said housing approaches the limit of its movement in an inward direction and to effect the closing of said control valve as said housing approaches the limit of its movement in an outward direction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,160,806	Wuestner et al.	Nov. 16, 1915
1,164,854	Oesterlen et al.	Dec. 21, 1915
1,671,494	Stewart	May 29, 1928
1,736,627	Ryalls	Nov. 19, 1929
2,342,597	Opalek	Feb. 22, 1944
2,537,947	Williams	Jan. 16, 1951
2,540,416	Asscher	Feb. 6, 1951
2,631,466	Deveson	Mar. 17, 1953
2,699,566	Hibner	Jan. 18, 1955
2,735,528	Dodge	Feb. 21, 1956

FOREIGN PATENTS

631,204	Great Britain	Oct. 28, 1949