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The Status of District Heating in Czechoslovakia

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HISTORY

The first district heating in Bohemia, at that time still a part of Austria, was started probably at the beginning of the 20th century and was of small extent, being limited to service to several large city buildings in close proximity to the plant.

District heating as a form of public utility service has been in operation in the City of Brno since 1928, 10 years after the rise of the Republic of Czechoslovakia. In 1929 in the capital of Czechoslovakia, Prague, construction of pipe lines for steam distribution was begun. The district heating systems of Usti and of the thermal springs of Karlovy Vary were followed by other district heating projects in Kolin, Pardubice and Nachod, the last mentioned being built while already under the menace of the approaching German expansion and the Great War. Nowadays seven-district heating systems, as a form of a public utility service, operate in Czechoslovakia; one of them transferring heat by means of hot water, the other six supplying steam. In addition to these public district heating plants, combined with electric generating stations, there are also many private district heating plants in the larger industrial establishments in Czechoslovakia, which produce the heat in the central power house, usually together with the electric power required for operation.

IN BRNO

District heating in the city of Brno supplies 138 customers on an average 820,000,000 lb of steam yearly. Their maximum demand is about 420,000 lb of steam per hour. From the plant go out two 20 in. supply mains, each of them having a capacity of 220,000 lb of steam per hour. Into these supply mains flows steam from the exhaust of the turbo-generators, its pressure being 115 psi and its temperature 340 F. The total length of these supply mains is 6.2 miles. As there are not return mains everywhere in the industrial district, which is the main centre of steam sale, only part of the condensate is returned.

During the wartime period the distribution piping and the plant sustained losses of small importance only, though Brno was besieged for some weeks. The sale of steam sustained a more important loss during the German occupation, as there was no possibility of connecting the establishments or prospects, so the progress of the district heating in general has stopped.

IN PRAGUE

Prague has two district heating plants. One of them supplies a large apartment house district and a smaller industrial district. The other plant operates in the east industrial quarter of the city. In the boiler house of the first plant steam is generated at a pressure of 1700 psi and a temperature of 940 F. This steam produces electrical power in the turbo-generator units. From the exhaust of this turbine, steam at a pressure of 215 psi and a temperature of 480 F is taken for distribution. Two 12 in. supply mains go out from the plant, each of them having a capacity of 155,000 lb of steam per hour. The total length of the supply mains including the branch mains and services is 13.8 miles. About 600,000,000 lb of steam per year is delivered and the maximum hourly demand is 290,000 lb. Almost all the condensate is returned. The return mains are protected against corrosion by filters, filled with iron splinters.

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The Great War had an unfavorable influence, causing rapid wearing out of the service valves, and especially the reducing valves. The required materials and workers were not available in sufficient quantity for repair. The prohibition of building during the war made impossible an increase of pipe lines. On the other hand the consumption of the steam by the factories, forced to work during the war with all their strength, increased.

The other plant at Prague supplies factories in its environs with steam at a pressure of 150 to 250 psi.

IN USTI

From the district heating plant in Usti, 6 supply mains go out with diameters of 8 in., 7 in., 6 in., and 3 in., and having a total capacity of 165,000 lb of steam per hour. Into the pipe lines totaling 12.4 miles in length, flows steam at a pressure of 57 psi and a temperature of 430 F. 83.5 Per cent of the steam is from the turbine exhaust, 12 per cent from the bleed point and only 4.5 per cent passes the reducing valve. 361 Customers are connected to the distribution system. They bought 350,000,000 lb of steam in 1944 at a maximum demand of 105,000 lb of steam per hour. About 60 per cent of the condensate returns through the return mains.

By the air bombing in April 1945, 27 buildings were ruined, which bought about 4.5 per cent of the total quantity of the steam annually sold.

IN KOLIN

In the town of Kolin are two district heating plants. From each of them goes out 8 in. supply mains with a capacity of 44,000 lb of steam per hour. Steam at a pressure of 100 to 130 psi and a temperature of 350 to 430 F flows into the mains through reducing valves, because the plants are not yet completely built. 65 Customers with total demands of 62,000 lb of steam per hour receive steam from the distribution system, the total length of which is 4.5 miles. As the demand of the steam was limited during the war, the figure decreased nearly to 40,000 lb of steam per hour. About 80 per cent of the condensate returns through the return mains, which are protected by filters, filled with iron splinters.

The insufficient quantity of material during the war made it impossible to satisfy many customers who desired to connect for want of coal.

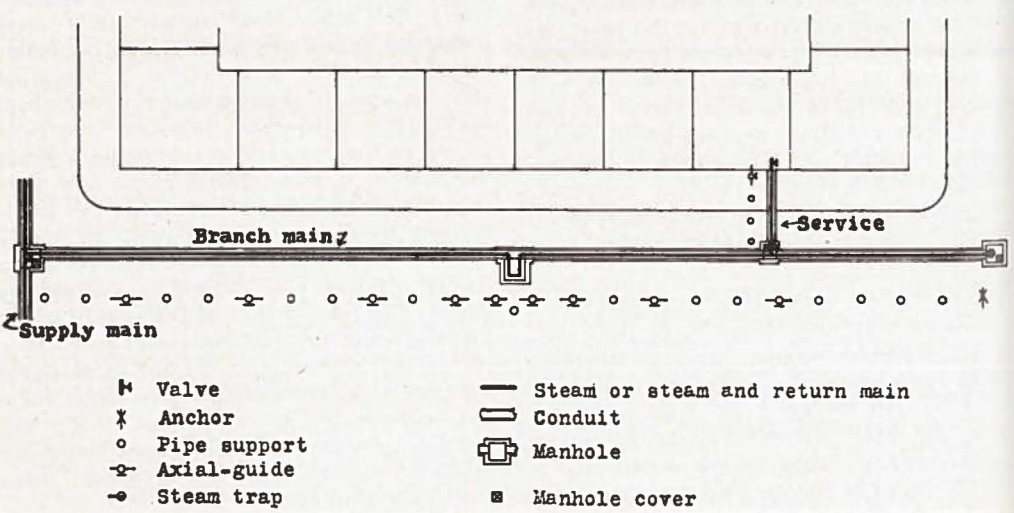

Figure 1. Typical arrangement of a branch main and service.

IN PARDUBICE

The district heating system in the town of Pardubice supplies steam at a reduced pressure of 100 psi and a temperature of 430 F. through two 7 in. supply mains for the demand of 44,000 lb per hour. Pipe lines for steam distribution total 5.1 miles including the branch mains and services. The sale of steam to 50 customers amounts to 81,000,000 lb per year. The maximum hourly demand is 40,000 lb. About 45 per cent to 55 per cent of the condensate returns through the return mains, protected by filters, which are filled with iron splinters and from time to time also by chemical means — inhibitors.

War incidents caused trouble, especially the air attacks, because the supply of steam had to be stopped for reasons of security.

IN NACHOD

In the town of Nachod the system partly supplies a large textile factory with bled steam at a pressure of 50 psi and a temperature of 360 F. It also partly serves a district of the town with reduced steam at a pressure of 85 psi and a temperature of 375 F. The pressure of this reduced steam will be raised later to 125 psi. The supply mains going out from the plant have diameters of 12 in. and 14 in. The distribution systems have a length of 3 miles and supply 70 customers 100,000,000 lb of steam per year. The maximum hourly load is 120,000 lb. About 70 per cent of the condensate is returned. The return mains are protected by filters filled with iron splinters.

The building of this plant was begun in 1940, therefore in the wartime. It was possible only under pretense of different reconstruction, which was given assent to by the German occupants. The building of this modern plant is therefore not yet finished.

IN KARLOVY VARY

Hot water district heating at the thermal springs of Karlovy Vary differs from steam district heating in principle and a description has not been included in this article.

DISTRIBUTION SYSTEMS

In Czechoslovakia district heating steam pipe lines are laid in conduits, where also the corresponding return mains are placed.

The conduits are built as tunnels, with a passageway only in special rare cases. Mostly they have the smallest dimensions possible. Their sizes are such that the distance between the surface of the steam pipe insulation or of the return main and the wall or floor of the conduit is at least 3 in. to 4 in. The distance between the insulation surface and the ceiling of the conduit is usually about 2 in. The conduits are formed directly in the trench. The concrete base is made in the first place, then the side walls of concrete or bricks, hollow tile, etc. are built. The installation and insulation of the pipe lines having been finished, the channel is covered with concrete boards forming the ceiling. This ceiling is covered with waterproofing paper and the trench is filled with earth well rammed with beeters. This way has an advantage because by the installation of piping and insulation the channel keeps proportionally clean and it does not disturb the trench shoring. This way is profitable also for incidental repairs and changes in the pipe lines. Drainage usually is not needed. The manholes for condensate separators, steam traps, and sectionalizing valves and service boxes are usually built of bricks, rarely of concrete. The bases and the ceilings are always of concrete. The dimensions of the manholes are from 3 x 4 feet to 5 x 6 feet.

The steam line pipes are carbon steel of a tensile strength of about 50,000 psi. Up to 16 in. diameter standard seamless pipes are used. For the larger diameters lap-welded pipes are used. The extra strong pipes used for return mains have walls about double the thickness of standard pipes for steam lines with regard to the danger of corrosion. For the same reason the return mains are protected by filters, filled with iron splinters. These filters are installed by every customer and in every manhole, where steam traps are placed. There is a tendency to use pipes of rustproof and acid-resistant Anticorro steel for the return mains, but war occurrences did not permit carrying out tests on a larger scale.

Globe valves of diameters above 2 in. usually are made from cast steel for a working pressure of about 300 psi. Globe valves of smaller diameters have bodies of wrought

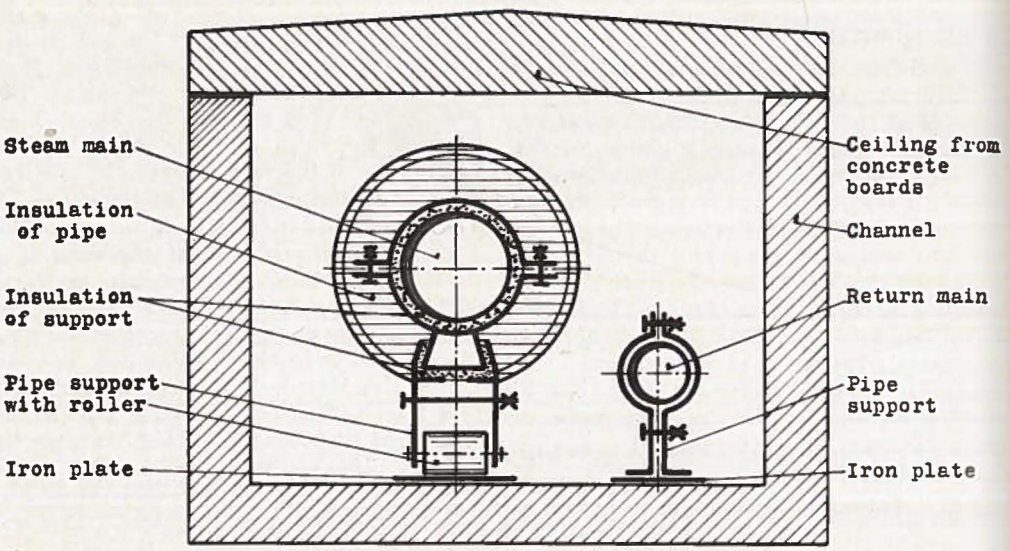

Figure 1. Cross-sectional view of a typical steam conduit.

iron. Globe and check valves for the return mains are of cast iron for a working pressure of about 125 to 200 psi. Gate valves are used only in special cases.

Piston type expansion joints are installed only in exceptional cases. Usually expansion "U" bends are used. Therefore, it is necessary to construct the pipe line in a straight axial direction. About one-third of all pipe supports are constructed as axial-guides. Figure 1 shows their order. The pipe supports are usually attached to the pipe and their uninsulated surface is as small as possible in order that the heat losses should be lowest. They are so constructed that the flow of heat from the pipe is at least twice interrupted by the obstacles from the asbestos paper. This construction is patented and is shown in Figure 2.

Male and female forged steel flanges are used only for the valves, otherwise all the pipe lines and the expansion bends are welded.

Insulation is customarily fixed to the pipe. Only rarely is the whole conduit filled with the insulating material. In the latter event mineral wool is most frequently used as insulation. To a smaller extent blocks or bricks of diatomaceous earth are used. The insulating surface is finished with a special kind of cement. The thickness of the insulation is about 2 in. for pipe lines of 1 in. to 3 in. sizes, about 4 in. for 8 in. pipe lines and even more for pipe lines of larger diameters. The average thermal conductivity of the mineral wool insulation is about 0.5 Btu per sq ft per hour per deg F. per in. thickness.

The whole arrangement of the steam lines as they are standardized in Czechoslovakia is best shown by Figures 1 and 2, which will clarify to the reader a great deal which is not easily expressed by words.

THE FUTURE

For the most part district heating in Czechoslovakia came about as a new sphere of activity for the power plants, which are arranging their generating stations for this service. The Great War, however, made the construction of new plants as well as the building of new branch mains and services impossible in most cases; therefore, district heating in Czechoslovakia was forced to keep the limits the reader finds described in this article. After the liberation of Czechoslovakia, the possibility of a large development is offered. It begins already to appear in the preparation for new district heating plants, which are proposed to be constructed on the most modern principles.