AUTOMATIC FUEL OIL METERING FOR
GLASS FURNACE BURNERS

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Two types of system are used for automatic control of the delivery of liquid fuels (mainly fuel oil). In one system the total quantity of fuel delivered to the entire furnace is regulated automatically and its distribution to individual burners is determined by the pressure in the fuel-oil distribution line and by the resistance in individual branch pipes to the burners and in the burners themselves. In the other system the delivery of fuel oil to each burner is regulated.

A major shortcoming of the first system is that the resistance in the fuel delivery lines is not constant but varies depending on the degree of clogging of the burners and viscosity and temperature of the fuel, which in turn markedly changes the distribution of fuel and consequently the heating of individual sections along the furnace.

This shortcoming is eliminated in the other system, but many regulating and measuring apparatuses are required for furnaces with numerous burners, which increases capital expenditures and the cost of operation and reduces the reliability of the system. If we take into account that the indicated apparatus is cumbersome, expensive, and unreliable, we cannot consider its use expedient.

It should be pointed out that both systems are built on the principle of measuring instruments detecting deviation of the flow rate from the prescribed value. Thus the presence of deviations is a necessary condition of operation of the systems.

In 1970, an experimental device, developed by the Institute of Glass, for automatic metering of fuel oil in glass furnace burners, which differs fundamentally from the systems described above, was put into operation at the Misheron Glass Plant. Its special feature is that the fuel oil is delivered to each burner by a metering pump driven by an electric motor controlled by a thyristor with motor rpm feedback and, consequently, fuel flow-rate feedback.

Each furnace burner has two nozzles. All burners are grouped in two zones: the first three pairs are in the first zone and the others in the second.

Figure 1 shows a diagram of the fuel-oil metering systems for nozzles of the first zone (the diagram for the second zone is the same).

The system consists of three main units: regulating I, control II, and fuel-oil pumping plants III.

The regulating unit automatically adjusts the fuel flow rate as a function of the temperature in the zone, measured by sensor 1, or as a function of the actual fuel flow rate, measured by sensor 2. Deviation of one of these parameters (depending on the position of regulating switch 3) from the value established by controller 4 or 5 actuates regulators 6 or 7. The regulators by means of selsyn controller 8 change the setting of the fuel flow rate of the three control systems II for the three burners.

Each of the three control systems is a thyristor drive of the PTO type which controls the rpm of motor 10 of the metering fuel-oil pumping plant III. The transducers are equipped with a manual rheostat controller 11 for adjusting the distribution of fuel to burners in the zone. This distribution (ratio of flow rates) remains constant for all changes of flow rates to the zone prescribed by controller 8.

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To lst-3rd burner of left side of furnace, the fuel oil is delivered from the zone line through filters 15 to the inlets of the metering plants III and through cocks 16 to pumps 12. The quantity of fuel metered out through cocks 17 is sent through switch valves 18 and cocks 19 or 20 to nozzles 21 of the right or left side of the furnace. The pneumohydraulic switch valves 18 are controlled by compressed air supplied to one or the other pair of them through electropneumatic valves EPV, which are part of the flame switching system.

The pumps are stopped during the period of switching the delivery of fuel oil from one side of the furnace to the other and the fuel oil flows through bypass valves 22 from the pump outlets to the inlets. These same valves are used to protect the pumps against overloading in the event of complete clogging of the fuel lines to the furnace.

The metering fuel-oil pumping plants III deliver fuel oil alternately to two burners on one and the other side of the furnace. The plant consists of two gear-type metering pumps 12, manufactured in accordance with the first class of precision, connected by couplings with the output ends of the shaft of reducing gear 13. The input shaft of the reducing gear is also connected by a coupling with the shaft of motor 10. The other end of the shaft of motor 10 is connected with a tachogenerator 14. The voltage removed from the brushes of the tachogenerator is used for monitoring the flow rate and feedback in the thyristor system for automatic stabilization of the motor rpm and consequently of the delivery of fuel oil to the furnace burner.

Fig. 1

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