Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 1

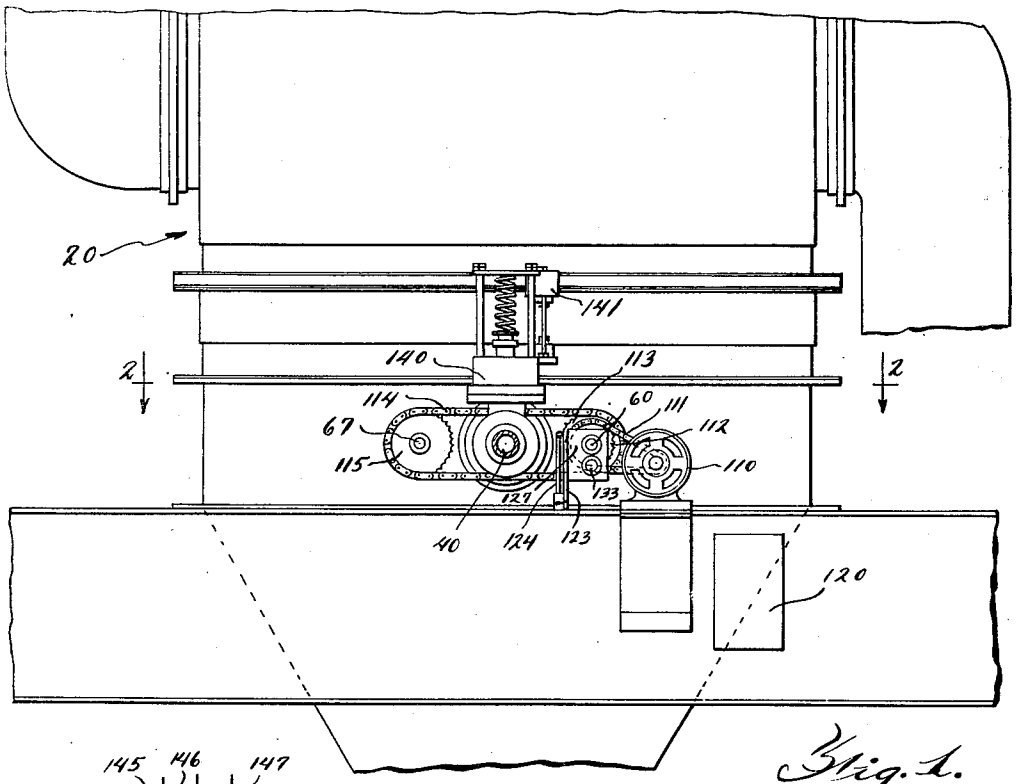


Fig. 1.

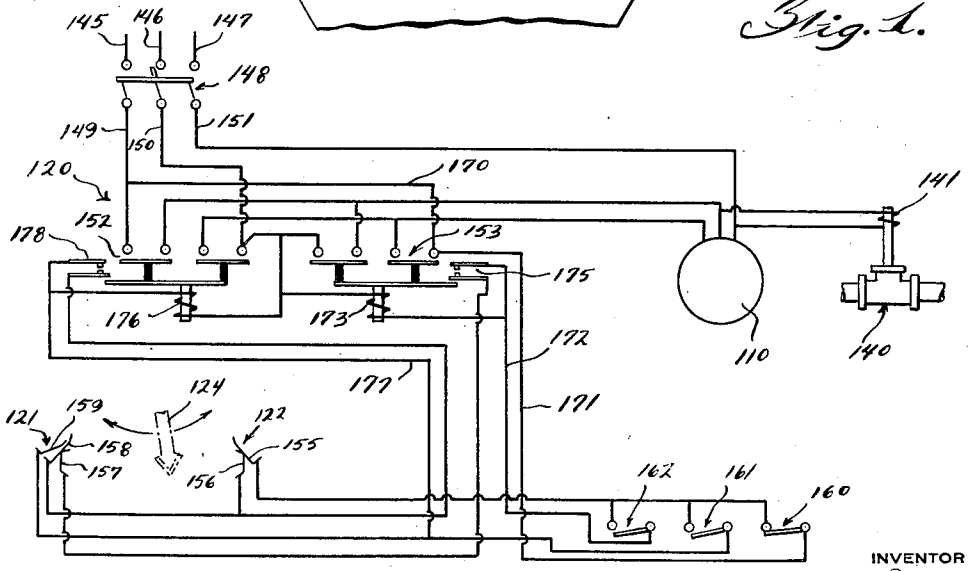


Fig. 15.

INVENTOR
FRANK BOWERS

BY Charles B. Belknap

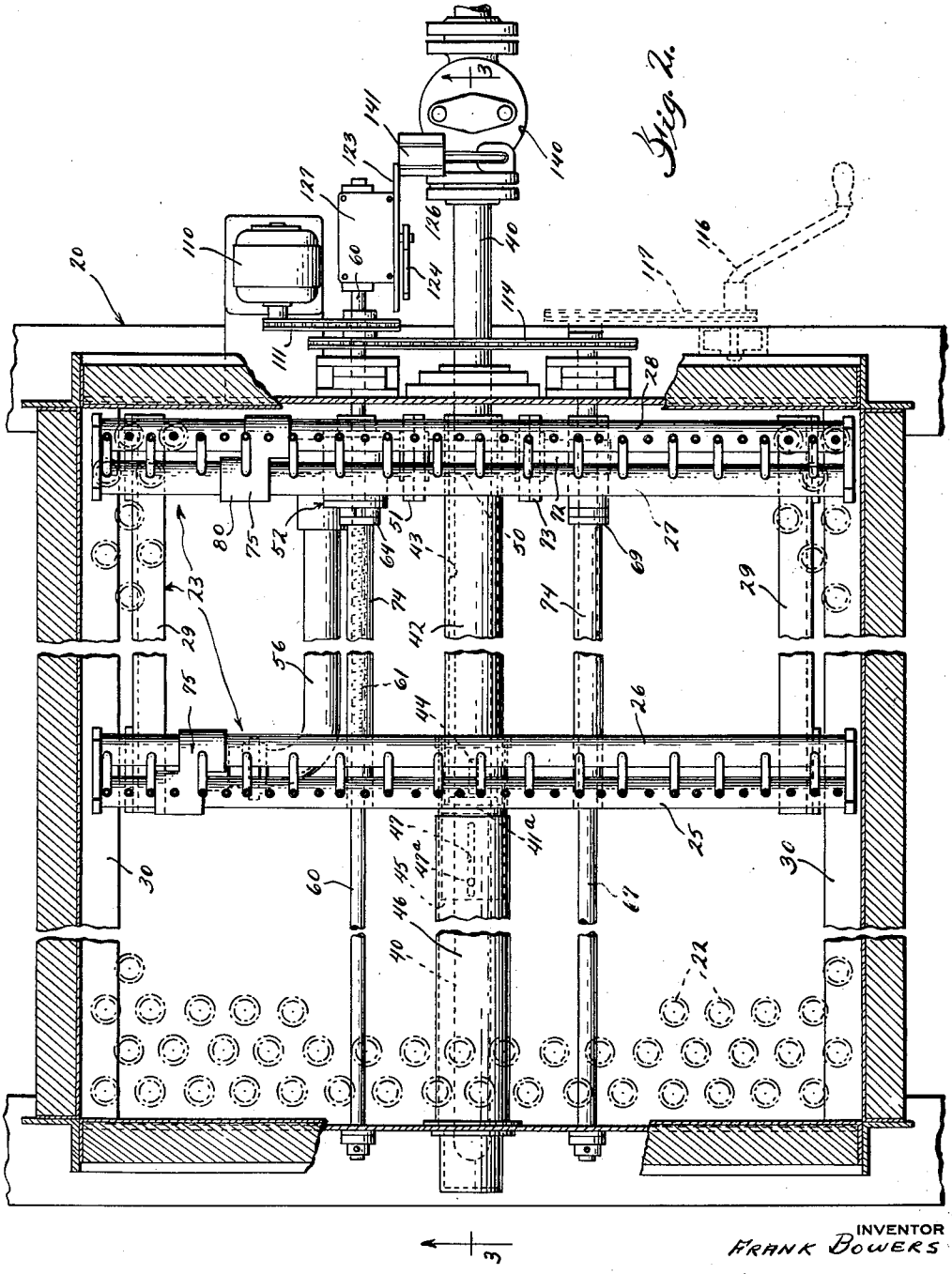
ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 2

Fig. 2.



INVENTOR
FRANK BOWERS

BY Charles B. Belknap

ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 3

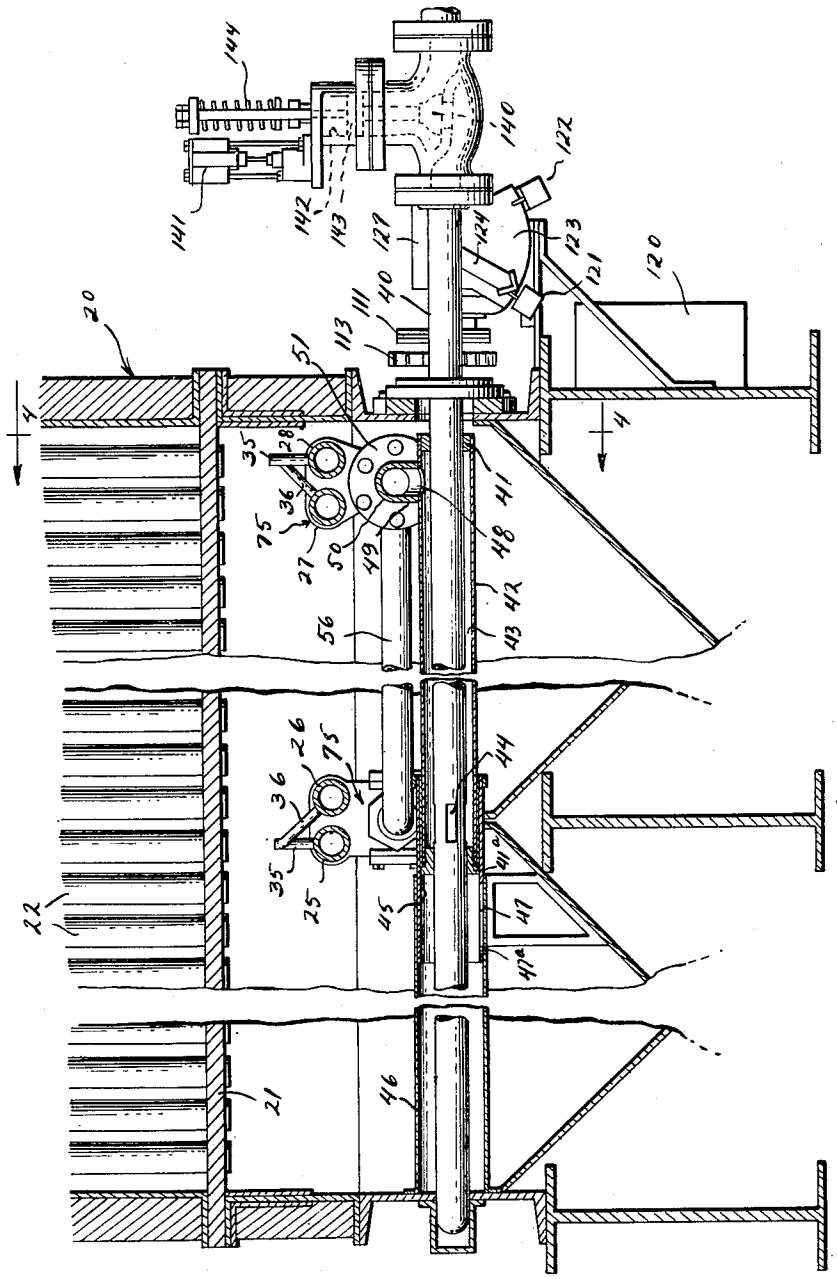


Fig. 3.

INVENTOR
FRANK BOWERS

BY Charles B. Belknap

ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 4

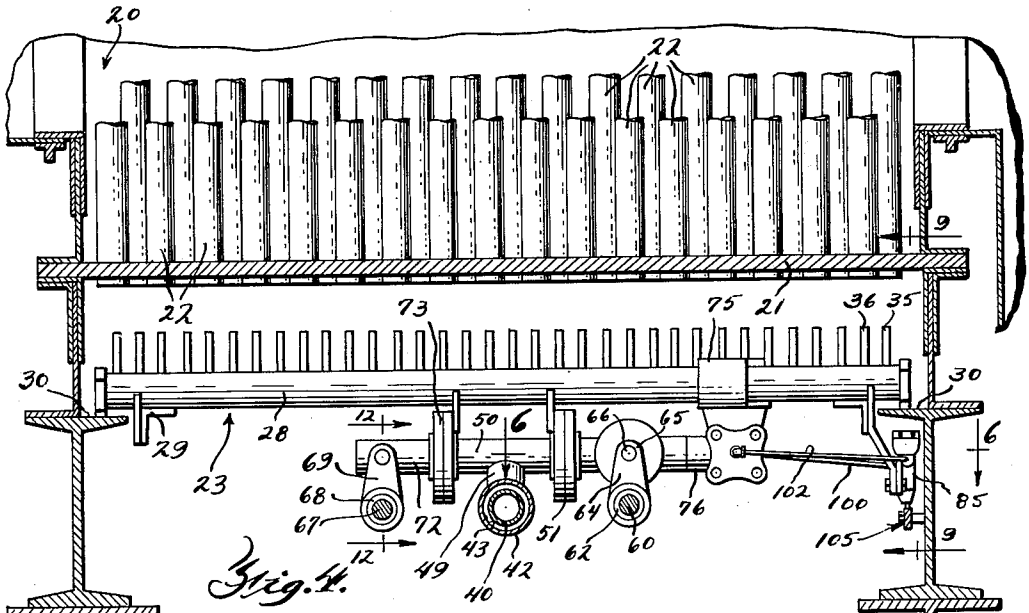


Fig. 4.

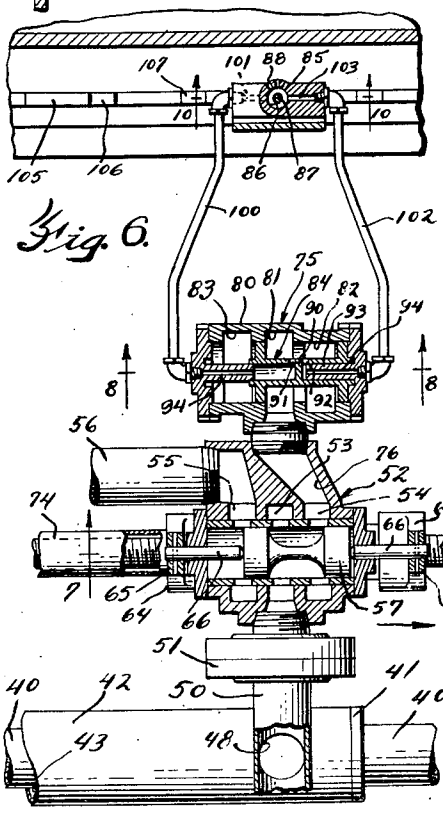


Fig. 6.

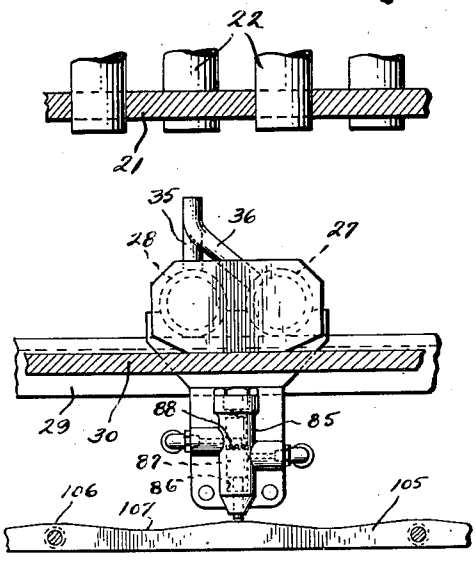


Fig. 9.

INVENTOR
FRANK BOWERS

BY Charles B. Belknap

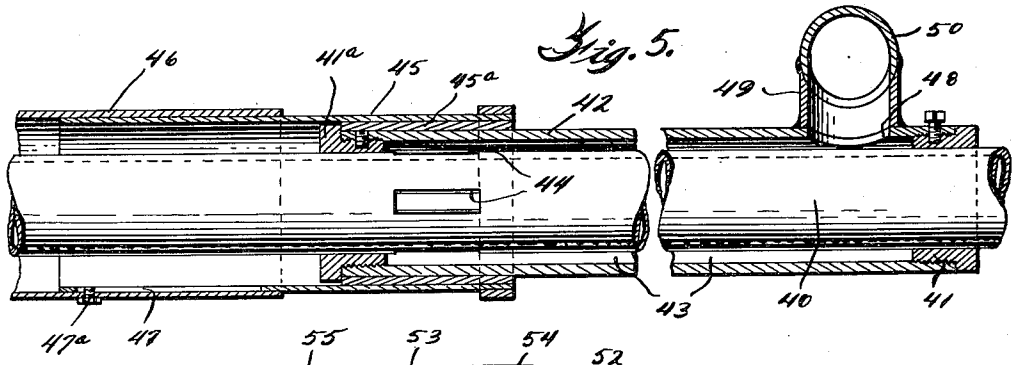
ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 5

Fig. 5.



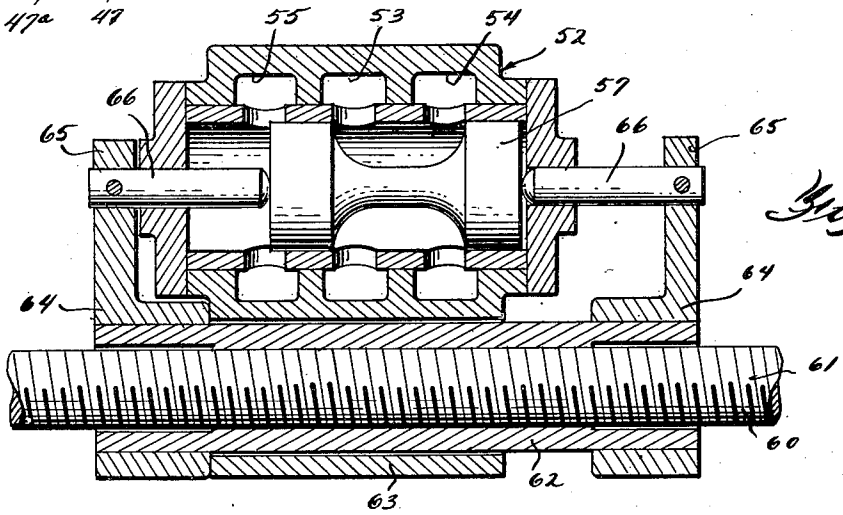


Fig. 7.

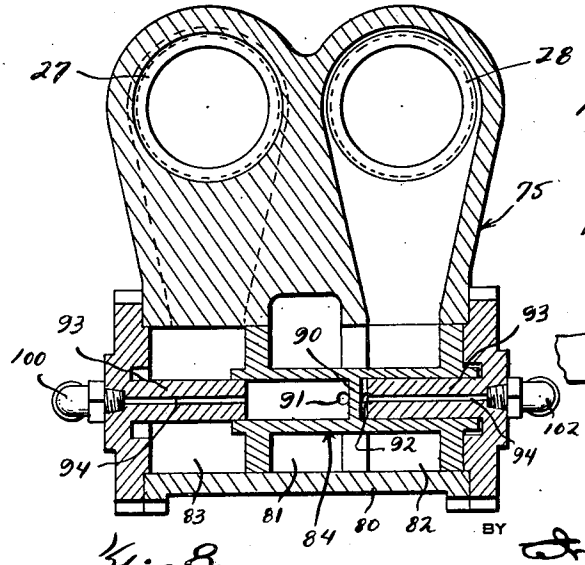


Fig. 8.

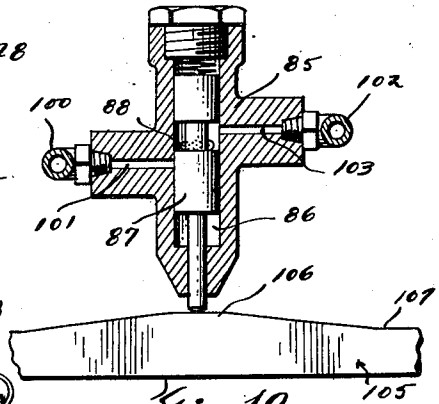


Fig. 10.

INVENTOR
FRANK BOWERS

BY Charles B. Baltorp

ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 6

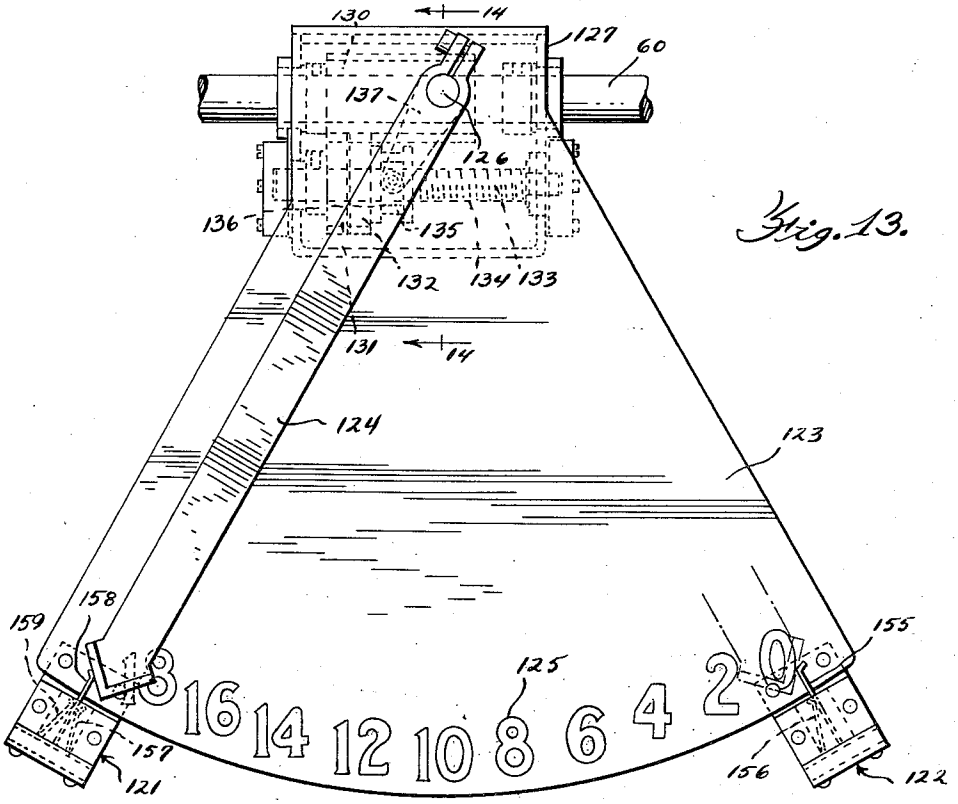


Fig. 13.

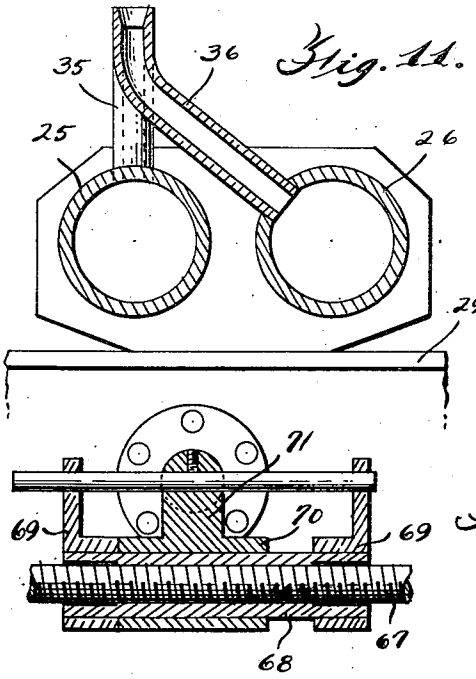


Fig. 11.

Fig. 12.

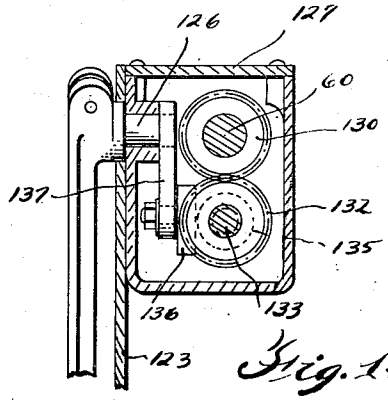


Fig. 14.

INVENTOR
FRANK BOWERS

BY

ATTORNEY

Feb. 2, 1937. F. BOWERS 2,069,574

FLUID HEATER CLEANER

Filed Dec. 3, 1935 7 Sheets-Sheet 7

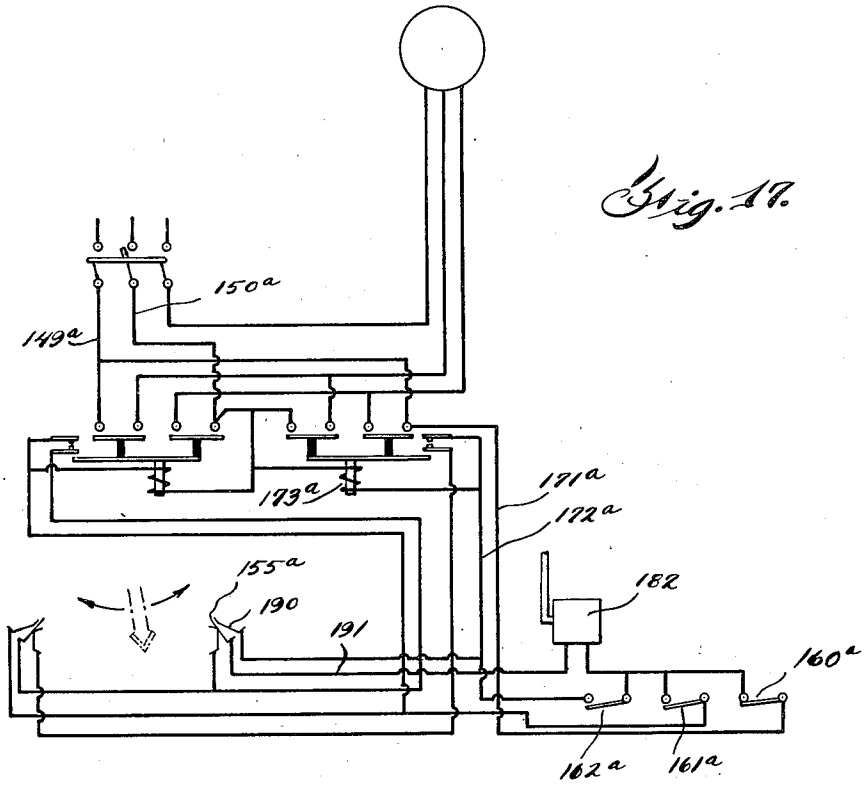


Fig. 17.

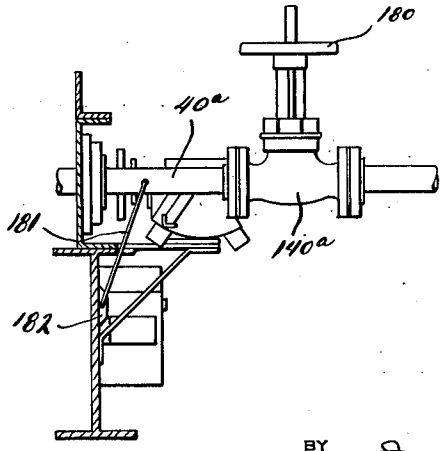


Fig. 16.

INVENTOR
FRANK BOWERS

BY Charles B. Belknap

ATTORNEY

Patented Feb. 2, 1937

2,069,574

UNITED STATES PATENT OFFICE

2,069,574

FLUID HEATER CLEANER

Frank Bowers, Detroit, Mich., assignor to Diamond Power Specialty Corporation, Detroit, Mich., a corporation of Michigan

Application December 3, 1935, Serial No. 52,687

24 Claims. (Cl. 257—1)

This invention relates to a fluid heater cleaner of the type adapted to discharge jets of cleaning fluid adjacent portions of the fluid heater to be cleaned.

One of the primary objects of this invention is to provide a fluid heater cleaner of the above mentioned character in which the blower elements, the means for controlling the flow of cleaning fluid to the blower elements, and the means for moving the blower elements may all be located within the fluid heater with which the cleaner is associated.

The invention has as a further object the provision of a fluid heater cleaner in which effective cleaning may be accomplished with a minimum discharge of cleaning fluid.

Still further the invention contemplates an improved arrangement of valves and actuating mechanisms for the same whereby the control of the supply of cleaning fluid to the blower elements may be conveniently controlled.

Numerous other objects and advantages of this invention will become more apparent as the following description proceeds particularly when reference is had to the accompanying drawings wherein—

Fig. 1 is a fragmentary side elevational view of an air preheater showing the invention associated with the same;

Fig. 2 is a horizontal sectional view taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary vertical sectional view at right angles to the section of Fig. 3, and taken substantially on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged fragmentary sectional view through the cleaning fluid supply means for the blower element;

Fig. 6 is a sectional view taken substantially on the line 6—6 of Fig. 4;

Fig. 7 is a fragmentary sectional view on the line 7—7 of Fig. 6;

Fig. 8 is an enlarged sectional view on the line 8—8 of Fig. 6;

Fig. 9 is a detail sectional view on the line 9—9 of Fig. 4;

Fig. 10 is a detail sectional view taken on the line 10—10 of Fig. 6;

Fig. 11 is a transverse sectional view through two of the blower elements forming part of the construction;

Fig. 12 is a sectional view taken on the line 12—12 of Fig. 4;

Fig. 13 is a fragmentary plan view of a portion of the control mechanism for the cleaner;

Fig. 14 is a fragmentary sectional view taken on the line 14—14 of Fig. 13;

Fig. 15 is a diagrammatic view showing the wiring diagram of the electrical control means utilized with the cleaner;

Fig. 16 is a diagrammatic side elevational view of a slightly modified form of construction; and

Fig. 17 is a view similar to Fig. 15 showing a slightly modified means for initiating the actuation of the system.

For the sake of convenience, the invention will be described as being incorporated in a cleaner associated with an air preheater of the type which includes vertically disposed tubes which open downwardly through a tube sheet. It will be apparent however, as the following description proceeds that the inventive principles may be incorporated in cleaning devices associated with other types of fluid heaters.

Referring then particularly to the drawings wherein like reference characters designate corresponding parts throughout all views, the numeral 20 designates generally an air preheater of the vertical tube type, this preheater having a lower tube sheet 21 through which the tubes 22 extend, these tubes opening downwardly below the tube sheet as clearly illustrated in Fig. 4 of the drawings. In accordance with the usual practice, the tubes in each row are staggered with reference to the tubes in adjacent rows and it constitutes a feature of this invention to provide a construction by which cleaning fluid may be discharged into these tubes.

The cleaner comprises generally a blower frame 23 which is mounted below the tube sheet for reciprocatory movement with respect thereto. The frame includes transversely extending blower elements 25, 26, 27 and 28, and frame or brace members such as the angle bars 29, which secure the blower elements together. The blower elements are arranged in pairs with the elements 27 and 28 parallel with but spaced from the elements 25 and 26. The blower frame is slidably supported on tracks 30 and is adapted to travel one half the length of the tube sheet 21.

The blower elements 25 and 28 are provided with upwardly extending discharge nozzles 35, while the blower elements 26 and 27 are provided with angularly arranged discharge nozzles 36, these latter nozzles terminating in vertically disposed discharge ends aligned with the discharge ends of the adjacent nozzles 35. Thus the blower elements 25 and 26 constitute one set of elements

with their discharge nozzles extending in a line across the fluid heater, while the blower elements 27 and 28 constitute a second set with their discharge nozzles disposed in a continuous line extending across the fluid heater.

In order that the following description may be more readily followed, it might be noted that provision is made whereby the complete frame including all the blower elements is adapted to move from the right to the left as viewed in Fig. 3 of the drawings and to then return to its initial position which is illustrated in this figure. During the travel from the right to the left, cleaning fluid is supplied to blower elements 25 and 26 with the result that the left half of the tubes of the air heater are cleaned during this portion of the cycle of operation. On the return trip, that is during movement of the frame from the left to the right the supply of cleaning fluid to blower elements 25 and 26 is cut off and cleaning fluid is supplied to blower elements 27 and 28 with the result that the right hand half of the tubes of the fluid heater are cleaned, during this return travel of the frame. The mechanism for thus controlling the supply of cleaning fluid to the blower elements will now be described.

A main cleaning fluid supply pipe 40 extends through the fluid heater in the direction of travel of the cleaner frame. Slidably supported on this pipe by the fluid-tight end closures 41 and 41a is a tube 42 which provides a supply chamber 43 surrounding the pipe 40. Pipe 40 is provided with ports 44 which are so located that cleaning fluid will always be admitted from the supply pipe to chamber 43. The tube 42 is adapted to slide within a tube 45 and this tube in turn is adapted for telescopic movement in housing 46. A slot 47 in tube 45 cooperating with a pin 47a carried by housing 46, prevents withdrawal of the tube 45 from housing 46.

Communicating with the chamber 43 by way of a port 48 is a branch 49 of fitting 50. This fitting is coupled as at 51 to a main control valve designated generally by the reference character 52 whereby cleaning fluid may be supplied from the chamber 43 to the inlet chamber 53 of this main control valve.

The function of valve 52 is to cause cleaning fluid to be supplied to elements 25 and 26 during the forward travel of the frame and to cause cleaning fluid to be supplied to elements 27 and 28 during the return travel of the frame and blower elements. For this purpose valve 52 is provided with discharge chambers 54 and 55, the former being connected in a manner which will later be explained to the elements 27 and 28 and the chamber 55 being connected by pipe 56 and through suitable mechanism which will later be explained, to blower elements 25 and 26.

Controlling communication between chamber 53 and either chamber 54 or chamber 55, is a valve member 57. This valve member is mounted for reciprocation in the valve 52 and in the position illustrated in Fig. 6 of the drawings provides communication between inlet chamber 53 and outlet chamber 54. It will be obvious that reciprocation of the valve member to the left as viewed in Fig. 6 will close communication between chambers 54 and 53 and open communication between chambers 53 and 55 whereby cleaning fluid will be supplied to pipe 56 and thus to blower elements 25 and 26.

The position of valve member 57 is dependent upon the direction of travel of the blower frame and it is therefore expedient at this time to refer to the mechanism provided for causing the blower frame to traverse the tube sheet of the fluid heater. Journalled in suitable bearings carried by the fluid heater and extending parallel with the supply pipe 40 is a shaft 60 provided with a threaded portion 61. Referring now to Fig. 7, it will be noted that threaded on shaft 60 is a nut 62 which is mounted for limited sliding movement in a depending portion 63 of the valve 52. Fixed to the ends of the nut 62 are brackets 64 which are adapted to engage the depending portion of the valve to cause the valve to travel with the nut 62 when the nut travels longitudinally of the shaft 60 incident to rotation of the latter. It is to be noted that the brackets 64 are spaced apart a sufficient distance to permit a limited movement of the nut 62 with reference to the valve 52.

Each bracket 64 is provided with an upstanding portion 65 and each portion 65 carries a pin 66 which is adapted for sliding movement through the adjacent end of the valve 52. These pins act on the valve member as will now be described.

As viewed in Figs. 6 and 7, the blower frame is travelling to the right with the result that the pin carried by the bracket at the left of the valve 52 is projected into the valve and has moved the valve member to a position where cleaning fluid is supplied to discharge chamber 54. Should the rotation of shaft 60 be reversed to cause the blower frame to travel to the left, it will be apparent that the initial reverse rotation of the shaft will cause the nut 62 to move relative to the valve 52 causing the pin carried by the bracket at the right as viewed in Fig. 7 to move the valve member to the left thus placing supply chamber 53 in communication with chamber 55. Further rotation of shaft 60 in the same direction will then cause bracket 64 at the right to engage the depending portion of valve 52 thus causing the blower frame to be carried along with the nut 62.

In order to balance the construction, there is preferably provided a second threaded shaft 67 which is rotated in synchronism with shaft 60. Threaded on shaft 67 is a nut 68 which carries at its ends brackets 69 adapted to engage the base portion 70 of a member 71 which is integral with or secured to a solid member 72 which is connected to the fitting 50 as at 73. Additionally, tubes 74 preferably surround the threaded portions of shafts 60 and 67 to protect the latter, these tubes being carried by the nuts 62 and 68 as indicated in Fig. 2 of the drawings.

In addition to the means just described for causing cleaning fluid to be supplied to blower elements 25 and 26 during travel of the blower frame in one direction and to blower elements 27 and 28 during travel of the frame in the other direction, there is also provided means whereby cleaning fluid is alternately supplied to the blower elements of each set during travel of the blower frame. Thus for example, and considering blower elements 27 and 28, when the discharge nozzles 35 are aligned with the open ends of the tubes 22 of one row, cleaning fluid is supplied to the blower element 28. When the blower frame moves however to the next row in which the tubes are staggered with reference to the row just cleaned and at which time the discharge nozzles 36 will be aligned with the fluid heater tubes, the supply of cleaning fluid to blower element 28 will be cut off and cleaning fluid will be supplied to blower element 27. To accomplish this an auxiliary control means is associated with each of the sets of blower elements but since these mech-

anisms are identical in construction one only will be described in detail.

Referring first to Fig. 2 there is associated with each set of blower elements what might be termed a transfer valve 75. As also indicated in Fig. 2, the pipe 56 communicates with the transfer valve 75 associated with blower elements 25 and 26, while as indicated in Fig. 4, a connection 76 connects discharge chamber 54 with the transfer valve 75 associated with blower elements 27 and 28.

The transfer valves are shown in detail in Figs. 6 and 8. Each valve comprises a casing 80, this casing being rigidly connected to the blower elements with which the valve is associated. The casing is divided into three chambers, there being an inlet chamber 81 and discharge chambers 82 and 83. The discharge chamber 82 communicates with blower element 28 while discharge chamber 83 communicates with blower element 27. Mounted for reciprocation in the casing, is a valve member 84 adapted in the position illustrated in Fig. 8 of the drawings to place the inlet chamber 81 in communication with the discharge chamber 82 and adapted when moved to the left from the position shown in Fig. 8 to place the inlet chamber 81 in communication with discharge chamber 83.

The reciprocation of valve member 84 is effected by the pressure of the cleaning fluid and is controlled by a suitable pilot valve illustrated in Figs. 6, 9 and 10. The pilot valve comprises a casing 85 formed with a bore 86 in which a valve plunger 87 is mounted for reciprocation. Discharge ports 88 are provided for the discharge of fluid under pressure from the bore 86 to the atmosphere or to any other suitable point of discharge.

Referring now again to the transfer valve shown in Fig. 8, the valve member 84 is substantially tubular but is divided interiorly by a partition 90. Ports 91 and 92 on opposite sides of this partition place the chambers thus formed within the valve member in communication with the inlet chamber 81.

Carried by the valve casing 80 and projecting inwardly thereof, are bosses 93 and each boss is provided with an exhaust passage 94. These bosses are of such a size as to be slidably received within the chambers formed in the valve member 84, with the result that the fluid supplied to the chambers in the valve member by the ports 91 and 92 may be exhausted by way of the passages 94.

One exhaust passage is as illustrated in Fig. 6 of the drawings connected by a conduit 100 to a bore 101 formed in the pilot valve, this bore communicating with the chamber 86. The other exhaust passage 94 is connected by a conduit 102 to a passage 103 formed in the pilot valve, this passage also communicating with chamber 86. By reference to Fig. 10 of the drawings, it will be noted that vertical reciprocation of valve plunger 87 will place either passage 101 or passage 103 in communication with the exhaust ports 88 so that fluid may be exhausted from either one side or the other of partition 90 in the transfer valve depending upon the position of plunger 87 in the pilot valve. It will be clear that when the exhaust is opened on one side of partition 90 in the transfer valve the pressure acting on the other side of the partition will move the valve longitudinally of the valve housing.

For the purpose of actuating plunger valve 87 in the pilot valve there is provided a cam rail 105, which is suitably supported below the path of travel of the blower frame as clearly illustrated in Fig. 4 of the drawings. This cam rail is provided with high and low portions 106 and 107 respectively, so that as the pilot valve moves longitudinally of the cam rail with the blower frame, the plunger 87 is reciprocated and conduits 100 and 102 are alternately opened to the exhaust.

As thus far described, the operation of the construction is as follows. The blower frame comprising as it does the four blower elements suitably tied together by braces is at the beginning of the cycle of operation in the position shown in Fig. 2. A complete cycle of operation consists in moving the blower frame to the left from the position shown in Fig. 2 until it has completely traversed the tube sheet and in then returning the blower frame to its initial position. This movement of the blower frame is effected by proper rotation of the shafts 60 and 67.

There is, as previously mentioned, a transfer and pilot valve associated with each two blower elements. During the outward travel of the blower frame that is from the right to the left as viewed in Fig. 2, valve 52 is actuated to supply cleaning fluid from chamber 43 to the transfer valve associated with blower elements 25 and 26. As the nozzles 35 are aligned with the fluid heater tubes the transfer valve operates to admit cleaning fluid to blower element 25 so that the tubes with which the nozzles 35 are aligned are cleaned. As the blower frame moves forwardly, the pilot valve associated with the blower elements 25 and 26 effects an actuation of its respective transfer valve so that cleaning fluid is admitted to element 26 with the result that the nozzles 36, which are now aligned with the tubes of the next row, discharge cleaning fluid into these tubes.

When the blower element has reached the limit of its outward movement, the shafts 60 and 67 are reversely rotated and the blower frame starts its travel back to its initial position. Upon the reversing of the travel of the blower frame, valve 52 is actuated so that cleaning fluid is supplied to the transfer valve associated with blower elements 27 and 28 so that these blower elements clean the right hand half of the fluid heater during the return travel of the blower frame. The cam rails 105 are of course so proportioned with reference to the spacing of tubes 22 that only those nozzles aligned with the tubes are supplied with cleaning fluid.

For driving the shafts 60 and 67 to effect the desired travel of the blower frame, there is provided a reversing motor 110. This motor drives through a suitable chain 111, a sprocket 112 secured to the shaft 60. A second sprocket 113 on shaft 60 is connected by means of a chain 114 to a sprocket 115 on shaft 67, whereby the two shafts are operated in synchronism. If desired, a suitable hand crank 116 connected to the shaft 67 by sprocket chain 117 may be provided for operating the blower frame in the event of failure of power.

The motor 110 is controlled by a magnetic switch designated generally by the reference character 120. The switch 120 is in turn controlled by switches 121 and 122, the former causing the magnetic reversing switch to reverse the motor to start the return movement of the blower frame and the latter causing the switch 120 to cut off the supply of current to the electric motor to thus terminate movement of the blower frame when the latter reaches its initial position.

The switches 121 and 122 are detachably se-

cured to the edge of a quadrant-shaped plate 123. Mounted to move over this plate and arranged to engage the switches 121 and 122 at the limits of its movement, is a pointer 124 which is actuated from the shaft 60 in a manner which will later be described. It might be noted that the switches 121 and 122 are preferably adjustable toward and away from each other so that the extent of movement of the blower frame may be varied and that additionally the quadrant-shaped plate may be provided with indicia 125 to facilitate the proper setting of the switches 121 and 122.

The pointer 124 is secured to an arm 126 which projects into a housing 127. The shaft 60 is extended through housing 127 and is provided within the housing with an elongated gear 130 adapted to mesh with and drive gears 131 and 132. Gear 131 is fixed to and drives a shaft 133 which is suitably journalled in housing 127 and this shaft has its outer surface threaded as indicated by the reference character 134.

Gear 132 has a hub which is threaded to engage the threads 134 and additionally the hub of gear 132 is provided with a groove 135 to receive a yoke 136 which is attached to the end of an arm 137 secured to the shaft 126.

As the shaft 60 rotates, it drives shaft 133 by virtue of the engagement of gears 130 and 131. Gear 132 is also driven by gear 130, but gears 131 and 132 have an unequal number of teeth with the result that gear 132 is rotated on shaft 133. This rotation of gear 132 relative to shaft 133 causes gear 132 to travel longitudinally of shaft 133 thus effecting an actuation of an arm 137 and pointer 124. The parts are so proportioned that the pointer moves from one switch to the other during movement of the blower frame across the tube sheet.

For controlling the admission of cleaning fluid to pipe 40, there is provided a main control valve 140. Actuation of this valve is controlled by a solenoid 141 which is so connected in the circuit of the motor 110 that whenever the motor is energized, valve 140 is opened. While the solenoid may control the valve in any manner, it is shown as being adapted to vent a chamber 142 whereby piston 143 which is connected to the valve may be moved upwardly by the pressure of the cleaning fluid, thus opening valve 140. When the solenoid 141 is de-energized pressure builds up in chamber 142 and cooperates with the force of spring 144 to close valve 140.

The magnetic reversing switch may be of any desired character insofar as it so controls the motor as to effect the movement of the blower frame which has previously been described. By way of example, one manner in which the circuits of the switch may be arranged is illustrated in Fig. 15 wherein reference characters 145, 146 and 147 designate the power supply lines adapted to be connected by a suitable switch 148 to the lines 149, 150 and 151. Line 151 is connected directly to the motor 110, while lines 149 and 150 are connected to suitable terminals under the control of solenoid actuated bridge contacts 152 and 153.

The circuit includes the previously mentioned switches 121 and 122, the latter including contacts 155 and 156 and the former including relatively movable contacts 157, 158 and 159. The circuit also includes a normally closed manually operable switch 160 and self opening switches 161 and 162, which may be momentarily closed for a purpose which will later become apparent.

When the blower frame is fully retracted, that is moved all the way to the right as viewed in Fig. 2, arm 124 will be in engagement with contact 155, and will break the circuit between this contact and contact 156. If now the starting switch 162 is momentarily closed, current will flow from line 149 through line 170, line 171, closed switch 160, switch 162, line 172, coil 173 and back to line 150. This will energize coil 173 causing bridge contact 153 to close the circuit to the motor 110 which will cause the blower frame to move toward the left as viewed in Fig. 3.

As soon as the blower frame starts its movement, it will be apparent that arm 124 will be moved out of engagement with contact 155 so that this contact may again engage contact 156 as illustrated. Switch 162 may now be released since current will flow from line 150 through coil 173 to line 172 and then through switch 175, which is closed upon actuation of bridge contact 153, and from switch 175 through contacts 157 and 158 and then through contacts 156 and 155 and back through closed switch 160 to line 149.

The forward movement of the blower frame will continue until arm 124 moves contact 158 out of engagement with contact 157 and into engagement with contact 159, whereupon the motor circuit will be reversed. This will be effected by virtue of the flow of current from line 150 through coil 176, line 177, contacts 158 and 159 of switch 121 then through switch 122, then through switch 160 and back to line 149. As soon as the blower frame starts its reverse travel, contact 158 moves back into engagement with contact 157 and current now flows from line 150 through coil 176, through switch 178 which is closed upon closing of bridge contact 152 by energization of coil 176 and from switch 178 through switch 122, closed switch 160 back to line 149. Obviously, the return movement of the blower frame will continue until arm 124 again breaks the circuit between contacts 155 and 156 whereupon the operation of the motor will be terminated.

As previously mentioned, the solenoid 141 which controls the actuation of valve 140 is connected to the motor circuit so that when the motor is operated and the blower frame is being moved, cleaning fluid will be supplied to the blower nozzles. The operation of the blower frame can be reversed at any time during its forward movement by opening switch 160 to de-energize coil 173 and by then closing this switch and momentarily closing switch 161 which accomplishes the same result as the momentary closing of contacts 158 and 159.

It might be noted that during the travel of the blower frame to the left, the tube 142 slides through the sleeve 45 and insert 45a which is fixed to sleeve 45 until fitting 50 engages the end of tube 45 forcing this tube into the housing 46. On the return stroke, tube 42 slides through sleeve 45a until the flange 41a engages sleeve 45a and draws the tube 45 outwardly to substantially the position shown in Fig. 5.

From the above it is believed that the general operation of the cleaner will be readily understood. With the blower in its normal position, the push button switch 162 may be momentarily closed and this will effect an opening of the main control valve 140 and will start the actuation of the motor 110. The blower frame will be moved outwardly or to the left and during this outward travel cleaning fluid will be supplied to blower elements 25 and 26 whereby the

left hand part of the fluid heater as viewed in Fig. 3 will be cleaned.

After the blower frame has reached the limit of its outward movement, the motor 110 is automatically reversed and the blower frame moved to the right as viewed in Fig. 3. During this movement of the blower frame cleaning fluid is supplied to blower elements 27 and 28 and is discharged from these elements to clean the right hand part of the fluid heater as the same is viewed in Fig. 3. When the blower frame reaches its initial position, the motor 110 will be automatically stopped and the supply of cleaning fluid to the blower elements will be cut off necessitating a further momentary actuation of switch 162 to effect another cycle of operation.

In Fig. 16 a slight modification of the main control means is illustrated as comprising a main valve 140a, which is adapted to be manually opened by hand wheel 180. Beyond the main valve 140a, there is tapped into the supply pipe 40a a conduit 181 which supplies fluid under pressure to a pressure actuated switch designated generally by the reference character 182.

The pressure actuated switch 182 functions in a manner similar to switch 162 to start the actuation of the motor which moves the blower frame and the manner in which this may be effected is diagrammatically illustrated in Fig. 17. It will be noted that the circuit utilized is practically identical with that shown in Fig. 15, there being however, added to the circuit a contact 190 which is connected to line 172a. The switch 182 is located in the line 191 which connects the contact 155a to the switches 160a, 161a and 162a.

When pressure builds up sufficiently to close switch 182 current flows from line 149a through line 171a, closed switch 160a, switch 182, to contact 155a. It will be understood that with the blower frame in its retracted position, contact 155a will be in engagement with contact 190, so that current will flow from this contact through line 172a, coil 173a to line 150a. As the blower frame starts to move outwardly this circuit will be broken but the circuit to the motor will be maintained in the manner previously described.

Upon the return of the blower frame to its original position, contact 155a will again be moved into engagement with contact 190 so that the motor will again be reversed if the pressure switch 182 is still closed. Thus the blower frame will continue to reciprocate until the valve 140a is closed.

If desired, a suitable alarm may be connected in parallel with the contacts 155a and 190, so that each time these contacts are closed the alarm is actuated to indicate that the blower frame has returned to its original position so that the operator may, if he so desires, cut off the supply of cleaning fluid to the blower frame.

While the invention has been described with some detail, it is to be clearly understood that the description is for the purposes of illustration only and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What I claim as my invention is:

1. In a fluid heater cleaner, a plurality of blower elements, means for moving all of said elements in a direction normal to their longitudinal axes and as a unit with reference to portions of the fluid heater to be cleaned, and means operating in dependence upon the movement of said blower elements to limit the supply of cleaning fluid to one of said blower elements at a time.

2. In a fluid heater cleaner, a plurality of blower elements fixed against movement with respect to each other, means for reciprocating said blower elements in a direction normal to their longitudinal axes, and means controlled by the movement of said blower elements for limiting the supply of cleaning fluid to one of said blower elements at a time.

3. In a fluid heater cleaner, a pair of blower elements, means for moving said blower elements in a direction normal to their longitudinal axes and as a unit with reference to portions of the fluid heater to be cleaned, and means operating to alternately supply cleaning fluid to said blower elements.

4. In a fluid heater cleaner, a pair of blower elements, means for moving said blower elements in a direction normal to their longitudinal axes and as a unit with reference to portions of the fluid heater to be cleaned, a valve controlling the flow of cleaning fluid to said blower elements, and means controlled by the movement of the blower elements for so actuating said valve that cleaning fluid is supplied to only one of said elements at a time.

5. In a fluid heater cleaner, a pair of blower elements, means for moving said blower elements in a direction normal to their longitudinal axes and as a unit with reference to portions of a fluid heater to be cleaned, and means controlled by the movement of said blower elements operating to alternately admit fluid to said blower elements.

6. In a fluid heater cleaner, a blower frame including two sets of blower elements, means for reciprocating said blower frame, and means operating to supply cleaning fluid to one set of blower elements during movement of the blower frame in one direction and to the other set of blower elements during movement of the blower frame in the opposite direction.

7. In a fluid heater cleaner, a blower frame including two sets of blower elements, means for moving said frame with reference to portions of the fluid heater to be cleaned, and means controlled by said moving means for admitting cleaning fluid to one set of blower elements during movement of the blower frame in one direction and to the other set of blower elements during movement of the frame in the opposite direction.

8. In a fluid heater cleaner, a blower frame including two pairs of blower elements, means for reciprocating said blower frame, a valve for controlling the admission of cleaning fluid to said blower elements, and means actuating said valve from said blower frame moving means operating to admit cleaning fluid to one pair of blower elements during movement of the frame in one direction and to the other pair of blower elements during movement of the frame in the other direction.

9. In a fluid heater cleaner, two pairs of blower elements, means for reciprocating said pairs of blower elements as a unit to cause the same to travel back and forth across the fluid heater, the pairs of blower elements being so spaced that during said reciprocation one pair of blower elements traverses one half of the fluid heater while the other pair of blower elements traverses the other half of the fluid heater, means controlled by the reciprocating means for admitting clean-

ing fluid to one pair of blower elements during movement of all the blower elements in one direction and to the other pair of blower elements during movement of the blower elements in the other direction, and means associated with each pair of blower elements for alternately admitting cleaning fluid to the elements of the pair during the interval of supply of cleaning fluid thereto.

10. In a fluid heater cleaner, a blower frame, including two pairs of blower elements, means for reciprocating said frame to cause the same to travel back and forth across the fluid heater, the pairs of blower elements being so spaced that during said reciprocation one pair of blower elements is adapted to discharge cleaning fluid into one half of the fluid heater while the other pair of blower elements is adapted to discharge cleaning fluid into the other half of the fluid heater, a valve operating upon reciprocation of said blower frame to admit cleaning fluid to one pair of blower elements during movement of said frame in one direction and to the other pair of said blower elements during movement of the blower frame in the other direction, a transfer valve associated with each pair of blower elements for controlling the admission of cleaning fluid to the same and means controlled by the movement of the blower elements for so actuating said transfer valves that cleaning fluid is alternately supplied to the blower elements of a pair during the interval of supply of cleaning fluid to the pair.

11. In a fluid heater cleaner, a pair of blower elements fixed in parallel relation with respect to each other, discharge nozzles carried by said blower elements, the discharge nozzles of one of said elements being bent to lie in the plane of the discharge nozzles of the other element, means for moving said blower elements in a direction normal to their longitudinal axes, and a transfer valve associated with said elements operable during movement thereof to admit cleaning fluid alternately to said elements.

12. In a fluid heater cleaner, a pair of blower elements fixed in parallel relation with respect to each other, discharge nozzles carried by said blower elements, the discharge nozzles of one of said elements being bent to lie in the plane of the discharge nozzles of the other element, means for moving said blower elements in a direction normal to their longitudinal axes, a transfer valve associated with said elements operable during movement thereof to admit cleaning fluid alternately to said elements, and a pilot valve controlling the actuation of said transfer valve.

13. In a fluid heater cleaner, a pair of blower elements fixed in parallel relation with respect to each other, discharge nozzles carried by said blower elements, the discharge nozzles of one of said elements being bent to lie in the plane of the discharge nozzles of the other element, means for reciprocating said blower elements in a direction normal to their longitudinal axes, a transfer valve associated with said elements to control the flow of cleaning fluid thereto, a pilot valve controlling the actuation of said transfer valve, and means including a cam rail disposed adjacent the path of reciprocation of said blower elements for actuating said pilot valve.

14. In a fluid heater cleaner, a blower frame including two pairs of blower elements, means for reciprocating said blower frame to cause the same to travel back and forth across the fluid heater, means controlling said reciprocating means to limit the reciprocatory movement of the blower frame, a source of cleaning fluid, a main valve controlling the flow of cleaning fluid from the source to the blower elements, and means for controlling the actuation of the main valve in dependence upon the actuation of said reciprocating means.

15. In a device for discharging cleaning fluid into openings arranged in rows with the openings in one row staggered with reference to the openings in adjacent rows, a blower frame comprising two pairs of blower elements, one blower element of each pair having nozzles adapted to register with the openings in alternate rows and the other blower element of each pair having nozzles adapted to register with the openings in the remaining rows, means for reciprocating said blower frame, means for admitting cleaning fluid to one pair of blower elements during a portion of the reciprocation of the blower frame and to the other pair of blower elements during the remaining portion of the reciprocation of the blower frame, and means associated with each pair of blower elements for alternately admitting cleaning fluid to the same during the interval of supply of cleaning fluid thereto.

16. In a cleaner for an air heater having a plurality of tubes opening through a tube sheet, said tubes being arranged in rows with the tubes in each row staggered relative to the tubes in adjacent rows, a blower frame comprising two pairs of blower elements, one blower element of each pair having nozzles adapted to register with the tube openings in alternate rows and the other blower element of each pair having nozzles adapted to register with the tube openings in the remaining rows, means for reciprocating said blower frame to cause the same to travel back and forth across the air heater, the pairs of blower elements being so spaced that during said reciprocation the nozzles of one pair move past the open ends of half of the rows of tubes while the nozzles of the other pair move past the open ends of the tubes in the remaining rows, and means controlling said reciprocating means operating to limit the reciprocatory movement of the blower frame and to terminate the movement of the blower frame after one complete reciprocatory movement thereof.

17. In a cleaner for an air heater having a plurality of tubes opening through a tube sheet, said tubes being arranged in rows with the tubes in each row staggered relative to the tubes in adjacent rows, a blower frame comprising two pairs of blower elements, one blower element of each pair having nozzles adapted to register with the tube openings in alternate rows and the other blower element of each pair having nozzles adapted to register with the tube openings in the remaining rows, means for reciprocating said blower frame to cause the same to travel back and forth across the air heater, the pairs of blower elements being so spaced that during said reciprocation the nozzles of one pair move past the open ends of half of the rows of tubes while the nozzles of the other pair move past the open ends of the tubes in the remaining rows, means controlling said reciprocating means to limit the reciprocatory movement of the blower frame, a main valve controlling the flow of cleaning fluid from a source of cleaning fluid supply to a main supply chamber, a second valve controlling the flow of cleaning fluid from said chamber to said pairs of blower elements, and a transfer valve associated with each pair of blower elements operating to supply cleaning fluid alternately to the elements of each pair.

18. In a cleaner for an air heater having a plurality of tubes opening through a tube sheet, said tubes being arranged in rows with the tubes in each row staggered relative to the tubes in adjacent rows, a blower frame comprising two pairs of blower elements, one blower element of each pair having nozzles adapted to register with the tube openings in alternate rows and the other blower element of each pair having nozzles adapted to register with the tube openings in the remaining rows, means for reciprocating said blower frame to cause the same to travel back and forth across the air heater, the pairs of blower elements being so spaced that during said reciprocation the nozzles of one pair move past the open ends of half of the rows of tubes while the nozzles of the other pair move past the open ends of the tubes in the remaining rows, a main valve for controlling the flow of cleaning fluid to said blower elements, and means operating upon the operation of said main valve to start the actuation of said reciprocating means.

19. In a cleaner for an air heater having a plurality of tubes opening through a tube sheet, said tubes being arranged in rows with the tubes in each row staggered relative to the tubes in adjacent rows, a blower frame comprising two pairs of blower elements, one blower element of each pair having nozzles adapted to register with the tube openings in alternate rows and the other blower element of each pair having nozzles adapted to register with the tube openings in the remaining rows, means for reciprocating said blower frame to cause the same to travel back and forth across the air heater, the pairs of blower elements being so spaced that during said reciprocation the nozzles of one pair move past the open ends of half of the rows of tubes while the nozzles of the other pair move past the open ends of the tubes in the remaining rows, means controlling said reciprocating means to limit the reciprocatory movement of the blower frame, a source of supply of cleaning fluid, a main valve controlling the flow of cleaning fluid from said source of supply to a main supply chamber, a second valve controlling the flow of cleaning fluid from said chamber to said pairs of blower elements, means controlled by said reciprocating means so actuating said second valve as to supply cleaning fluid to one pair of blower elements during movement of the blower frame in one direction and to the other pair of blower elements during movement of the blower frame in the other direction, a transfer valve associated with each pair of blower elements operating to supply cleaning fluid alternately to the elements of its respective pair, a pilot valve associated with each transfer valve to control the actuation thereof, and means actuating said pilot valves in dependence upon the movement of the blower frame.

20. In a fluid heater cleaner, blower elements arranged in parallel spaced relation to each other, means for reciprocating said blower elements as a unit to cause the same to travel back and forth across the fluid heater, and means controlled by the reciprocating means for admitting cleaning fluid to one of said blower elements during movement of the blower elements in one direction and to another of the blower elements during movement of the blower elements in the opposite direction.

21. In a fluid heater cleaner, a pair of blower elements fixed in parallel relation with respect to each other, discharge nozzles carried by said blower elements, means for moving said blower elements in a direction normal to their longitudinal axes, and means operating upon movement of the blower elements to admit cleaning fluid alternately to said blower elements.

22. In a fluid heater cleaner, a pair of blower elements fixed in parallel relation with respect each other, discharge nozzles carried by said blower elements, means for moving said blower elements in a direction normal to their longitudinal axes, and a pressure actuated transfer valve associated with said blower elements and operable during movement thereof to admit cleaning fluid alternately to said elements.

23. In a fluid heater cleaner, a plurality of blower elements fixed against movement with respect to each other, means for effecting a travel of said blower elements as a unit with reference to portions of the fluid heater to be cleaned, and means controlled by the movement of said blower elements for limiting the supply of cleaning fluid to one of said blower elements at a time.

24. In a fluid heater cleaner, a pair of blower elements, means for effecting a travel of said blower elements as a unit with reference to portions of the fluid heater to be cleaned, and means controlled by movement of said blower elements operating to alternately supply cleaning fluid to said blower elements.

FRANK BOWERS.