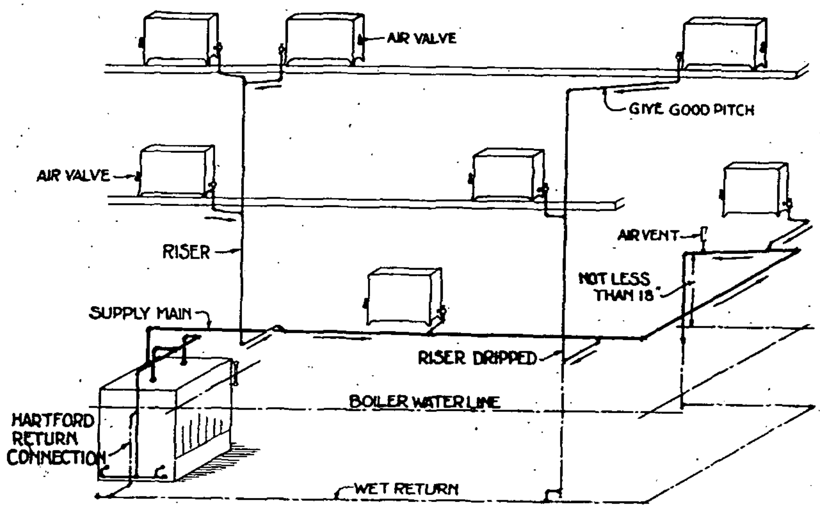

FIG. 1. TYPICAL GRAVITY ONE-PIPE STEAM SYSTEM

The following should be kept in mind in laying out any type of system:

1. The initial pressure should be kept as low as possible, not exceeding 5 lb. gage.
2. The drop in pressure in the mains and riser to the farthest heating unit should not exceed 1 oz. per 100 ft. of straight pipe or its equivalent length, with a lower rate of drop for systems with long runs.
3. In small installations, such as residences, where the longest actual run is seldom over 200 ft. and where the firing periods extend over several hours, resulting in boiler pressure, fluctuating from zero to about 1 lb., the total pressure drop should not exceed 2 oz. for gravity systems. In large buildings, where boilers are under the constant care of a fireman and a uniform pressure is maintained, and where the water-line difference will permit, the total drop in pressure may range from 3 to 8 oz., depending upon the equivalent length of the longest run.
4. The total allowable drop in pressure depends upon (*a*) the water-line difference, (*b*) the equivalent length of main and riser from the boiler to the farthest heating unit, and (*c*) the regularity of the pressure maintained at the boiler or source of steam supply.
5. The water-line difference, or distance between the water line of the boiler and the low point of steam main and dry return main should be not less than 24 in., because of the heavy drop in pressure from condensation in heating up a cold system. This difference should be increased 2 in. for every ounce pressure drop in the system. If the total pressure-drop were 6 oz., the water-line difference should be $6 \times 2 + 24$ or 36 in.
6. There should be a nearly uniform drop in pressure between the source of steam supply and the farthest heating unit on every riser. Care should be taken, however, to see that the maximum allowable velocity for smooth operation is not exceeded.
7. In using this method of proportioning a system, care must be exercised to see that no pipe carrying condensate counter to the steam is loaded to a capacity above the maximum for the particular part of a system in question.

While the pipe size tables given in this chapter, literally followed out, will doubtless serve as an efficient guide to the designer, it is impossible entirely to eliminate the factor of good engineering judgment. For example: While a given main might be calculated to begin at 5 in. and to end at 1½ in., better practice often would make it begin at 4 in. and end at 2½ in., since the dryer steam and higher velocity at the entry would compensate for smaller size at the end.

TABLE 5. MAXIMUM ALLOWABLE CAPACITIES OF UP-FEED RISERS FOR ONE-PIPE LOW PRESSURE STEAM

Based on A. S. H. V. E. Research Laboratory Tests

PIPE SIZE INCHES	VELOCITY FEET PER SECOND	PRESSURE DROP OUNCES PER 100 FT.	CAPACITY		
			Sq. Ft. Radiation	B.t.u. per Hour	Lb. Steam per Hour
A	B	C	D	E	F
1	14.1	0.68	45	10,961	11.3
1¼	17.6	0.66	98	23,765	24.5
1½	20.0	0.66	152	36,860	38.0
2	23.0	0.57	288	69,840	72.0
2½	26.0	0.54	464	112,520	116.0
3	29.0	0.48	799	193,600	199.8
3½	31.0	0.44	1144	277,000	286.0
4	32.0	0.39	1520	368,000	380.0

INSTRUCTIONS FOR USING TABLE 5

1. Capacities given in Table 5 should never be exceeded on one-pipe risers.
2. Capacities based on ¼ lb. condensation per square foot equivalent radiation and actual diameter of standard pipe.
3. All pipe should be well reamed and free from constrictions. Fittings should be up to size. (See Tables 7 and 8).

Gravity One-Pipe System

The gravity one-pipe system (Fig. 1) is considered by many engineers to be the simplest steam circulating system. It may be either of the atmospheric or of the vacuum type depending on whether or not vacuum-type or non-return air valves are used on radiators and return mains. If vacuum-type air valves are used the entire system must be tight and reasonably free from air leaks through supply valves, piping and boiler trimmings.

Each radiator has but a single pipe connection, through which steam must enter and through which the condensation also must return, flowing in the opposite direction to the steam flow. The main from the boiler should pitch downward from the highest point above the boiler, and at the end of this main it should drop down and be sealed independently below the boiler water line. This may be done at the remote end of the main or the main may loop back, above the boiler water line, to a point near the boiler, where it may be more convenient to seal it. Steam and condensation flow in the same direction in this supply main and the branches from the main are taken off the top.

The ends of the supply mains, before they are sealed below the water line, must be vented. Each radiator must have an air valve. Perfect grading of the mains and radiators so that no pools of water will lie in depressions in the pipes is imperative with this system, since these water pools always cause objectionable noise. Radiators with this system usually require that the supply valve be all-open or all-closed, since any intermediate valve-position is likely to cause interference with the necessary return of condensation.