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# DISTRICT HEATING

INTERNATIONAL DISTRICT HEATING ASSOCIATION
IDHA

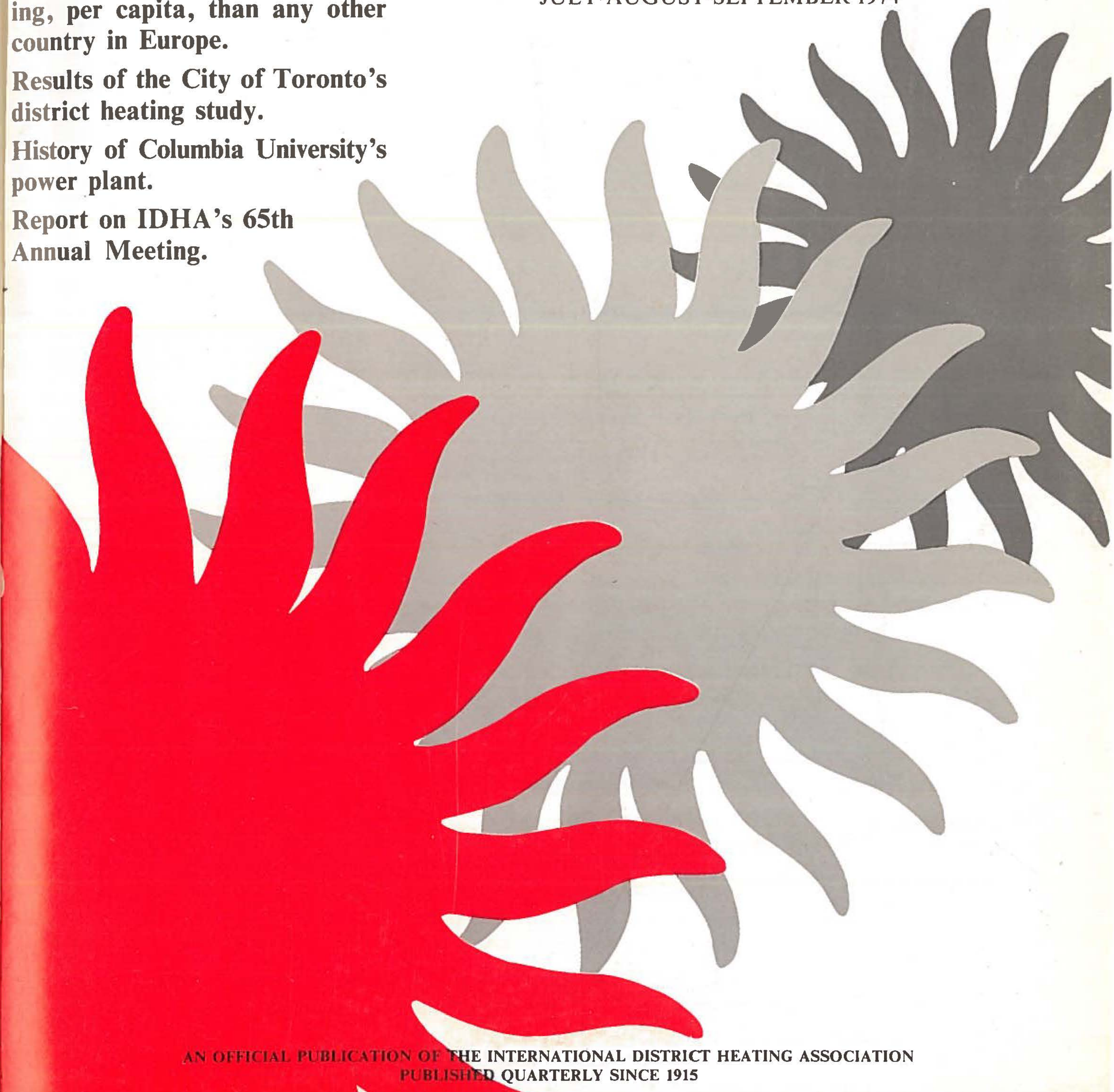
JULY-AUGUST-SEPTEMBER 1974

Denmark has more district heating, per capita, than any other country in Europe.

Results of the City of Toronto's district heating study.

History of Columbia University's power plant.

Report on IDHA's 65th Annual Meeting.



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# Denmark Leads In District Heating

by **The Special Correspondent** of *The Building Services Engineer*, Journal of the Institution of Heating and Ventilating Engineers, United Kingdom.

With a population of only 4.9 million, Denmark tops the European league in terms of district heating per capita.

One third of its 1.9 million dwellings are supplied from a district heating network, and out of 500 towns having 500 or more dwellings, 450 have district heating stations.

District heating goes back about 50 years in Denmark, but the greatest progress has been made in the last 25 years. Denmark was one of the first countries to begin wide-scale development of independent thermal stations not associated with power generation. At the moment, three quarters of all the 500 or so stations supply heat only: the remainder form part of a heat power facility or are combined with refuse incineration.

The economic case for district heating is not as good as the United Kingdom's: although design winter temperature in Denmark is minus 12 C compared with minus 1 C in the UK. Copenhagen has only 25 per cent more degree-days than London. On the whole, Denmark's climate is much milder than that of the other Scandinavian countries.

*Fig. 1*—Tall chimneys disperse $SO_2$ from Denmark's district heating stations.

**Network**

All the district heating networks in Denmark use hot water as the heat transport medium. Some 95 per cent of all consumer installations are supplied direct from the network without the intervention of a heat exchanger. The send-out temperature from the station is not often above 90 C in severe weather, and the maximum allowable to consumers' connections is about 100 C. Network losses account for a further 5K or so of cooling.

Send-out temperature is matched to the weather conditions, so that temperatures of 90 to 100 C are confined to relatively few days in the year. The lower limit is 65 C, fixed by the need to supply the hot water generators in each block or dwelling. The network is run at this minimum temperature throughout the summer, first to maintain the hot water service, and second to protect the network by keeping it alive—insulation remains dry, stress range is reduced in the piping, and operating conditions for the valves remains relatively steady.

Pressure breakdown via a heat exchanger from the network to the consumer's installation becomes necessary with tall buildings (over 10 stories), and when connecting to older-type existing installations where the resistance to pressure is unknown.

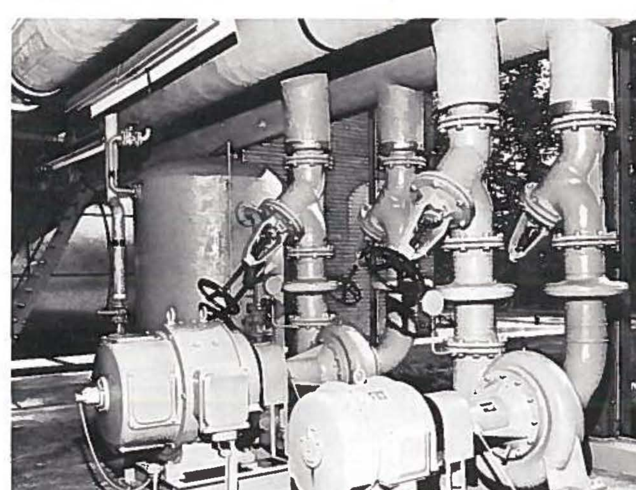

*Fig. 2*—Variable speed pumps save power with off-peak network loads.

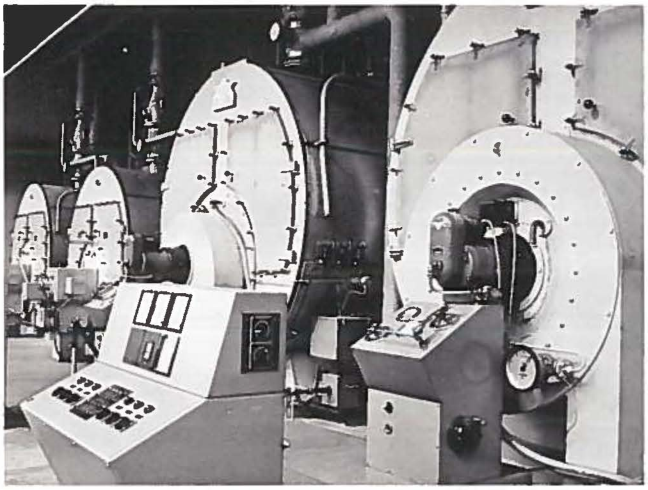

*Fig. 3*—Rotary cup burners atomise heavy oil in this district heating station.

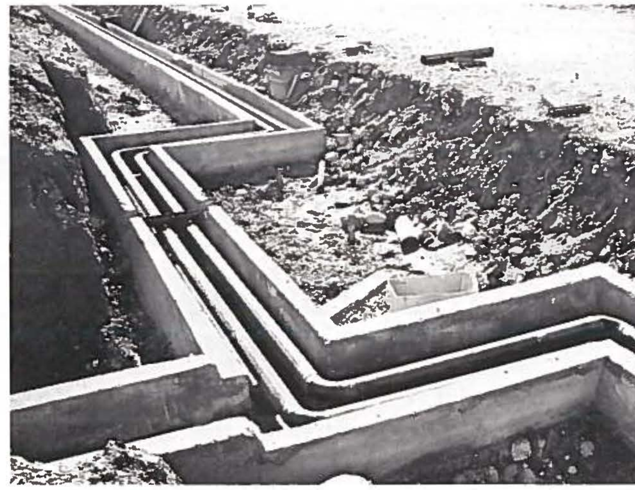

*Fig. 4*—Expansion in the buried network is taken up by simple U offsets.

Two types of distribution network are in general use in Denmark: the linear or branched network, and the meshed network. The linear network is not as flexible in terms of load spreading as the meshed network which provides two or more sources of supply at a given point. Shut-down is not as critical and extensions can be made more readily. Moreover, the meshed network lends itself to addition of peak load stations. For these reasons, the preference in Denmark is for the meshed network.

The network represents by far the greatest cost factor in the total installation, and choice of the right technique in insulation and protection is critical. Like many other countries, including the UK, Denmark has had some spectacular failures due to flooding and corrosion, where in some cases the whole network needed to be replaced after a few years' operation. The technique which was finally evolved, and is still being used for most installations, is to place insulated pipes in a rectangular-section concrete duct, the free space then being filled with foamed concrete. Channels along the base of the duct lead to drainage sumps. The general opinion now, however, is that future installations will be using the pipe-in-pipe technique with the outer pipe in plastics material. Previously, pipe-in-pipe has been used only for consumers' connections.

Denmark was one of the first countries to start using differential pressure regulators on the consumers' connections. With direct supply from the network, the effect of pressure variations on the consumer circuits can be considerable, particularly where part of the network is at a lower level than the station. Higher pump pressures needed with an extended network can also lead to very large pressure differences across the site. The differential regulator stabilises the pressure and enables the designer to plan each installation for the same differential pressure regardless of the location along the network. With predictable driving pressures, radiators can be designed to use return temperature limiting valves, and proportional flow regulators.

**Largest and Smallest**

One of the largest district heating installations in Denmark, and one of the oldest, is at Odense—the third largest town in Denmark. The main heat-power station is 5 km from the city, and supplies the major part of the load of 650 MW. The main distribution network is 570 km long, and serves 20,000 consumers. The installation for Sonderborg (population 25,000), is one of the smaller district heating schemes typical of many in Denmark. The network has a length of about 30 km with 850 consumers. Total heat capacity is 50 MW, with 5 MW coming from the town's incinerator. Send-out temperature to the network is 85 C. A 30 per cent speed reduction in the circulating pumps reduces the head from 2 bar to 1.2 bar for summer operation. The minimum differential pressure maintained at the furthest point of the network is 0.3 bar. Static head is about 2 bar. Apart from the main district heating station, there are two smaller units connected at different points around the network. The whole system is under the supervision of a team of four engineers.

Heavy oil is the principal fuel for nearly all the district heating stations. Boilers are generally of the wet back, steel shell type. Gas-side corrosion is kept to a minimum by the use of a pumped shunt across the boiler, plus alkaline powder injection.

Tall stacks with gas exit velocities of 10 m/s and above keep down $SO_2$ pollution.

*(Some of the statistical data in this article has been taken from the review by F. R. Pedersen and T. Christensen published in the No. 4 (1973) issue of Schweizerische Blätter für Heizung und Lüftung, Switzerland. Photographs by courtesy of Danfos, Norborg.)*

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*To make a long story short, there's nothing like the boss walking in.*

*Be bold in what you stand for, but be careful what you fall for.*