In This Issue

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TENDENCIES IN DISTRICT HEATING

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ASKING

When you are contemplating a new piping installation... or planning one... remember that the ADSCO Engineers' Service Department is at your command for first aid and counsel on any intricate problems that arise.

These engineers have devoted years to the study of steam distribution and the planning of District Heating installations. Their opinions are authoritative. Through their constant contact with pipeline engineering, they have a thorough knowledge of the latest systems and devices with which installation and maintenance costs can be lowered, and operating efficiency improved.

Engineers who have enlisted that cooperation have paid high tribute to the wisdom of their counsel, and the helpfulness of their service. They will be glad to work with you on any major steam piping project, even to the point of visiting your city. Call upon them. You'll be more than satisfied with the results.

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AMERICAN DISTRICT STEAM COMPANY
GENERAL OFFICES AND WORKS
NORTH TONAWANDA, N.Y.
Offices and Agents in Principal Cities
Specialists in Steam Distribution for over 50 Years

AIRPORTS
Now adopting District Heating Systems

During the development of the landing field from its crude shack and field form to the well planned and carefully managed airport of today, attention, of necessity, has been concentrated largely upon securing a good field and adequate shelter.

Everything outside the sphere of these two absolute essentials has been left, more or less, to follow a process of natural evolution. So, instead of an approved plan of heating airport buildings, we find today, every device from salamander to electric resistance heaters. Coal stoves, hot air furnaces, gas radiators, gas stoves, hot air blast outfits, have been used indiscriminately to meet the need for warmth, regardless of heating efficiency.

However, now that some of the initial trying problems have been overcome, attention focuses on the need for more economical and efficient heating systems. And even the most superficial study points to the overwhelming advantages of an adaptation of district heating, or supplying steam from a Central Boiler Plant.

The compact grouping of buildings, the periodic expansion necessary to provide hangars for new planes; the importance of minimizing fire hazard; the danger of numerous chimneys to night fliers—all have been instrumental in focusing the attention of airport
“Naturally, we are enthusiastic about our district heating plant. We have always considered it the safest and most efficient method for heating of airport buildings... and pending approval of plans for installing a central plant, actually heated our buildings by hooking tractor-boilers on to the steam lines, rather than install an individual system for each of the different buildings.

“It is quite true that the initial cost of the installation may have been higher than that of some other systems; but it is entirely reasonable to expect this higher initial cost to be offset over a period of years by the resultant operating and labor economies.

“Our installation is so arranged and the steam lines so laid, that new buildings which are to be erected, can be supplied with heat with a minimum of work and expense...

“As to the fire hazard; we have never had a fire... we might never have one. But it seems ridiculous to compare individual systems with centralized production of heat where safety is concerned. With our remote boiler plant, fire hazard from that source is completely eliminated... and that means a lot.”

Airport Rating Regulations under requirement for “A”, “B” and “C” Ratings, explicitly provide that “In localities where freezing temperatures are experienced, the hangars should be heated sufficiently to prevent freezing of water.”

The Buffalo Airport meets this stipulation—not only adequately, but superlatively, by insuring uniform warmth for every building whatever the variation in outside temperature.

Other interested airports are planning centralized heating systems. And they will find, as a Buffalo official has expressed it, “If properly planned and operated for efficiency and economy, the district heating plant is vastly superior to any other method of airport heating.”

TEN DENCIES IN DISTRICT HEATING

By Prof. C. H. B. Hotchkiss

The business of supplying heat to buildings as a utility enterprise has reached its present status through a gradual development over a long period of years. During this period there have been times of activity and expansion as well as times of retrogression. Ideas, inventions, changes in ownership, changing ideas in management, and changes in the general life of communities have all been reflected just as truly in this business as in most others. Out of it all has come the business as it exists at present. In view of this, probably the best way to get a clear picture of things as they are, is to glance briefly at some of the more outstanding features as revealed by the past.

First Central Heating Plant

The actual beginning of the practice of supplying heat from a central plant antedates the supplying of electricity from such plants. The first heating plant started operating in the ’70’s. It was a steam plant and steam heating was used in the buildings. Naturally, it was a purely heating plant and was not connected with electric generation in any way. It is also interesting to note that it employed a pressure which at that time was moderately high. Steam was carried underground from the generating plant to the buildings. For some years following the successful operation of this plant, a considerable boom developed in the extension of such plants. These were operated with varying degrees of success.

In the late ’80’s, the first installation using hot water underground made its appearance. The argument in favor of this method was that of utilizing the heat in the exhaust steam from engines to heat hot water in the generating plant. This hot water was then pumped to, and through, the buildings to be heated. The point of most interest in connection with this method is that it used the heat of exhaust steam—for a steam system would do the same—but that in its actual use it served to ally the supplying of heat very closely with the supplying of electric service. It served to draw the attention of the rapidly expanding electrical industry to the close relationship between central station heating and central station electric service.

Relation between Power and Heating Realized

Here began one of the features which has greatly influenced the course of development of central station heating. As soon as the close relationship between the two services was fully realized, they began to develop together. Many electric utilities installed a heating service operating on the heat contained in the
such heat were often ridiculously low, exhaust from their engines. Rates for long-term contracts to supply heat at set figures were entered into, and the long-term contracts to supply heat at heating service was often used as a means of securing electrical business. In general, the business of supplying utility heat was linked to the business of supplying utility electricity.

Growth of Utility Heating Checked

Scarcely had this taken place before the growth of utility heating was noticeably checked. So long as reciprocating engines were used for electrical generation, and so long as the generating plants were located close to a heating load, the combination of electric generation and exhaust steam heating lived rather peacefully together. Soon, however, the turbine made its appearance and the use of high vacuums was developed. The turbine was most attractive when installed in large units and when operated at high vacuums. This required the extraction of the heat of vaporization at the generating station, and made it necessary to transfer the heat formerly used for heating to the condenser cooling water. This cooling water was often at too low a temperature to be useful as a means of heating buildings.

Moreover, the tendency was to build the generating stations at points distant from the heating load. As a result of these, and other, conditions the growth of electrical generating plants with exhaust-steam heating was checked. In many cases the existing plants were, however, operated and continued to furnish heat. Very often, though, the electrical load developed so rapidly and furnished so attractive a return that attention was turned to it, almost to the exclusion of heating. The low rates charged for heating, and the long-time contracts also conspired to throw the heating function into disfavor.

This period may be said to represent one of stagnation and even of decline of utility heating. This period, generally speaking, ended some ten to fifteen years ago.

Recent Tendencies

Since that time there has been a marked revival of interest and of growth in district heating. This later period has been marked by several noteworthy features.

First of all, there has been a fairly general realization that the supplying of a building-heating service can be made to pay for itself when reasonably well planned and conducted. The realization of this fact has tended to make the managements of electric utilities disposed to consider the heating as something other than an nuisance. Another notable point is that the use of hot water as a carrier of the heat has greatly declined. Not only have hot-water systems not been built in recent years but a sizable number of those in existence has been changed to steam, although the use of hot water has much to recommend it from the utility standpoint. Perhaps this general decline of district hot-water heating has been the most clear-cut feature of the new period. It has not been universal, however.

Heating Divorced from Electric Generation

During the past ten years there has been a tendency to divorce the heating entirely from electric generation. As a result, many of the newer plants have been built as purely steam-generating plants delivering their entire heat output into the heating lines as steam. Where district heating is conducted by a corporation independent of the electric utility, its generating plant is often, indeed nearly always, of this type. This practice represents a considerable swing away from that which originally brought the two services into contact. It is interesting to note, that such plants were used when district heating first started, and that consequently the idea of steam-generating plants apart from electric generation is not a new one. Like their predecessors these plants operate on what may be called moderate pressures. Recent examples of plants of this type are those in New York and Philadelphia.

Electric Generation Incidental

We have already noted the fact that early use was made of the idea of extracting both electric energy and heat from steam. This practice is still in use but the newer plants are arranged with an important change in their design. The older plants were intended to be primarily electric stations which used the exhaust for heating purposes. The newer plants are intended to be primarily heating plants which use some of their heat to produce electricity. In the new type of plant, the electrical generation is quite incidental to the primary purpose of furnishing steam for heating. In these plants, the basis of the load is the demand for steam for heating and not the demand for electrical energy. The turbines essentially act as reducing valves. They deliver their electrical output to the electric distribution system only on occasion, the turbines can be cut out entirely and the plant would then operate essentially as a heating plant. Recent examples of such plants are those in Rochester, N. Y., and Pittsburgh.

At the present time, then, we have a decided tendency toward growth and development inutility district heating with hot-water dropping out of use and with the steam being generated in plants of one of two general types. Many of the older systems are still in operation, however. The map on page 6 gives a good idea of the present extent and distribution of district heating with some 300 projects in existence.

The recent growth of district heating has also been marked by at least two other features which differ from its earlier expansion. In the first expansion in the early '80's, many of the developments were in small towns and in residential districts. During the
HIGH PRESSURES HOLD NO TERRORS

for THESE two Expansion Joints!

“...No repair gang shall be called out of bed for hurry-up service—no important main shall be cut off by enforced shutdowns—no cost sheet shall be burdened with calamitous entries for repairs...”

Let that be written into your rules for buying high pressure, high temperature expansion joints—and prudence will tell you to specify ADSCO’S Multiple Diaphragm Variator, or ADSCO’S Duplex Sleeve-Guided Expansion Joints.

Choose the ADSCO Variator for high pressure underground installations where you want to bury and forget the expansion devices. ADSCO Variators have demonstrated that they give 20 to 30 years of 24 hour a day service without attention of any kind...

Use the Duplex Sleeve Guided Expansion Joint either above or below ground whenever provision can be made for occasional inspection and attention to packing...

Whichever type you select, you can depend upon ADSCO Expansion Joints to give exemplary service. They are built to “hold everything”.

With the exception of new metals in diaphragm and other parts, the design of the new ADSCO Variator for high pressures (to 400 lbs.) and high temperatures (to 750 degrees Fahrenheit) is substantially the same as the ADSCO Low Pressure Variator, hundreds of which have been installed during the past 30 years, with less than 1/10 of 1% ever having required attention.

Each diaphragm of this new Variator accommodates a full 3/4-inch movement, and can be assembled in series to provide for any expansion requirement up to 41/2 inches per unit. Per inch of traverse, they cost little, if any, more than much less satisfactory equipment.

No other slip-type expansion joint approaches the Duplex in long-life and freedom from maintenance. It is, unquestionably, the most popular slip-type joint in District Heating, and holds all records for remaining tight under the severe requirements of high temperature service.

Because of its “Air Chamber”, by which air is constantly circulated through the Duplex sleeve, the life of the packing is greatly prolonged. Tests made at the Carnegie Institute of Technology showed that heat transmission to packing is reduced from 25% to 35%.

Please send complete technical data and prices on ADSCO Multiple Diaphragm Variator
ADSCO Duplex Sleeve Guided Expansion Joint

Company ........................................................................................................................................
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Interesting developments have taken place in "block" or community systems. Apparently the general tendency is to treat the furnishing of a heating service to a scattered residential district in a somewhat different fashion, and by other interests, from those used in dense, downtown business centers. Probably such a policy has much to recommend it and we may look for it to continue.

Supplying Demand For Process Steam

The recent success and growth of the heating services of some of the utility companies probably has had considerable to do with the beginning of a movement which is just appearing. For some time the tendency has been to generate electricity in huge central turbine-driven steam stations. Increasingly large plants have been built and increasingly large turbine units have been operated. All have been operated condensing and almost invariably the condenser cooling water containing much heat has been wasted. Recently attention has been turned once more to the problem of securing some use of this heat, while still getting good economies from the turbines. The problem is of long standing, but is now being approached from a rather new angle. The idea is to locate utility generating plants at or near industrial plants which have a heavy demand for hot water and process steam. If such plans work out successfully, the value of a steam generating plant which utilizes the latent heat may be better demonstrated and the utility heating plant with electrical by-product generation may be reappraised at higher values than have been assigned to it in the past. This tendency, now just starting, holds much of hope for the future development of building-heating services by utility companies. Far from being merely temporary, the recent growth of district heating bids fair to be long sustained.

Long Distance Steam Transmission

In every field where steam is being used there is an ever-increasing application of high pressure steam transmission piping. Not only are public utility companies finding it very advantageous to connect two or more boiler plants with a high pressure steam tie-in line, but we find the same idea being used extensively in the industrial field. Pulp and paper mills, which have grown so rapidly in the last few years, are effecting tremendous operating economies by eliminating a number of their individual boiler plants and connecting separated plants or buildings with a system of high pressure piping. Steel mills, textile plants, furniture factories, chemical plants and other large industrial units are reducing their heating, power and process costs in this way.

There are many features of these piping systems which are of exceptional interest to the consulting engineer and the plant manager, since so much depends on the design and specification of such installations. Of course, no fixed rules can be laid down that are universally applicable to steam transmission and distribution piping, nor can a yardstick easily be produced to estimate accurately the cost of such work. Every major piping project is a problem within itself and only after an exhaustive study of conditions can specific recommendations be safely advanced, or an intelligent estimate of cost be submitted.

A careful study of each problem must be made to determine, first, whether or not there is a possibility of improving operating conditions or effecting economies by the installation of a steam line to deliver steam from here to there at the pressure and temperature desired, and in adequate volume. If it is apparent that a steam transmission line would prove advantageous, the next step is to determine accurately the amount of steam required at the period of maximum demand at the terminal. This knowledge, then, with the information as to terminal pressure and temperature desired, enables the engineer to decide on the proper size of line after giving consideration to the distance to be covered, the number of changes in
ground where they are not only out of the way, but where the insulation of the ground itself adds materially to the overall efficiency of the installation. Natural expansion and contraction of the pipe under changing temperature is also controlled more easily and dependably.

Assuming that the decision is made in favor of the underground construction, the next step is to survey the ground and make a rough layout of the line. Effort should be made to avoid obstructions and provide the most direct route possible. The line should be laid out with the fewest possible changes of grade and direction. As a general principle, every change in direction or grade should call for securely anchored points in the steam line. Means must be provided between all anchor points to compensate for pipe expansion. The actual amount of expansion in each straight run of pipe must be calculated and whatever type of expansion device is selected, it must have an adequate factor of safety to absorb the expansion and contraction in the run of pipe for which it is installed.

Absorption of Pipe Movement

Of the many methods used for absorbing the expansion and contraction of steam pipe, only three are recognized by experienced engineers as suitable for high pressure steam lines. Pipe bends, slip-type expansion joints, and packless expansion joints. In overhead lines, pipe bends have been more frequently used than expansion joints, because the great amount of space required by a bend is less important in the air than under ground. To accommodate the bends in underground construction, it is necessary to construct large and very costly expansion chambers.

However, an increasing number of aerial lines are now using slip-type expansion joints wherever secure anchorage can be made—either on the side of a building or other stable structure. There are some splendid joints of this type on the market today which will absorb from 4" to 8" of pipe movement and render continuous, satisfactory service throughout the life of the installation. When scientifically designed for the particular installation, the slip joint will remain tight for a long period without attention and is generally preferred wherever it can be properly employed—especially on long runs of straight pipe. It is less costly than pipe bends; effects a considerable saving in insulation and causes no loss in pressure.

There was, for a long time, a decided prejudice in the minds of some engineers against slip type expansion joints. However, in the last few years, this prejudice has largely disappeared, due to the greatly increased efficiency of slip-type expansion joints. Too many miles of important high-pressure steam lines are being taken care of by very satisfactory slip joint type joints, properly packed and installed, to leave much argument on this point.

Packless Joint Perfected

A slip joint installed underground must, of necessity, be in a manhole, since from time to time the packing gland must be tightened and after a few years new packing will be required. There are many underground installations where, for one reason or another, the elimination of expansion joint manholes is highly desirable. This is where the newer developments in packless expansion joints meet the requirements with remarkable success. The cost of the packless expansion joints per inch of traverse is considerably above the same relative cost of the slip joint, but to offset this additional cost there is a considerable saving in manholes and certainly there is an advantage in having the entire installation buried and free from attention of any kind throughout its operating life.

The selection of the type of packless joint is a matter that requires discrimination. Different kinds of metal have different characteristics, and these must be considered with respect to the operating conditions of the line. There are packless expansion joints or packless joints in which the packing gland is secured with corrugated copper diaphragms. These joints have given remarkable service where they have been properly installed under the operating conditions of pressure and temperatures for which they were designed.

Failures in these joints, however, have occurred where pressures and temperatures have been carried above the respective points set by the manufacturers, so that the limitations of any joint must be thoroughly understood in selecting this class of equipment. Some metals such as copper, for example, tend to change their molecular structure at temperatures in the neighborhood of 400 degrees F., since the amount of pipe movement in each run is relatively small, the packless joint can be installed at less cost and with greater operating efficiency and freedom from attention.

The selection of the type of packless joint is a matter that requires discrimination. Different kinds of metal have different characteristics, and these must be considered with respect to the operating conditions of the line. There are packless expansion joints or packless joints in which the packing gland is secured with corrugated copper diaphragms. These joints have given remarkable service where they have been properly installed under the operating conditions of pressure and temperatures for which they were designed.
and when this change takes place the metal loses its flexibility and becomes crystalline. Other metals have been developed and are now being used which will operate within their elastic limit, with apparently no effect on their durability for temperatures as high as 900 degrees F.

The more often a steam line is likely to be hot and cold, the more flexible the packless joint must be. Manufacturers can now supply joints of the same general design to accommodate varying amounts of traverse. This permits the selection of just the right size joint for each section of pipe, and results in economy since excess traverse capacity is avoided.

**Anchorage and Guidance**

Regardless of what type of expansion joint is selected for the underground installation, too much stress cannot be placed on the necessity of secure and adequate anchorage. If the joint is the slip type, the joint itself must be anchored, whereas if the packless type, the pipe immediately adjacent to one end of the expansion joint should be anchored. The practice of floating a packless joint or even a slip-type joint in the middle of a run of pipe anchored at both ends, should always be avoided.

In addition to the secure anchorage, a very desirable practice is to install an alignment guide around the pipe a few feet in front of the expansion joint to prevent any possibility of a lateral strain on the pipe being transmitted to the expansion joint. In the case of a slip joint, a guide is frequently furnished as a part of the joint body, but if not, an alignment guide is very important to prevent lateral distortion of the packing, which, if permitted, would soon set up a leaking stuffing box.

Between the distant anchor point and the alignment guide near the expansion joint, the pipe should be mounted on roller guides of a type that will create the least possible friction when the pipe is moving in contraction or expansion. It has been found that the least amount of friction is present when the roller moves along with the pipe, traveling in its own base or track. A refinement worthy of attention is the pipe saddle, which supports the pipe away from the roller guide for a distance equal to the thickness of the insulation on the pipe. The application of the saddle permits of the complete insulation of the pipe and effects a minimum heat transfer to exposed surface.

**Conduit and Insulation**

Practically every underground steam line installation requires proper underground drainage to reduce the possibilities of water getting into the conduit and ruining the efficiency of the insulation. This drainage can most easily and least expensively be procured by the laying to grade of farm drain tile in a bed of native or broken rock. The joint foundation is most easily secured by a concrete base laid on paper over the drainage rock. This base may or may not be reinforced, as conditions require. The selection of insulation and type of conduit is the next consideration in point of design, and this again is a matter of suitting the specification to the individual requirements and local conditions.

The pressure and temperature of steam to be conveyed in some measure determine practically all of the materials required for the construction. This is particularly true of the insulation and conduit to be employed. For a low pressure or exhaust steam line where, at the maximum of operating periods the pressure will not exceed 50 lbs. to the square inch and where the temperature will always be below 310 degrees F., the special kiln-dried wood casing with thoroughly water-proofed exterior and tin and asbestos lined, would be recommended. This type of conduit is used by a great number of the large District Heating companies and is beyond question the ideal combination of insulation and conduit for an underground steam line. Low pressure underground steam lines in comparatively dry soil, lend themselves well to the economy and very high efficiency of casing construction. This is always a safe and satisfactory specification for such conditions.

Where higher pressures and temperatures are to be encountered, it is necessary to change to some other type of construction. A concrete conduit is perhaps the most common type for high pressure lines, but in the majority of cases a concrete conduit properly designed for high pressure steam lines is somewhat more costly than even a more satisfactory type of construction. Sewer tile is sometimes used in complete sections or split in two halves. In the one case it is threaded on over the pipe, following the application of insulation; in the other case the lower half is installed first, then water piping and insulation are in the upper half is lowered in place and the two are cemented together. The solid tile is of course much stronger and resists, more successfully, the tendency of longitudinal cracks which have been found to be almost unavoidable when tile is used in two sections. This type of construction is used to some extent for service lines and temporary installations, but wherever the surface load sets up a probable hazard of broken tile, a more durable construction is to be preferred.

The greatest enemy to underground steam lines is water or moisture. Any type of construction which allows water to enter the installation, is conducive to rapid deterioration and loss of efficiency. In designing a conduit, it is always well to make provision for the prompt disposal of any water which may get inside the conduit before it can saturate or even dampen the insulation. For this reason it has been found good practice to bring a recognized standard type of high efficiency insulation directly in contact with the pipe, and make arrangements to hold it securely in place. The insulation is then water-proofed so that if any water should find its way into the conduit it will be diverted by the waterproof covering to the open section in the bottom of conduit, where it will be disposed of with out damage to the insulation.

**Preferred High Pressure Construction**

A type of underground construction which has been found to prove very satisfactory in a great number of large District Heating installations and industrial transmission lines, is a special patented built-up tile construction known as Multicell Tile Conduit. This is similar in cross-section to the concrete conduit but has the advantage of dead air spaces in the walls of the conduit thus increasing the efficiency, and in addition can be readily entered from the side if future connections are required. In most localities this type of construction can be installed at or below the cost of concrete conduit, and these advantages undoubtedly account for its popularity.

Both the concrete conduit and the Multicell Conduit are easily and thoroughly waterproofed. During the past ten years, this type of water-proofed construction has been used extensively and has proven most successful in underground installation where excessive moisture is encountered.

Although briefly given, these are some of the essential points in the consideration and designing of steam transmission lines. Too much emphasis cannot be laid on the importance of giving careful study to each problem involved, and the advisability of obtaining experienced assistance.

Adasco maintains an Engineers' Service Department which is constantly making studies of projected work on small systems, systems for public utilities, industrial plants, colleges, government departments, institutions, and others interested in steam piping. Inquiries welcomed.
THE DeVeaux Military Academy, like many other schools, is well aware of the advantages of specializing. When DeVeaux installed a central heating system for their many buildings, Northeastern was given the job.

The planning and installing of underground steam lines calls for experience, knowledge and facilities of the highest order. An infinite number of details and responsibilities, burdensome even to public utilities, suggests to any keen executive the advisability of engaging the most advanced engineering facilities. That this idea is gaining support, is best shown by the ever-increasing list of important utility installations made by Northeastern.

To any utility or institution planning or extending a district heating system, the counsel of the Northeastern construction engineers is always available. Everything necessary for the economical installation of steam lines—from blueprint to backfill—is included in this specialized service. You are invited to use our facilities.

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Over 50 Years' Experience in the Installation of District Heating Systems

Photo of section installation at DeVeaux Military Academy showing 8 in. low pressure line, 3 in. high pressure main and 3 in. return—running from Chapel Wing to Dormitory.