Jan. 26, 1960 G. ROWE 2,922,469

FUEL OIL DISTRIBUTION SYSTEM

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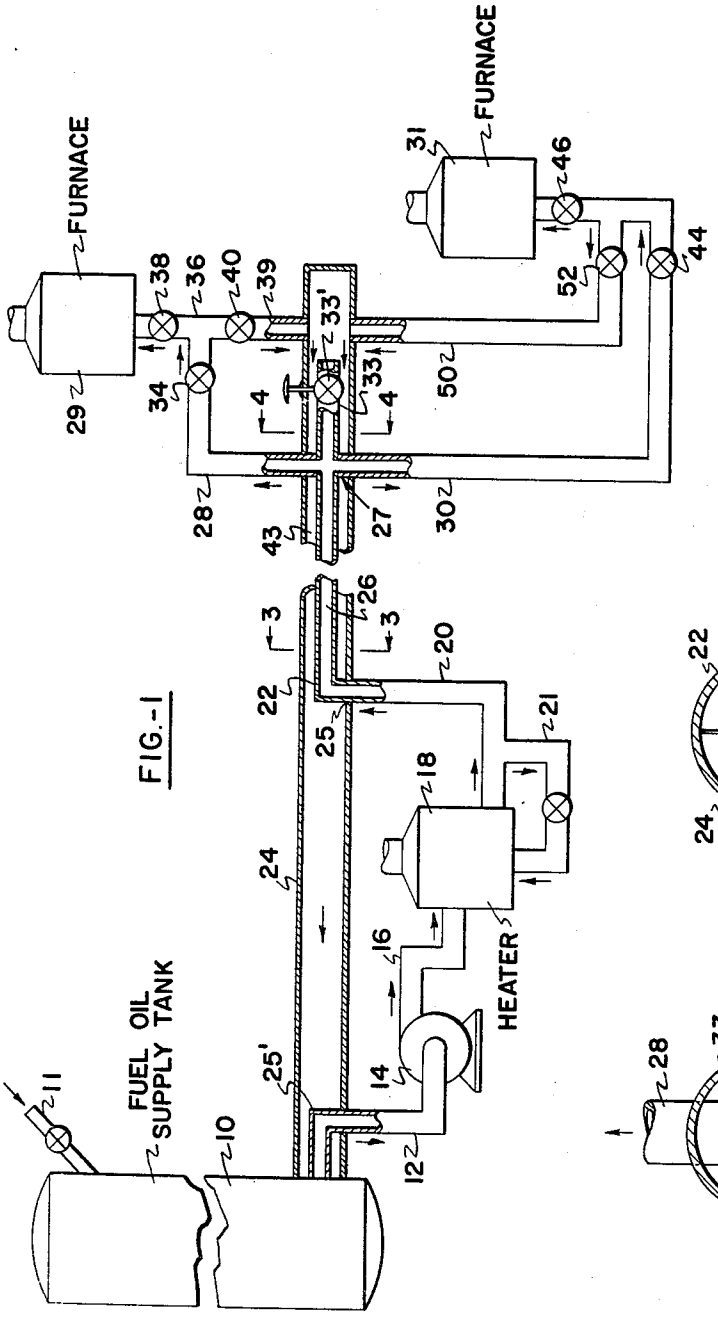

FIG.-1

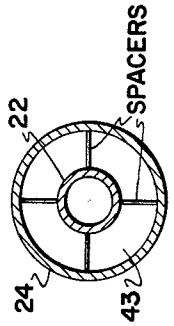

FIG.-3

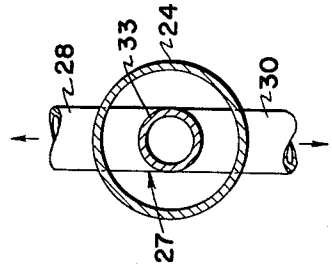

FIG.-4

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FUEL OIL DISTRIBUTION SYSTEM

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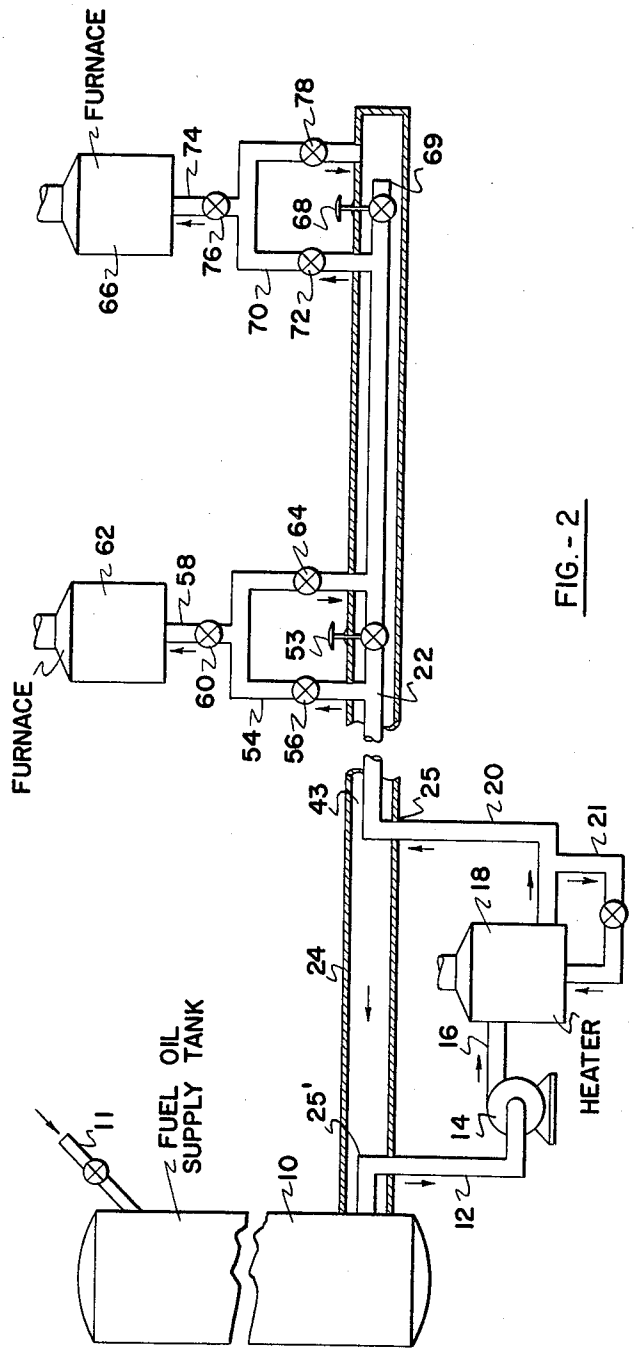

FIG. - 2

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FUEL OIL DISTRIBUTION SYSTEM

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3 Claims. (Cl. 158—36)

This invention relates to improvements in fuel oil distribution systems, and more particularly relates to heavy oil distribution systems for consumer furnaces.

The most common scheme for heavy fuel oil distribution to furnaces is a loop distribution system. The fuel oil is pumped from a supply tank to a fuel oil heater which heats the oil to permit freer flowing. The fuel oil then flows through a pipe or tubing to one or more consumer furnaces. The excess fuel oil is then returned via a loop or separate line to the fuel oil supply tank. All lines are usually completely insulated to keep heat losses to a minimum. Fuel oil in excess of the requirements of the furnaces is returned in order that heated fuel oil will be continuously circulated throughout the supply system which is necessary to insure a free and adequate flow of fuel oil to the consumer furnace or heater. In practice, the distance from the fuel oil heater to the consumer furnaces is usually great and in some cases this distance is nearly half a mile. The cost of the installation is therefore high and the heat loss is likewise rather high. As the distance increases, the increasing heat loss will also necessitate the use of larger heaters and pumps for a given requirement of fuel oil.

The present invention provides a new and improved system for the distribution of heavy oil to one or more consumer furnaces. The invention employs a double pipe sysem comprising a smaller pipe and a larger pipe whereby the larger pipe surrounds and is concentric to at least a portion of said smaller pipe. The freshly heated oil from the heater is pumped through the smaller line to the furnaces and a greater amount of oil is pumped than is utilized by the furnace or furnaces. The excess oil from the furnace or furnaces is returned to the storage tank through the annular passageway between the smaller pipe and the larger pipe permitting the oil flowing to the furnaces to be in indirect contact with the oil flowing from the furnaces. As will be explained more fully hereinafter, the use of this system will result in lowering the heat losses and also lowering the installation and operational costs of the system.

In the drawings:

Fig. 1 shows a side elevation of one form of apparatus adapted to practice the present invention, with parts shown in section to more clearly illustrate the invention;

Fig. 2 illustrates another form of the invention where a different arrangement of furnaces is used;

Fig. 3 represents a vertical cross section taken substantially on line 3—3 of Fig. 1; and

Fig. 4 represents a vertical cross section taken substantially on line 4—4 of Fig. 1.

Referring now to Fig. 1 of the drawing, the reference character 10 designates a fuel oil supply tank provided with an inlet line 11 for fuel oil. Fuel oil, such as vacuum pipestill bottoms is withdrawn from the supply tank 10 through line 12 by pump 14 which can be any suitable pump. Oil is passed through line 16 by pump 14 to the fuel oil heater 18 which can be a petrochem or other type furnace. The oil is heated in heater 18 to a temperature between about 400° F. and 450° F. The heated oil from the heater 18 flows through line 20 into line 22 which is located within and concentric to a larger pipe or line 24. A portion of the heated oil is withdrawn from line 20 by valved line 21 and used as fuel for heater 18. The heated oil flows through line 22 within passageway 26 in the direction of the consumer furnaces.

Line or pipe 24 is provided for returning excess heated fuel oil from the burners to tank 10. Line or pipe 20 is of a smaller diameter than pipe 24 and extends through the wall of pipe 24 at 25 and then turns at a right angle to form the pipe or line 22 which is concentric with the pipe 24. It is to be noted that the pipe 24 from about the region 25 to the tank 10 does not have any concentric pipe therein except for pipe or line 12 which leads from tank 10 and turns at a right angle at about 25' downstream from tank 10 and passes through the wall of outer pipe 24 and then leads to pump 14 as described above. The temperature of the fuel oil in tank 10 will be between about 300° F. and 350° F. and as this will be a little cooler than the excess fuel oil being returned to tank 10 by larger line 24, it is desirable to withdraw the cooler oil from tank 10 through line 12 which, for a short distance, is concentric with larger pipe 24 to maintain fluidity of the fuel oil while it is being withdrawn from tank 10. In some cases it may be desirable to withdraw oil directly from tank 10 without having line or pipe 12 concentric with larger pipe 24.

The distance or length of larger pipe 24 from region 25 to tank 10 will be the shortest distance and will usually be between about 30 feet to 50 feet, whereas the distance or length of larger pipe 24 from region 25 to a pair of cross connected conduits or lines providing a supplementary discharge outlet 33 with valve 33' and a T-shaped branch line 27 which leads to the furnaces presently to be described will usually be between about 1000 feet and 2500 feet or greater depending on the physical layout of the plant.

Where more than one consumer furnace is used, the line 22 opens into a branched line 27 with one branch 28 going to one furnace 29 and the other branch 30 going to furnace 31. Discharge outlet 33 is an extension of line 22 downstream of branch line 27 and is provided with valve 33' which may be used to regulate or permit the flow of excess oil directly from line 22 into larger line 24. Branched line 27 is a T-shaped line or connection which extends at right angles through the wall of the larger pipe or line 24 as shown in Figs. 1 and 4. The one line 28 is provided with a valve 34 leading into a feed line 36 for the furnace 29 with feed line 36 being provided with valve 38 to control the amount of oil going to the furnace 29. Line 36 is also T-shaped and the other portion or that portion 39 leading away from furnace 29 is provided with a valve 40 which may be used instead of valve 34 to regulate total flow through lines 28 and 39. Valve 40 may also be used with valve 34 to block off furnace 29. Line 39 communicates with and empties into the larger line 24. The excess heated oil or that oil not needed for firing furnace 29 is returned to the supply tank 10 through the annular passageway 43 and through the larger pipe or line 24 as shown in Figs. 1 and 3. The other branch 30 of the T-shaped line 27 extends in the other direction and this leads to the second furnace 31. Line 30 is provided with valve 44 and a second valve 46 which controls the amount of oil feed going to the second furnace 31. The excess amount of oil not needed for firing the second furnace 31 is returned through line 50 and the flow is controlled in this line by valve 52. Line 50 also communicates with and empties into the larger pipe or line 24 for returning the hot oil back to the supply tank 10. In returning

the heated oil to the supply tank 10, the oil contacts the outer surface or wall of the smaller oil line 22 and thus maintains the temperature of the oil feed which is being delivered to the consumer furnaces in a heated condition.

When valve 34 in line 28 in Fig. 1 is opened, it permits heated fuel oil to flow through lines 28 and 36 to furnace 29 with the amount of fuel oil to the furnace being controlled by a valve 38. Valve 40 is opened sufficiently to permit the excess fuel oil to return through line 39 to the larger pipe 24. The oil then returns to the fuel oil supply tank 10 through pipe 24 with a considerable portion of the passageway being the annular passageway 43. The flow of the excess heated oil through the annular passageway 43 and around the smaller pipe 22 effects indirect contact with the freshly heated oil flowing through line 22, thus reducing the heat loss from the heated oil in line 22. The flow of fuel oil to furnace 31 is accomplished in a similar manner. Valve 44 is opened and valve 46 controls the flow of heated oil to furnace 31 and valve 52 regulates the return of oil through line 50 to the line 24. Valve 33' may be closed or partly opened depending on the amount of excess oil required to be circulated through passageway 43 and line 24.

In case it is desired to use only burner or furnace 29 and not furnace 31, valve 46 may be closed and heated oil circulated through pipe 30, valves 44 and 52 and pipe 50 to maintain flow of oil through these lines and to prevent congealing or solidification of the heavy fuel oil. Normally valves 34, 40, 44, and 52 will be located as closely as possible to line 24. They can then be closed when furnace is shut down, reducing heat loss.

Fig. 2 illustrates another embodiment of the invention with a different arrangement and location of furnaces. Similar elements are designated by the same reference characters used in Fig. 1. A valve 53 is located in smaller line 22 and is downstream from an outlet line 54 extending at a right angle from the smaller line 22 through the wall of larger pipe 24. The outlet line 54 is essentially a bypass around valve 53 and is provided with a hand control valve 56. Line 54 communicates with a feed line 58 which is provided with a valve 60 to regulate the amount of heated oil going to the furnace 62 through line 58. Downstream of the feed line 58 and valve 60, the bypass line 54 extends through the wall of larger pipe 24 and makes connection with the smaller pipe 22. The excess heated oil, or oil not needed as fuel for furnace 62, which is passed through by-pass line 54, continues its flow through line 22 toward furnace 66. As shown in Fig. 2, the outlet end of line 22 is provided with a valve 68 substantially at its open end 69 so that, if necessary, valve 68 can be opened to deliver heated oil from line or pipe 22 into the end of larger pipe 24 which is furthest from tank 10 to supply additional heat to the oil in pipe 24, if necessary.

Upstream of valve 68, line 22 is provided with a bypass line 70 around valve 68. The bypass line 70 is provided with a valve 72 and a feed line 74 which leads from the bypass line to the furnace 66 with the rate of fuel oil fed to the furnace 66 being controlled by valve 76. Downstream of the feed line 74, the bypass line is provided with a valve 78. Downstream of valve 78, the bypass line 70 communicates with and empties into the larger line 24 for returning the excess heated oil to the supply tank 10. In returning the heated oil to the supply tank 10, the oil contacts the outer surface of the smaller pipe 22 and insulates the freshly heated oil in pipe 22 and reduces the heat loss from the freshly heated oil.

In the arrangement shown in Fig. 2, valve 53 is used as a source of pressure drop which will cause oil to flow through lines 54 and 58. Valve 53 would not be fully closed as this would cause a dead zone in line 22 downstream of valve 53. By partially closing valve 53 in line 22 which is downstream of the outlet of bypass line 54 and upstream of the bypass return to line 22, some of the oil is diverted through bypass line 54 and valve 56 to the furnace 62 with the amount of oil being burned being controlled by valve 60 while the rest of the oil passes on through line 22 to furnace 66. The excess oil in bypass line 54 returns through valve 64 to the smaller pipe 22 which leads to an additional furnace or furnaces. Valve 68 may be closed or partly open depending on the amount of excess oil required in line 24. This in turn will depend on the temperature in tank 10, the viscosity of the fuel which sets the temperature required at the consumer furnaces and the air temperature which sets the overall heat loss. With valve 68 closed, heated fuel oil is passed through the outlet of bypass 70 and valve 72 through line 74 and regulating valve 76 to another furnace 66. The excess oil is returned through valve 78 and the bypass return to larger pipe or line 24. It will be noted that the bypass return opens into the larger line 24 thus permitting the direct return of the excess oil through the annular passageway 43 to the fuel oil supply tank 10. Valve 68 may be opened or partially opened depending on the amount of excess oil required in passageway 43 and line 24. The excess oil is in indirect contact with the freshly heated oil flowing through line 22 toward the furnaces and any heat loss from the freshly heated oil will be largely absorbed by the excess oil returning to the supply tank.

While no insulation is shown on the pipe lines in the drawings, it is to be understood that insulation is provided for all the external lines or pipes carrying heated oil and also for tank 10.

While the larger pipe or line 24 is shown in the drawing as a straight pipe, it will be understood that in installations where the furnaces are at a great distance from the oil supply tank 10, the larger pipe line 24 may take other forms and may have elbows and different forms of couplings to carry the heated oil around the outside of the smaller pipes for heat exchange purposes.

In a specific example, where only one furnace 29 is used and is set to burn 900 gallons of oil per hour, the line 24 will be about 3 inches in diameter and line 22 about 2 inches. The lines 12, 16 and 20 will be about 2 inches in diameter. The lines or pipes leading to and from the furnaces and communicating with pipe 22 will be about the same diameter as pipe 22. The fuel oil in supply tank 10 is a residual type oil having an API gravity of about 7.5° and at 400° F. has a viscosity of about 37 centistokes which at a cooler temperature of about 300° F. may go up to about 160 centistokes. The temperature of the oil in tank 10 is about 350° F. The insulation for the pipes in this example is 1 inch thick 85% magnesia insulation.

In this example the length of pipe 24 from tank 10 to region 25 is about 50 feet and the length of pipe 24 from region 25 to branch line 27 in Fig. 1 is about 1000 feet. The length of pipe 12 from tank 10 to bend 25' is about 20 feet. Oil enters tank 10 through line 11 at about 300° F. and upon mixing with the recycle oil returned through line 24, the resultant temperature of the oil in tank 10 is about 350° F.

The oil is heated in heater 18 to a temperature of about 435° F. The pump 14 is selected to pump oil at the desired rate to the furnaces. In this example using only furnace 29, an excess of oil is pumped at the rate of about 1600 gallons per hour through line or pipe 28 leading to furnace 29 and there is an excess of about 700 gallons per hour which are returned to tank 10 through larger pipe or line 24. The temperature of the heated oil in line 22 in region 25 is about 435° F. The temperature of the heated oil passed through line 28 to furnace 29 has a temperature of about 420° F. which is lower than that of the freshly heated oil leading to line 22 in the region of 25. The temperature of the oil being returned through larger pipe or line at the outlet end of pipe 39 or at the right hand end of pipe 24 as shown

in Fig. 1 is about 420° F., whereas the temperature of the oil passing to the left of region 25 in Fig. 1 in larger pipe 24 is about 410° F.

As an example, if for a given fuel requirement, the conventional loop system would require two 2 inch lines, the system described in the invention could utilize a 2 inch line within a 3 inch line. Heat loss is a direct function of the exposed area and inasmuch as the circumference of a 3 inch pipe is less than the circumference of two 2 inch pipes, it will be seen that the heat loss is reduced, thereby permitting the use of a smaller fuel oil heater. This in addition will result in permitting the use of a smaller fuel oil pump. A given length of insulation for 3 inch pipe costs less than twice the given length of insulation for 2 inch pipe, and only half the insulation time is required as only one length need be installed instead of two. Therefore, the insulation material and labor cost are decreased. The labor cost for pipe erection is also decreased inasmuch as only one length of pipe will be laid in place of two. The distance from the fuel oil heater to the consumer furnaces is usually long and it is through this distance that the main advantages of the concentric piping arrangement will be realized, although the concentric piping arrangement may be used in other portions of the distribution system such as the take-off or bypass lines from the supply line 22 to the individual furnaces if justified by the distance of the furnace from the supply line 22.

It is to be understood that various changes in shape, size and arrangement of the different elements may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

What is claimed is:

1. A fuel oil distribution system including an insulated oil supply tank, an oil consuming furnace, and means for delivering oil from said tank to said furnace at a rate in excess of the consuming rate of said furnace and returning excess oil to said tank, said means including an oil pump, an oil heater, and piping thermally insulated on all exposed surfaces comprising a main supply pipe connecting said tank, pump, and heater, extending beyond said heater, terminating in an open end, and having a flow control valve closely adjacent said open end, a main return pipe larger than but less than twice the diameter of said main supply pipe and concentric therewith for substantially the full length of said main supply pipe forming an annular passageway communicating with said tank, said main return pipe terminating in a blanked end shortly beyond the open end of said main supply pipe, a branch supply pipe departing from said main supply pipe closely upstream from said flow control valve, penetrating the wall of said main return pipe, and terminating in a T-fitting, a flow control valve in said branch outlet pipe, a furnace feed pipe extending from said T-fitting to said furnace, a flow control valve in said furnace feed pipe, a branch return pipe extending from said T-fitting to said main return pipe in the region beyond the open end of said main supply pipe whereby excess oil from said furnace is admitted to said annular passageway, and a flow control valve in said branch return pipe.

2. A fuel oil distribution system according to claim 1 characterized by a cross fitting in said main supply pipe providing departure connection therefrom for said branch supply pipe, a second branch supply pipe departing from said cross fitting, penetrating the wall of said main return pipe, and terminating in a second T-fitting, a flow control valve in said second branch supply pipe, a second furnace, a second furnace feed pipe extending from said second T-fitting to said second furnace, a flow control valve in said second furnace feed pipe, a second branch return pipe extending from said second T-fitting to said main return pipe in the region beyond the open end of said main supply pipe whereby excess oil from said second furnace is admitted to said annular passageway, and a flow control valve in said second branch return pipe.

3. A fuel oil distribution system according to claim 1 characterized by a second flow control valve in said main supply pipe substantially upstream from said first mentioned flow control valve therein, a second branch supply pipe departing from said main supply pipe closely upstream from said second flow control valve, penetrating the wall of said main return pipe, and terminating in a second T-fitting, a flow control valve in said second branch supply pipe, a second furnace, a second furnace feed pipe extending from said second T-fitting to said second furnace, a flow control valve in said second furnace feed pipe, a second branch return pipe extending from said second T-fitting through the wall of said main return pipe and joining said main supply pipe closely downstream from said second flow control valve therein whereby excess oil from said second furnace is returned to said main supply pipe, and a flow control valve in said second branch return pipe.

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