Steam is capable of furnishing such general service as cooking, laundry work, etc., which water will not do. Steam can be adapted to customer's hot water installations already in place, either directly or through reheaters, and can be applied to hot air systems by means of indirect radiators. Hot water, on the other hand, cannot be successfully applied without alteration to steam systems which are already installed.

When the cost of operation is considered, hot water systems have the advantage that partial vacuums can be carried on the engine exhaust. However, as the load factors are usually low in electric stations, it is advisable in all cases—as will be pointed out later—to figure the plant for the production of heat alone, in which case this apparent advantage largely disappears. Higher circulating pressures must be maintained on hot water systems than with steam. Hence heavier and more expensive pipe lines and fittings must be installed.

The elevation of the area to be served in relation to the plant location, and also the height of the highest building to which heat is furnished, will determine the pressure to be maintained on a hot water system. This is usually about 15 pounds above the static pressure at the plant. If a city is hilly, then the hot water system cannot compare favorably with steam on account of excessive pressure in the pipes, the power required for pumping and the friction losses in the system.

Some device must be employed on hot water systems to regulate the amount of water flowing through the customer's radiators. Valves with adjustable openings controlled by a special key are sometimes installed. On other systems choking discs or nipples are inserted in the return pipes and also at each of the radiators. The holes in these are so proportioned that only the proper amount of water will be forced through the radiators by the prevailing pressure.

Hot water lends itself more readily to temperature regulation than steam. With the latter some form of thermostatic control must be employed, while with hot water a schedule of flow temperature to be maintained at the central station can be prepared for varying outside temperatures and wind velocities. In this way the customer receives heat in just the right amount to avoid overheating his rooms in any kind of weather.

The amount of steam used by various customers can be determined by metering the condensed steam and charges for service may be based on this amount. The customer then pays for the heat used and may be as economical or wasteful as he desires. In such systems cooling or economizing coils with 15 to 20% of the total radiation capacity should be installed by each customer to recover the heat in the condensed steam before discharging it through the trap and meter to the sewer. This is an absolute necessity in some cities where citizens are prohibited by ordinance from discharging water into the sewers above 125° F. or so.

Hot water service, on the other hand, cannot be metered, and charges for the same must be made on the basis of square feet of radiating surface or on some other flat rate basis. In actual service it has been noted that where there is no financial incentive to economy 25 to 50% more heat will be used than is actually required. As a result of this, all flat rates must be higher proportionally than metered service, and so the economical customer helps to pay for the carelessness and extravagance of others.

As a rule, steam service is more popular in business sections, while in residence districts hot water seems to be more generally sought.

When a customer has his residence or building piped up for hot water and the district heating system supplies steam, all that is necessary to secure central station service is to install some form of heat transformer or interchanger, of which there are many on the market. These devices consist, as a rule, of double tube manifolds with the steam supply connected to the inner tube while the hot water circulates between the tubes. The steam in condensing gives up its heat to the water which rises and establishes a circulation in the same manner as when a coal-fired heater is used. The condensed steam can be metered and charged for in the usual way. Kitchen and bath heaters can also be piped up to one of these heat interchangers, or a coil of pipe carrying steam can be placed in the water reservoir itself.

Some schedule of service for varying outside temperatures should be prepared for the guidance of the central station operators with either hot water or steam systems. For the former, tables of flow temperatures to be maintained at the central station should be prepared, with corrections to be applied for various velocities and directions of wind. Such a schedule of temperatures is shown in Table II., and applies to a central hot water heating station in Columbus, Ohio.

Table II.—Relation Between Outside Temperature and Hot Water Flow Temperature.

Temperature. Weather.	Flow.	Temperature. Weather.	Flow.	Temperature. Weather.	Flow.
70 above	stopped	36 above	157	Zero	210
68 "	106	34 "	159	2 below	212
66 "	112	32 "	162	4 "	215
64 "	117	30 "	165	6 "	218
62 "	121	28 "	170	8 "	221
60 "	125	26 "	175	10 "	224
58 "	128	24 "	178	12 "	226
56 "	131	22 "	180	14 "	229
54 "	133	20 "	184	16 "	232
52 "	135	18 "	187	18 "	235
50 "	137	16 "	189	20 "	237
48 "	139	14 "	191	22 "	240
46 "	141	12 "	194	24 "	243
44 "	144	10 "	196	26 "	246
42 "	147	8 "	198	28 "	249
40 "	150	6 "	201	30 "	252
38 "	154	4 "	204		
		2 "	207		

The above schedule is to be applied in still weather only. With falling outside temperature and a wind of 12 miles per hour add 5 degrees; with falling outside temperature and a wind of 18 miles per hour, add 10 degrees.

[A second part of this article, dealing with the design of heating stations, pipe lines and conduits, will appear in the next issue of *The Canadian Engineer*.—Ed.]

Drills of hard electric steel have recently been adopted in connection with the boring machines employed by the State mining authorities in the Goslar district of Germany. The result is stated to be not only an increased output, but a marked reduction in the number of replacements necessary, and also in the number of drills that require sharpening.