TABLE 3. HEAT-CARRYING CAPACITY OF TYPE L COPPER TUBING WITH TEMPERATURE DROP OF 20 DEG[a]

Nominal Tube Sizes ⅜ in. to 4 in., and Friction 60 to 720 milinches per foot. (A = Capacity, Mbh. B = Velocity, inches per second). (One milinch equals 0.001 in.)

Nominal Tube Size, In.		Milinch Friction Loss per Foot of Tube											
		720	600	480	360	300	240	180	150	120	90	75	60
⅜	A	8.9	7.8	7.0	5.9	5.4	4.7	3.9	3.6	3.1	2.7	2.3	2.1
	B	23.6	20.8	18.6	15.7	14.4	12.5	10.4	9.6	8.2	7.2	6.1	5.6
½	A	16.7	15.0	13.0	11.2	10.0	8.7	7.5	6.6	5.6	5.0	4.5	3.9
	B	27.6	24.8	21.5	18.5	16.5	14.4	12.4	10.9	9.3	8.3	7.4	6.4
⅝	A	29.0	26.0	22.5	19.0	17.5	15.0	13.0	11.5	10.0	8.5	7.6	6.7
	B	32.2	28.8	25.0	21.1	19.4	16.6	14.4	12.8	11.1	9.4	8.4	7.4
¾	A	43.5	39.0	34.5	29.0	26.5	23.0	19.6	17.5	15.0	13.0	12.0	10.5
	B	34.6	31.1	27.5	23.1	21.1	18.3	15.6	13.9	12.0	10.4	9.6	8.4
1	A	93	84	74	63	57	50	42.5	38	34	28.5	26	23
	B	43	39	34	29	27	23	20	18	16	13	12	11
1¼	A	160	145	128	107	97	85	73	65	57	48.5	44	39
	B	49	45	39	33	30	26	22	20	18	15	14	12
1½	A	260	240	206	175	160	140	118	106	93	79	71	62
	B	56	52	45	38	35	30	26	23	20	17	15	13
2	A	560	510	450	380	340	300	250	225	195	170	150	133
	B	70	64	56	47	42	37	31	28	24	21	19	17
2½	A	1100	930	820	700	630	550	470	420	370	310	280	250
	B	89	75	66	57	51	44	38	34	30	25	23	20
3	A	1650	1500	1300	1100	990	860	730	650	565	480	430	375
	B	94	85	74	62	56	49	41	37	32	27	24	21
3½	A	2500	2250	2000	1750	1500	1320	1100	1000	860	730	660	580
	B	105	94	84	73	63	55	46	42	36	31	28	24
4	A	3600	3200	2800	2400	2150	1900	1600	1440	1250	1150	950	840
	B	116	103	90	77	69	61	51	46	40	37	31	27

[a] For other temperature drops the pipe capacities may be changed correspondingly. For example, with temperature drop of 30 deg the capacities shown in this table are to be multiplied by 1.5.

spectively. These figures would also illustrate forced circulation if a pump or circulator were shown in the return line at the boiler.

One-pipe gravity systems require very precise design owing to the small circulating head available. Also, circulation in them is slow, and temperature drop is large toward the end of the main, and consequently these systems are usually considered impractical.

One-pipe forced systems compared with gravity systems provide more rapid circulation, with consequent smaller temperature drop in mains and more uniform water temperature in all radiators, and are therefore preferred. Special flow and return fittings are available for improving the circulation to risers.

Two-pipe systems have separate flow and return mains. If the return main is *direct* as shown in Fig. 5 the radiator at the end of the system has

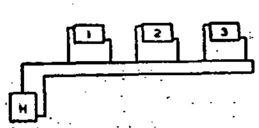

FIG. 4. ONE-PIPE SYSTEM

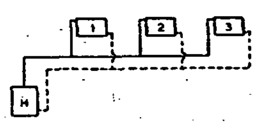

FIG. 5. A TWO-PIPE DIRECT RETURN SYSTEM

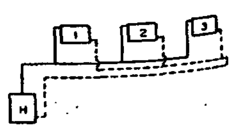

FIG. 6. A TWO-PIPE REVERSED RETURN SYSTEM

TABLE 4. FRICTION (IN MILINCHES) OF CENTRAL CIRCULAR DIAPHRAGM ORIFICES IN UNIONS

(One milinch equals 0.001 in.)

Diameter of Orifices (Inches)	Velocity of Water in Pipe in Inches per Second									
	2	3	4	6	8	10	12	18	24	36
					¾-in. Pipe					
0.25	1300	2900	5000	11,300	20,800	32,000	45,000			
0.30	650	1450	2500	5700	10,400	16,000	23,000	57,000		
0.35	330	740	1300	2900	5200	8000	12,000	26,000	47,000	
0.40	170	380	660	1500	2600	4000	6800	13,000	24,000	53,000
0.45		185	330	740	1300	2000	2900	6500	12,000	27,000
0.50			155	350	620	970	1400	3200	5700	13,000
0.55			75	170	300	480	700	1600	2800	6400
					1-in. Pipe					
0.35	900	2000	3500	7800	14,000	22,000	32,000			
0.40	460	1000	1800	4000	7200	12,000	17,000	37,000	65,000	
0.45	270	570	1000	2300	4100	6400	9300	21,000	37,000	
0.50	160	330	580	1400	2300	3700	5400	12,000	22,000	50,000
0.55		190	330	750	1300	2200	3000	7000	13,000	28,000
0.60			200	440	800	1300	1800	4200	7400	17,000
0.65			120	260	460	720	1100	2400	4300	10,000
					1¼-in. Pipe					
0.45	1000	2250	4000	8900	16,000	25,000	36,000			
0.50	660	1450	2600	5800	10,400	16,400	23,000	53,000		
0.55	430	950	1700	3800	6800	10,500	15,000	34,000	60,000	
0.60	280	630	1100	2500	4400	6900	10,000	22,000	40,000	
0.65	190	420	750	1700	3000	4700	6700	15,000	27,000	60,000
0.70		285	510	1150	2000	3100	4500	10,000	18,000	40,000
0.75		190	330	750	1300	2100	3000	6700	12,000	26,000
					1½-in. Pipe					
0.55	850	1900	3300	7400	13,000	21,000	30,000			
0.60	600	1300	2300	5400	8600	16,800	21,000	50,000		
0.65	400	850	1500	3600	7200	10,400	14,000	30,000	53,000	
0.70	260	600	1100	2600	4400	7000	10,000	21,000	39,000	
0.75	180	400	760	1800	3000	5000	7000	14,000	28,000	
0.80		300	540	1200	2200	3200	5000	10,200	19,000	45,000
0.85		200	380	860	1600	2300	3000	7800	13,000	30,000
					2-in. Pipe					
0.70	890	1850	3500	7400	14,000	22,300	33,000			
0.80	470	975	1800	3900	7400	11,700	17,000	37,000		
0.90	255	560	1000	2200	4200	6500	9500	20,500	38,000	
1.00	160	340	610	1320	2520	4000	5800	12,500	23,000	49,000
1.10		214	375	850	1600	2500	3700	7900	14,000	30,000
1.20			195	460	950	1360	1910	4200	8100	16,800
1.30				275	525	980	1375	3100	4400	8850

Note.—The losses of head for the orifices in the 1½-in. and 2-in. pipe were calculated from those in the smaller pipes, the calculations being based on the assumption that, for any given velocity, the loss of head is a function of the ratio of the diameter of the pipe to that of the orifice. This had been found to be practically true in the tests to determine the losses of head in orifices in ¾-in., 1-in., and 1¼-in. pipe, conducted by the Texas Engineering Experiment Station, and also in the tests to determine the losses of head in orifices in 4-in., 6-in., and 12-in. pipe, conducted by the *Engineering Experiment Station of the University of Illinois*, (*Bulletin* 109, Table 6, p. 38, Davis and Jordan).