HOFFMAN DATA BOOK

FOR

Heating Engineers and Contractors

SECOND EDITION

COMPILED BY

JOHN M. SEWELL, M. E.,
CHARLES V. HAYNES, H. E.

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FOREWORD

HOFFMAN CONTROLLED HEAT has established an entirely *new standard* of heating efficiency.

It is now installed in hundreds of buildings, from the smallest homes to the largest skyscrapers, and is working with a flexibility of control, simplicity of operation and economy of fuel hitherto unknown in the heating world.

The purpose of this booklet is to provide the industry with the necessary data to enable it to plan and install this latest development in the science of heating—HOFFMAN CONTROLLED HEAT.

Air and Condensation are the two important factors that must be adequately provided for wherever STEAM is used.

The most efficient gravity return steam heating system is that one which eliminates air to the greatest degree—prevents its return, and also provides means for promptly returning the water of condensation to the boiler.

If the air relief port is correctly located and the pipe lines for condensation properly connected and graded toward the point where condensation is to be accumulated or discharged, steam will flow quickly and quietly to the point desired. Steam is the most efficient and economical heat conveyor known today, and when properly *controlled* is the last word in Heating Comfort.

While the make of boiler and radiators used with HOFFMAN CONTROLLED HEAT is left to the owner, architect, engineer or contractor, careful thought should be given to the type best suited for each particular installation.

No more radiation is required in HOFFMAN CONTROLLED HEAT than for an ordinary steam installation, and no larger boiler, grate area, or heating surface is required than used for steam or hot-water installations.

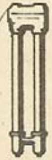
CONTROLLED HEAT is low pressure gravity Steam Heat, measured in *ounces* instead of *pounds*, with two pipe lines; one a steam flow line and the other a return air and condensation line.

The Hoffman devices which transform what would be an ordinary steam heating system into HOFFMAN CONTROLLED HEAT are six in number:—

THE CONTROL VALVE (No. 7 Hoffman Modulating Valve) is connected to the inlet end of the radiator. A handle, with pointer, indicates on a dial the flow of steam, and, working by a touch of the finger, regulates positively and accurately the amount of steam entering the radiator, and consequently the amount of heat in the room.

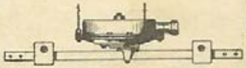
THE TRAP (No. 8 Hoffman Return Line Valve) is a Thermostatic valve, connected to the outlet end of the radiator, which accurately distinguishes between steam, air and water; keeping every bit of steam in the radiator and passing the air and water into the return pipe.

THE VENT VALVE (No. 11 Hoffman Vapor Vacuum Valve) is located in the basement. It is a large valve which vents all the air from the entire system and *prevents* its return.



THE HOFFMAN DIFFERENTIAL LOOP is a safety device placed in the basement. It always maintains the proper difference in pressure between the supply and return piping, thereby insuring the return of all condensation to the boiler by gravity independent of pressure conditions. It is simple and never failing in its faithfulness.

Its operation is based entirely upon a positive principle of physical law, obviating the necessity of any complicated mechanism with moving parts.



THE HOFFMAN DAMPER REGULATOR controls all dampers of the boiler. It is an exceedingly sensitive device which instantly reflects the slightest change in steam pressure conditions retarding the fire as the demand for heat lessens, and increasing the fire to meet the demand for more heat.

THE HOFFMAN THER-KOMPO GAGE is connected directly to the steam space of the boiler.

Measures pressure up to 30 pounds, vacuum to 30 inches and temperature to 225 degrees.

Pressure is registered in ounces up to five pounds.

Vacuum is recorded in half inches up to ten inches.

Temperature of Steam or Vapor is indicated on the thermometer to correspond with the pressure or vacuum.

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SECTION I

SHORT RULE FOR FIGURING RADIATION

While the B. T. U. method of figuring radiation is the most accurate, and the one to be generally used, it is frequently necessary to have available a shorter method which will meet the usual conditions with sufficient accuracy to serve all practical purposes.

In figuring radiation good judgment must *always* be shown so as to meet the many variable conditions applying to each particular installation.

Table B—Page 5 used in estimating radiation is based on the following:

Buildings of good construction.
All windows and openings reasonably tight.
Unduly exposed floors and ceilings properly insulated.
Entire window openings figured as glass.
Outside doors figured as all glass.
Ceilings not over 12′ 0″ in height.
Outside temperature zero Fahrenheit.
One air change per nour.
Heated continuously.
Steam or vapor the heating medium.

Due consideration and allowance must be made for:
Poor construction.
Loose fitting windows, doors, etc.
Surfaces exposed to prevailing winds.
Rooms having ceilings over 12′ 0″ in height.
Outside temperatures above or below zero F.
More than one air change per hour.
Rooms heated in daytime only.
Rooms heated intermittently.
Semi-direct radiation.
Indirect radiation.

SHORT RULE FOR FIGURING RADIATION

To find the amount of direct cast iron radiation required to heat a room of good construction, not over 12′ 0″ in height, to a given degree Fahrenheit, outside temperature being specified, using vapor or steam as the heating medium:

First—Determine the number of air changes by using Table "A." (See Figure I as example.)

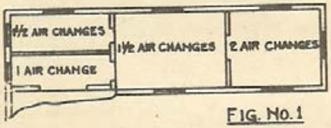


FIG. No. 1

Air changes for average conditions, without providing for mechanical ventilation, can be figured as follows:

TABLE "A"

Rooms 1 side exposed	1 air change per hour
" 2 " "	1½ " " " "
" 3 " "	2 " " " "
" 4 " "	2½ " " " "
Drug Stores	2 to 3 " " " "
Clothing Stores	1 " 2 " " " "
Churches, Factories, Garages, Lofts, etc.	1 " 2 " " " "

RESIDENCES:

Entrance Halls	1 to 2 air changes per hour
Reception Halls	1 " 2 " " " "
Living Rooms	1 " 2 " " " "
Dining Rooms	1 " 2 " " " "
Bath Rooms	1 " 2 " " " "
Rooms with fire-places	2 " 3 " " " "
Bed Rooms	1 " 2 " " " "

BUILDINGS:

With large rolling steel doors ......2 to 3 air changes per hour

SHORT RULE FOR FIGURING RADIATION

Determine the temperature to which the room is to be heated; then refer to Column 1, Table "B," and use the *corresponding* figures in Columns 2, 3, 4 and 5 for divisors, as follows:

First—Figure the glass area in square feet and divide by determined number given in Column 2.

Second—Figure the net wall area by determining the square feet of *exposed* wall (plus exposed roof, if any), and divide this result by the correct number in Column 3. (NOTE—Deduct from each wall or roof area the glass area to obtain net wall area; do not take into consideration the inside walls.)

Third—Figure unheated ceiling area (if any) and divide by the number found in Column 4.

Fourth—Figure the contents of the room in cubic feet, multiply by number of air changes and then divide by number given in column 5.

These results added together will give the total amount of radiation required when the outside temperature is zero.

TABLE "B"

COL. 1 Temp. Room is to be Heated	COL. 2 Divide Glass By	COL. 3. Divide Net Wall or Exposed Roof By	COL. 4. Divide Ceiling with Unheated Air Space Above	COL. 5 Divide Cubical Contents By
40° F.	6.0	22	44	360
50° F.	5.0	18	36	270
60° F.	3.8	14	28	200
65° F.	3.3	12	24	180
70° F.	**3**	**10**	**20**	**160**
75° F.	2.6	9.5	19	150
80° F.	2.4	8.8	17	130
85° F.	2.0	8.0	16	118
90° F.	1.9	7.0	14	105
100° F.	1.5	5.7	11	85
110° F.	1.2	4.7	9	70
120° F.	1.0	3.8	7	55

SHORT RULE FOR FIGURING RADIATION

Should the outside temperature be other than zero, multiply the radiation required for zero by factors as follows:

TABLE "C"

25° F. below	1.37
20° F. "	1.30
15° F. "	1.22
10° F. "	1.15
5° F. "	1.07
ZERO	1.00
5° F. above	0.94
10° F. "	0.86
15° F. "	0.79
20° F. "	0.71
25° F. "	0.64
30° F. "	0.57

As it is customary to figure the outside temperature at ten degrees above the lowest recorded for a given locality, and as the prevailing wind in the heating season must be considered, when these are not known, or definitely specified, consult the local office of the United States Weather Bureau.

Where rooms have surfaces exposed to prevailing winds, addition to the total radiation figured for such rooms should be made as in the following table:

TABLE "D"

	Add for Rooms Facing			
	North	West	East	South
Prevailing Wind from North N. E. or N. W.	15%	10%	5%	0
Prevailing Wind from West or S. W.	10%	15%	0	5%
Prevailing Wind from East or S. E.	10%	0	15%	5%
Prevailing Wind from South	0	10%	5%	15%

(Note—If room is exposed to the north, west and east and the prevailing wind is from the north add only for the extreme condition, i. e., 15%.)

SHORT RULE FOR FIGURING RADIATION

For rooms heated in daytime only add 10% to radiation as figured.

For rooms heated intermittently, with long intervals of non-heating, add 30% to radiation as figured.

For semi-direct radiation figure as for direct radiation and add 40%.

For indirect radiation figure as for direct radiation and add 80%.

TABLE "E"

For rooms over 12′ 0″ in height, figure as above and add as follows:

14 ft.	4%	35 ft.	31%
16 ft.	8%	40 ft.	34%
18 ft.	12%	45 ft.	36%
20 ft.	16%	50 ft.	38%
25 ft.	22%	55 ft.	39%
30 ft.	27%	60 ft.	40%

To find the amount of radiation required for *hot water* heating, figure as for steam and add 60%.

EXAMPLE NO. 1

Room 16 ft. x 10 ft., exposed on one 16-ft. side, 10-ft. ceiling, 30 sq. ft. of glass, 130 sq. ft. net exposed wall of good construction. Direct cast-iron radiation with vapor or low pressure steam used as the heating medium.

Heat above room to 70° F., with zero outside. Refer to Table "A" and find one change to be figured, then referring to Table "B," find—

Cubic Contents	$1600 \div 160 = 10$
Net Exposed Wall	$130 \div 10 = 13$
Glass Surface	$30 \div 3 = 10$
TOTAL RADIATION REQUIRED	33 sq. ft.

EXAMPLE NO. 2

Heat the room to 80° F., with zero outside: (Refer to Tables used in Example No. 1). Find—

Cubic Contents ......1600 ÷ 130 = 12.3
Net Exposed Wall ... 130 ÷ 8.8 = 14.7
Glass Surface .... 80 ÷ 2.4 = 12.5

TOTAL RADIATION REQUIRED 39.5 sq. ft.

EXAMPLE NO. 3

If the room, as figured in Example No. 1 had the ceiling exposed to an unheated air space, then (refer to Tables used in Example No. 1), find—

Cubic Contents ....1600 ÷ 160 = 10
Net Exposed Wall ..... 130 ÷ 10 = 13
Glass Surface .... 30 ÷ 3 = 10
Exposed Ceiling .... 160 ÷ 20 = 8

TOTAL RADIATION REQUIRED 41 sq. ft.

If the room is located in New Haven, Conn., by referring to the United States Weather Bureau, find that the prevailing wind will be from the North, then, if the exposed wall faces the North, by referring to Table "D" find 15% must be added to the amount of radiation as figured. Or, if it faces the East 5% must be added.

EXAMPLE NO. 4

If the room were located in New Orleans, Louisiana, by referring to the United States Weather Bureau, find the outside temperature to be figured as 20° F., and from Table "C" find its corresponding factor to be .71, the result of any of the above examples, multiplied by .71 would give the required amount of radiation when it was 20° F. outside.

If the room given in above examples also had a 10 ft. side exposed, refer to Table "A" and find where two sides of a room are exposed 1½ air changes must be figured. Then, by referring to Table "B," refigure Example No. 1, as follows:

Cubic Contents....1600 × 1½ ÷ 160 = 15
Net Exposed Wall ...... 230 ÷ 10 = 23
Glass Surface .... 30 ÷ 3 = 10

TOTAL RADIATION REQUIRED 48 sq. ft.

If any of the radiators in these examples were set in a recess, without a grill, as shown in Fig. 2, 15% must be added to the total radiation as figured; or, if a grill were placed in front of radiation, as shown in Fig. 4, 25% must be added.

To enclose, or partly enclose a radiator reduces its efficiency. The per cent. of additional radiation required for a given condition is indicated below.

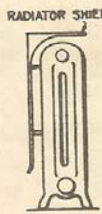


FIG. 1
ADD 10%

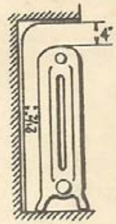


FIG. 2
ADD 15%

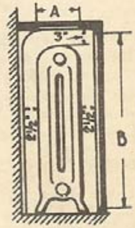


FIG. 3
ADD 20%

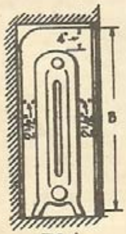


FIG. 4
ADD 25%

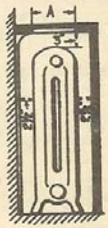


FIG. 5
ADD 30%

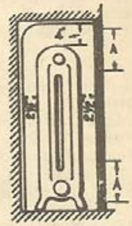


FIG. 6
ADD 35%

Allow 2½" of space between the wall and the back of an enclosed radiator.

"A" to be at least the width of the radiator and also its length.

"B" to be the full area of the opening of the recess.

SECTION II

FIGURING HEAT LOSSES AND RADIATION

In planning a heating installation, heat losses and the way in which they are to be overcome, are the two factors to be considered.

If air within a room is maintained at a higher temperature than air surrounding the room there will be a loss of heat through the walls, partitions, ceiling or floor, to air of lower temperature. This heat loss may be to the outside, an adjoining room, or space above or below.

Heat losses from buildings are of two kinds, those due to leakage of cold air into and warm air out of the building, termed infiltration losses, and those due to transmission through the building material, termed transmission losses.

The number of air changes per hour which will occur in a room depends upon its construction, exposure, number and type of windows, doors and other openings.

The actual cubic feet of air which must be heated per hour is the cubic content of the room multiplied by the number of air changes.

The unit of measure commonly used for this work is the B. T. U., which is the amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit (as from 59° F. to 60° F.).

One cubic foot of air heated one degree Fahrenheit requires .02 B. T. U.

When the cubic content of a room is multiplied by the number of air changes and then by .02 and then by the difference in temperature between the inside and outside air, the product will be the number of B. T. U. required for heat losses due to infiltration.

As the kind and thickness of the building material affects the heat transmission losses to be figured, the constants used in the examples given are found in the tables designated, which cover the subject.

The heat transmission constants, when multiplied by the square feet of each kind of exposed surface, then added together and this total multiplied by the difference in temperature between the inside and outside air will give the heat units to overcome losses by *transmission*.

In computing glass surface figure the entire window opening. It is customary to figure outside doors as all glass, taking the entire door opening.

The total heat loss is the sum of the infiltration and transmission losses to which should be added allowances to take care of exposures, poor construction, etc.

The heat required to raise the temperature of a cold building and its contents to the desired degree in a given time is termed HEATING-UP-FACTOR.

The total heat the apparatus must furnish includes the total heat loss plus the heating-up-factor.

In actual practice, to meet average conditions, the heating-up-factor has been added to the infiltration losses, and expressed in terms of air changes.

In practice, heat losses are figured on an hourly basis.

The radiator unit of measure is the square foot of heating surface, which is one square foot of external surface.

To heat and maintain a pre-determined temperature in a room, an equal amount of heat must be supplied at the rate at which it is lost, and as radiation is the heating medium to offset this loss, it is necessary to know the heat transmission in B. T. U. of one square foot of radiation per hour.

The amount of heat a square foot of heating surface (radiation) will give off depends upon its design, the temperature of the heating medium (steam or hot water), the temperature of the surrounding air, and the *velocity* at which the air passes over the heating surface.

It is therefore necessary to decide upon the type of radiator, the heating medium, and the temperature to which the room is to be heated before determining the heat transmission factor.

The standard practice is to regard the radiator as standing in still air.

By adding the total B. T. U. required for infiltration and transmission, and dividing this total by the B. T. U. heat transmission from one square foot of radiation of the type desired, the result will be the number of square feet of radiation required.

EXAMPLE:

To show how to use tables and other information given on pages 21 to 39, figure the heat losses and radiation to offset same for the building shown by Plan No. 1, page 13.

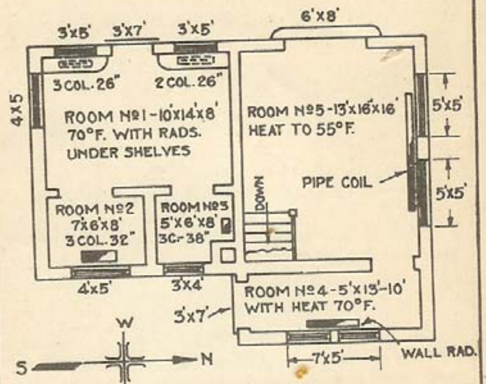
This building is to be heated continuously, using vapor or low-pressure steam for the heating medium, to temperatures as indicated on plan when it is 10° below zero outside, and the prevailing wind is from the North. The relation of the building to the points of the compass is indicated on the plan.

The walls are 10″ hollow tile, plastered on the inside, and the windows are of single thick glass, set in wood sashes.

All rooms except No. 5 have plastered ceilings with approximately three-foot air space above.

The ceiling of room No. 5 consists of 4″ reinforced concrete roof.

All dimensions of building and types of radiation are indicated on Plan No. 1, page 13.



PLAN No1

Obtain the following information by referring to the various tables as shown on pages 21 to 39. (See index, page 20.)

To find Transmission Losses refer to Table No. 6, page 24, and find that a 10″ hollow tile wall, plastered on one side, transmits .3 B. T. U. per sq. ft. per degree difference in temperature per hour. Then use this as a constant for all outside walls.

Refer to Table No. 2, page 22, and find that single windows transmit 1.1 B. T. U. per sq. ft. per degree difference in temperature per hour. Then use this as a constant for all windows and outside doors.

Refer to Table No. 11, page 28, and find that the constant for ceilings with unheated air space above is 0.6, which is to be used for all rooms except No. 5. For 4″ reinforced concrete roof find that the constant 1.0 is used for ceiling of room No. 5.

Refer to Table No. 19, page 33, and find that 8% is to be added to figured radiation for room No. 5, due to the ceiling being 16 ft. in height.

To find Infiltration Losses refer to Table No. 1, page 21, and find

Room No. 1	= 2 sides exposed	= 1½	air changes
" " 2	= 2 " "	= 1½	" "
" " 3	= 1 " "	= 1	" "
" " 4	= 3 " "	= 2	" "
" " 5	= 2 " "	= 1½	" "

Refer to Table No. 18, page 33, and find that

Room 1, facing	West = 10%	To be added to radiation as figured.
" 2, "	East = 5%	
" 3, "	East = 5%	
" 4, "	North = 15%	
" 5, "	North = 15%	

Refer to page 39, Figure No. 3, and find that 15% is to be added to radiators under shelves as shown on plan for room No. 1.

As the number of B. T. U. required to heat one cu. ft. of air one degree is .02, use this as a constant in figuring heat necessary to warm the air.

As room No. 5 is to be heated to 55° F. when 10° below zero, the total temperature difference between the inside and outside air will be 65° F.; therefore, all constants for room No. 5 must be multiplied by 65.

Room No. 5 is to be heated to 55 degrees F. and adjoining rooms are to be heated to 70 degrees F., therefore the interior walls will transmit heat to room No. 5, i. e., 70 — 55 = 15 degrees F. temperature difference. Heat transmission per sq. ft. of wall per degree temperature difference per hour = 0.3, then, temperature difference x sq. ft. of interior wall x 0.3 = B. T. U. to be deducted from heat losses as figured for room No. 5.

As the heat transmission from interior walls to room No. 5 is from rooms 1, 3 and 4, it must be figured exactly as above and added to other heat losses from these rooms.

As rooms 1, 2, 3 and 4 are to be heated to 70° F., when 10° below zero outside, the total temperature difference will be 80° F.; therefore, all constants except for the ceilings and inside partitions must be multiplied by 80.

Note from Table No. 11, page 28, that unheated air spaces are to be taken at 35° F. above outside temperature; therefore, as the outside temperature is 10° below zero, the space above rooms 1, 2, 3 and 4 will be 25° F.

As these rooms are to be heated to 70° F., the temperature difference between the unheated air space above and the room will be 70 — 25 = 45° F.; therefore, constants for these ceilings must be multiplied by 45.

Refer to Table No. 13, page 30, and find heat transmission from radiators, as follows:

Room No.	Type of Radiation	Temperature in which it is to set	B. T. U. Radiator will give off per sq. ft.
1	3-col. 26″	70° F.	247
2	3-col. 32″	70° F.	240
3	3-col. 38″	70° F.	231
4	Wall	70° F.	285
5	Coil	55° F.	338

Refer to Tables Nos. 14 to 17, pages 31 and 32, and select a standard size radiator of at least the amount figured, except in case of a fraction of a sq. ft.

Note: (While Tables 14 to 17 may be regarded as standard, they are shown herein merely as a guide. Dimensions of radiators and their ratings in square feet are determined by the manufacturers thereof. Consult the catalog of the manufacturer whose product is to be used).

ROOM NO. 1

Cu. Cont... $10\times14\times8=1120\times1\tfrac{1}{2}\times.02\times80=2688$

Glass $\left\{\begin{array}{l}2—3\times5=30\\1—4\times5=20\\1—3\times7=21\end{array}\right\}=71\times1.1\times80=6248$

Wall $10+14\times8=192\quad 71=121\times0.3\times80=2904$

Ceiling .... $10\times14=140\times0.6\times45=3780$

Inside Partition .... $10\times8=80\times0.3\times15=360$

Total Heat Loss in B. T. U. 15,980

15,980 B. T. U. ÷ 247 B. T. U. = 64.3 sq. ft. Rad.

Add for shelf over Rad. 15% = 9.6 " " "

73.9 " " "

Add for Western exposure 10% 7.39 " " "

Total Radiation required ......81.29 " " "

Size 3-col. 26″ Rad. nearest to required amount is 82½ sq. ft.

ROOM NO. 2

Cu. Cont.. $7\times6\times8=336\times1\tfrac{1}{2}\times.02\times80=806$

Glass..... $20\times1.1\times80=1760$

Wall ....$7+6\times8=104—20=84\times0.3\times80=2016$

Ceiling... $7\times6=42\quad 42\times0.6\times45=1134$

Total Heat Loss in B. T. U. 5716

5716 B. T. U. ÷ 240 B. T. U. = 23.8 sq. ft. Rad.

Add for Eastern exposure 5% = 1.19 " " "

Total Radiation required .... 24.99 " " "

Size 3-col. 32″ Rad. nearest to required amount is 27 sq. ft.

ROOM NO. 3

Cu. Cont.. $5\times6\times8=240\times1\times.02\times80=384$

Glass..... $3\times4=12\times1.1\times80=1056$

Wall..... $5\times8=40—12=28\times0.3\times80=672$

Ceiling... $5\times6=30\times0.6\times45=810$

Total Heat Loss in B. T. U. 2922

2922 B. T. U. ÷ 231 B. T. U. = 12.2 sq. ft. Rad.

Add for Eastern exposure 5% = .6 " " "

Total radiation required 12.8 sq. ft.

Size 3-col. 38″ Radiator nearest to required amount is 15 sq. ft.

ROOM NO. 4

Cu. Cont.. $5\times13\times10=650\times2\times.02\times80=2080$

Glass.... $7\times5+3\times7=56\times1.1\times80=4928$

Wall—

$5+5+13\times10=230—56=174\times0.3\times80=4176$

Ceiling .... $5\times13=65\times0.6\times45=1755$

Interior Partition—$13\times10=130\times0.3\times15=585$

Total Heat Loss in B. T. U. 13,524

13,524 B. T. U. ÷ 285 = 47.4 sq. ft. Rad.

Add for Northern exposure 15% = 7.1 " " "

Total wall radiation required...54.5 " " "

Size 9 sq. ft. Wall Radiation nearest to required amount is 54 sq. ft.

ROOM NO. 5

Cu. Cont.—

$13\times16\times16=3328\times1\tfrac{1}{2}\times.02\times65=6{,}490$

Glass $2(5\times5)+1(6\times8)=98\times1.1\times65=7{,}007$

Wall—

$13+16\times16=464—98=366\times0.3\times65=7{,}137$

Ceiling.. $13\times16=208\times1.0\times65=13{,}520$

Total Heat Loss in B. T. U. 34,154

Less Heat gain from interior walls:

Room No. 1....... $8\times10\times.3\times15=360$

" " 4.......$13\times10\times.3\times15=585$

Total deduction for heat gain 945

Actual B. T. U. required 33,209

33,209 B. T. U. ÷ 338 B. T. U. = 98.2 sq. ft. Rad.

Add for Northern exposure 15% = 14.7 " " "

Total radiation required in coil 112.9 " " "

In using pipe coil for radiation it is always well to use pipe not less than 1¼″ in size.

Warm air rises, hence the temperature in a room at various levels will differ according to conditions. For rooms not over 12′0″ high this difference can be taken at one degree per foot, and the average can be taken at temperature to be maintained at the breathing line (5′0″ from the floor, at 5′0″ from the wall).

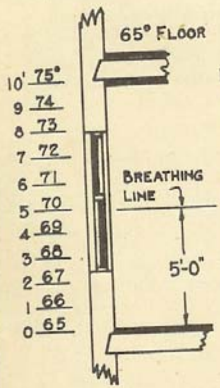


FIG. NO. 1

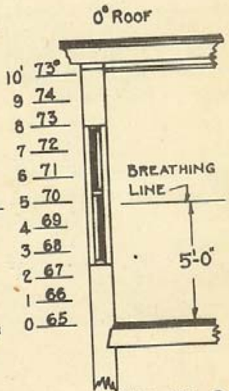


FIG. NO. 2

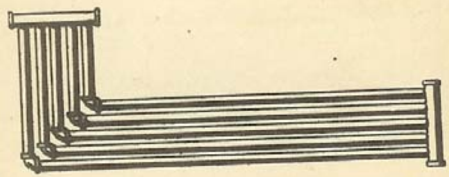
From Fig. 1 it will be noted that the warmest part of a room with heated space above is at or near the ceiling, and from Fig. 2, with exposed roof above, the warmest part is slightly below the ceiling.

Note: Radiation can be classified as Direct, Semi-direct and Indirect, and is usually made of cast iron or pipe. When made of cast iron it is termed column, wall, semi-indirect or indirect radiation, and when made of pipe is termed pipe coils.

Wall radiators of over 22′0″ in length should be made into two units rather than one, and for steam or vapor should be connected top and bottom, opposite ends.

Pipe coils should be of the header type of not less than 1¼″ or 1½″ pipe, not over 60′0″ long, fastened to hangers placed not more than 8′0″ apart. Provision should be made for expansion by a mitre piece which should be at least one-tenth the length of the coil, and the steam supply connected to the mitre end.

All coils should be securely anchored at the return header so as to throw the expansion towards the mitre end.



HEADER TYPE COIL USUALLY CALLED MITRE OR HARP COIL.

FIGURING HEAT LOSSES AND RADIATION

Index to Tables giving Heat Transmission Constants and other information used in Figuring Heat Losses and Radiation.

AIR CHANGE TABLE NO. 1

AIR CHANGES FOR AVERAGE CONDITIONS, WITHOUT PROVIDING FOR MECHANICAL VENTILATION, CAN BE FIGURED AS FOLLOWS:-

ROOMS 1 SIDE EXPOSED	= 1 AIR CHANGE PER HOUR
2	= 1½ " " "
3	= 2 " " "
4	= 2½ " " "
DRUG STORES	2 TO 3 " " "
CLOTHING STORES	1 " 2 " " "
CHURCHES, FACTORIES, GARAGES, LOFTS, ETC.	= 1 TO 2 " " "

ADD TO THE ABOVE, FOR THE FOLLOWING: -

RESIDENCES:-

ENTRANCE HALLS	= 1 TO 2 AIR CHANGES PER HOUR
RECEPTION HALLS	= 1 " " "
LIVING ROOMS	= 1 TO 2 " " "
DINING ROOMS	= 1 " 2 " " "
BATH ROOMS	= 1 " 2 " " "
ROOMS WITH FIRE PLACES	= 1 " " "

BUILDINGS:-

WITH LARGE ROLLING STEEL DOORS	= 1 " " "

THE HEATING-UP-FACTOR IS INCLUDED IN THIS TABLE.

THE CUBIC CONTENTS OF A ROOM MULTIPLIED BY NUMBER OF AIR CHANGES EQUALS AMOUNT OF AIR TO BE HEATED.

TO HEAT ONE CUBIC FOOT OF AIR ONE DEGREE REQUIRES 0.02 B.T.U.

EXAMPLE:-

ROOM 12'X12'X10' = 1440 X
AIR CHANGES PER HR = 2
CU. FT. TO BE HEATED = 2880
PER HOUR X .02
B.T.U. REQUIRED TO HEAT THE AIR 1°F. = 57.6 B.T.U.

THEN:-

57.6 MULTIPLIED BY NUMBER DEGREES F. AIR IS TO BE HEATED = TOTAL B.T.U. REQUIRED TO OVERCOME INFILTRATION LOSSES.

HEAT·TRANSMISSION·OF·BUILDING·MATERIALS

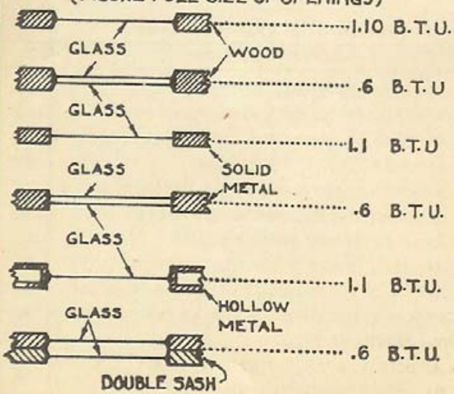
HEAT FLOWS FROM A HIGHER TO A LOWER TEMPERATURE AT A DEFINITE RATE, DEPENDING UPON THE DIFFERENCE IN TEMPERATURE AND THE CHARACTER AND THICKNESS OF THE MATERIAL THROUGH WHICH IT PASSES.

THE FOLLOWING HEAT TRANSMISSION TABLES ARE FOR AVERAGE CONDITIONS OF CONSTRUCTION AND THE RATE OF TRANSMISSION FOR ANY MATERIAL IS GIVEN IN THE NUMBER OF B.T.U. WHICH WILL BE TRANSMITTED PER DEGREE DIFFERENCE IN TEMPERATURE PER HOUR PER SQ. FT. OF SURFACE.

THE RESEARCH BUREAU OF THE AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS ARE MAKING HEAT TRANSMISSION TESTS OF DIFFERENT MATERIAL AND WHEN RESULTS ARE PUBLISHED, ALL HEAT TRANSMISSION TABLES MAY BE REVISED.

Table No. 2

WINDOWS, ROOF GLASS AND SKYLIGHTS (FIGURE FULL SIZE OF OPENINGS)



HEAT TRANSMISSION TABLE

Table No. 3

WOOD DOORS AND WOOD PARTITIONS

3/4" TO 1" THICK TONGUED & GROOVED	= .65 B.T.U.
1" - 1¼" " " & "	= .60 "
1¼" - 1½" " " & "	= .50 "
1½" - 2" " " & "	= .42 "
2" - 2½" " " & "	= .35 "
2½" - 3" " " & "	= .30 "

Table No. 4

WALLS OF VARIOUS CONSTRUCTIONS.

THICKNESS OF BOARD IN INCHES	TWO BOARDS WITH PAPER BETWEEN	BOARD AND CORRUGATED IRON	BOARD AND SHEET IRON
½"	.32 B.T.U.	.45 B.T.U.	.50 B.T.U.
1	.24 "	.36 "	.40 "
1½	.19 "	.30 "	.33 "
2	.16 "	.26 "	.28 "
2½	.14 "	.23 "	.25 "

Table No. 5

WALLS OF CLAPBOARD

CONSTRUCTION	B.T.U.
CLAPBOARD ON STUDS	.62
CLAPBOARD ON STUDS, LATH & PLASTER	.48
CLAPBOARD, PAPER, STUDS, LATH & PLASTER	.34
CLAPBOARD, STUDS, 1" SHEATHING	.57
CLAPBOARD, SHEATHING, STUDS, LATH & PLASTER	.37
CLAPBOARD, PAPER, SHEATHING, STUDS, - & "	.30
CLAPBOARD, STUDS, BRICK FILL	.40
CLAPBOARD, STUDS, BRICK FILL, PAPERED	.36
CLAPBOARD, STUDS, BRICK FILL, LATH & PLASTER	.31
CLAPBOARD, SHEATHING, STUDS, LATH & PLASTER WITH SAWDUST FILL	.21
CLAPBOARD, PAPER, SHEATHING, STUDS, LATH & PLASTER WITH SAWDUST FILL	.15

HEAT TRANSMISSION TABLES

Table No. 6
WALLS

PLAIN BRICK A	B.T.U.
8"	.38
12	.29
16	.25
20	.22
24	.19
28	.17
32	.15
36	.14

BRICK PLASTERED ONE SIDE A	B.T.U.
8"	.36
12	.28
16	.24
20	.21
24	.18
28	.16
32	.14
36	.13

BRICK FURRED LATHED & PLASTERED A	B.T.U.
8"	.28
12	.24
16	.21
20	.19
24	.16
28	.15
32	.13
36	.12

HOLLOW TILE A	B.T.U.
4"	.64
6	.57
8	.40
10	.35
12	.26

HOLLOW TILE PLASTERED ONE SIDE A	B.T.U.
4"	.57
6	.50
8	.36
10	.30
12	.23

STUCCO HOLLOW TILE PLASTER A	B.T.U.
4"	.50
6	.46
8	.32
10	.26
12	.22

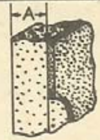
STUCCO HOLLOW TILE FURRING, LATH & PLASTER A	B.T.U.
4"	.45
6"	.40
8"	.30
10"	.23
12"	.20

4" BRICK HOLLOW TILE A	B.T.U.
4"	.40
6	.35
8	.30
10	.25
12	.20
16	.14

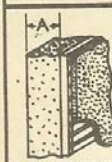
·HEAT·TRANSMISSION·TABLES·

TABLE Nº7
WALLS

CONCRETE A	B.T.U.
4"	1.00
6"	.86
8"	.71
10"	.65
12"	.57
16"	.50
20"	.40



CONCRETE PLASTERED A	B.T.U.
4"	.90
6"	.80
8"	.65
10"	.60
12"	.52
16"	.46
20"	.34

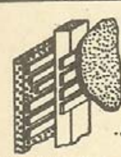


CONCRETE, FURRED, LATHED & PLASTERED A	B.T.U.
4"	.63
6"	.57
8"	.47
10"	.43
12"	.40
16"	.33
20"	.26

STONE A	B.T.U.
4"	.99
6"	.85
8"	.70
10"	.64
12"	.56
16"	.49
20"	.39

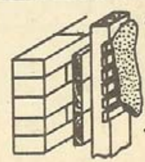
STONE PLASTERED A	B.T.U.
6"	.79
8"	.65
10"	.59
12"	.51
16"	.45
20"	.33

STONE, FURRED LATHED & PLASTERED A	B.T.U.
6"	.56
8"	.46
10"	.42
12"	.39
16"	.32
20"	.25



STUCCO, WOOD LATHS, STUDS, WOOD LATHS, PLASTER. .57 B.T.U.

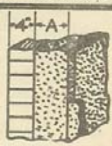
WITH METAL LATHS IN PLACE OF WOOD—.64 B.T.U.



4" BRICK BOARDS STUDS LATH & PLASTER .28 B.T.U.

·HEAT·TRANSMISSION·TABLES·

TABLE Nº8
WALLS

	A	B.T.U.		A	B.T.U.
 4" BRICK HOLLOW TILE PLASTERED	4"	.30	 4" BRICK HOLLOW TILE FURRED, LATHED & PLASTERED	4"	.24
	6"	.27		6"	.22
	8"	.23		8"	.20
	12"	.18		12"	.17
	16"	.13		16"	.11
	A	B.T.U.		A	B.T.U.
 4" BRICK CONCRETE	4"	.50	 4" BRICK CONCRETE PLASTERED	4"	.46
	8"	.40		8"	.36
	12"	.31		12"	.28
	16"	.26		16"	.23
	A	B.T.U.		A	B.T.U.
 BRICK, CONCRETE FURRED, LATHED & PLASTERED	4"	.36	 LIMESTONE OR SANDSTONE	6"	.90
				8"	.80
	8"	.30		10"	.70
				12"	.65
	12"	.23		16"	.55
				20"	.47
	16"	.18		24"	.39
	A	B.T.U.		A	B.T.U.
 LIMESTONE PLASTERED ONE SIDE	4"	.94	 LIMESTONE FURRED, LATHED & PLASTERED	4"	.71
	6"	.83		6"	.60
	8"	.70		8"	.53
	10"	.65		10"	.48
	12"	.60		12"	.43
	16"	.50		16"	.36
	20"	.41		20"	.30

·HEAT·TRANSMISSION·TABLES·

TABLE Nº9
INTERIOR WALLS

CONSTRUCTION	B.T.U.
PLASTER, LATH, STUDS, LATH & PLASTER	.34
STUDS, LATH & PLASTER	.60
4" HOLLOW TILE, PLASTERED 1 SIDE	.57
4" HOLLOW TILE, PLASTERED BOTH SIDES	.50
2" GYPSUM BLOCK, PLASTERED 1 SIDE	.64
2" GYPSUM BLOCK, PLASTERED BOTH SIDES	.60

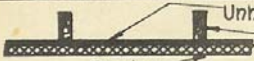
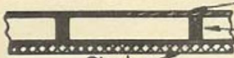
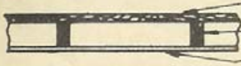
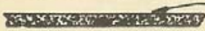
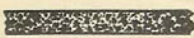
TABLE Nº10
ROOFS.

CONSTRUCTION	B.T.U.
1" WOOD, 5 PLY PAPER, TAR & GRAVEL	.30
1" WOOD, FELT ROOFING	.36
1½" WOOD, 5 PLY PAPER, TAR & GRAVEL	.26
2" WOOD, " " " " " "	.21
2½" WOOD, " " " " " "	.18
TIN ON WOOD STRIPS	1.60
TIN ON SHEATHING	.60
TIN ON SHEATHING, WITH PAPER	.43
SHINGLES ON WOOD STRIPS	.87
SHINGLES ON SHEATHING	.43
SHINGLES, PAPER, SHEATHING, STRIPS	.21
4" HOLLOW TILE, PAPER, TAR & GRAVEL	.30
6" HOLLOW TILE, PAPER, TAR & GRAVEL	.27
2" CONCRETE, PAPER, TAR & GRAVEL	.71
3" CONCRETE, PAPER, TAR & GRAVEL	.64
4" CONCRETE, PAPER, TAR & GRAVEL	.57
FLAT TILE ON WOOD STRIPS	1.07
FLAT TILE ON SHEATHING	.64
SLATE ON WOOD STRIPS	1.10
SLATE ON PAPER & SHEATHING	.50
CORRUGATED IRON ON STRIPS	1.50
CORRUGATED IRON, SHEATHING	.64

HEAT TRANSMISSION TABLES

Table No. 11
CEILINGS

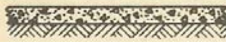
ASSUME TEMPERATURE OF UNHEATED AIR SPACE ABOVE TO BE 35° FAHR. ABOVE THE OUTSIDE TEMPERATURE.

CONSTRUCTION	B.T.U.
 Unheated Space Joists Plaster Lath	.60
 Floor Joists Plaster Lath	.26
 Floor Joists Metal Ceiling	.36
 1" Floor Joists	.40
 Floor Paper Floor Joists	.21
 Floor 4" Reinforced Concrete	.41
 4" Reinforced Concrete	1.00
 6" Reinforced Concrete	.86
 8" Reinforced Concrete	.41
 10" Reinforced Concrete	.36

·HEAT·TRANSMISSION·TABLES·

TABLE Nº 12
FLOORS.

ASSUME TEMPERATURE UNDER FLOOR TO BE 40° F. ABOVE OUTSIDE TEMPERATURE

CONSTRUCTION	B.T.U.
 4" CONCRETE GROUND	.31
 4" CONCRETE CINDER FILL GROUND	.29
 1" TILE 4" CONCRETE GROUND	.30
 2½" BRICK 4" CONCRETE GROUND	.29
 1½" WOOD FLOOR WATERPROOFING 3" CONCRETE GROUND	.10
 1½" WOOD FLOOR 3" CONCRETE CINDER FILL GROUND SLEEPERS	.07
 1½" WOOD FLOOR 5" CINDER FILL GROUND SLEEPERS	.11
 1½" WOOD FLOOR AIR SPACE GROUND SLEEPERS	.13

Radiation Data

Heat Transmission from Radiators

Number of B.T.U. Transmitted per Hour per Sq.Ft. of Radiation with Low Pressure Steam when Heating Room to Given Temperature.

Temp. of Room	Kind of Radiation — Table No. 13				
	3 Col. 26"	3 Col. 32"	3 Col. 38"	Wall	Coil
Col. A	Col. B	Col. C	Col. D	Col. E	Col. F
40°F	309	305	293	362	381
45	301	292	281	347	365
50	290	282	271	335	354
55	279	270	261	322	338
60	269	261	250	310	326
65	258	250	240	297	313
70	247	240	231	285	300
75	236	230	220	273	288
80	226	220	211	261	277
85	216	210	200	251	265
90	206	200	190	242	253
95	196	190	180	228	239
100	186	180	170	215	226
105	176	171	162	203	214
110	167	162	155	192	202
115	158	153	147	181	191
120	149	144	139	171	180
125	140	135	130	160	169
130	130	126	121	150	158
135	121	118	113	140	147
140	113	110	106	130	137

If 500 sq.ft. of Wall Radiation is heating a room to 50°F. what will it's equivalent be in Column Radiation setting in 70°F.— Refer to Col. E & find one sq.ft. Wall Radiation setting in 50°F=335 B.T.U., then 500×335=167,500 B.T.U.–Refer to Col. C. at 70°F for average Col. Rad. & find–240 B.T.U. per Sq.Ft., therefore 167,500÷240=698 sq.ft. direct equivalent.

Radiator Data.

Two-Column Radiators. Table No. 14

No. of Sections	Length 2½"/Sec.	Heating Surface–Sq. Ft.					
		45 In. 5 sq.ft./Sec.	38 In. 4 sq.ft./Sec.	32 In. 3⅓ sq.ft./Sec.	26 In. 2⅔ sq.ft./Sec.	23 In. 2⅓ sq.ft./Sec.	20 In. 2 sq.ft./Sec.
3	7½	15	12	10	8	7	6
4	10	20	16	13⅓	10⅔	9⅓	8
5	12½	25	20	16⅔	13⅓	11⅔	10
6	15	30	24	20	16	14	12
7	17½	35	28	23⅓	18⅔	16⅓	14
8	20	40	32	26⅔	21⅓	18⅔	16
9	22½	45	36	30	24	21	18
10	25	50	40	33⅓	26⅔	23⅓	20
11	27½	55	44	36⅔	29⅓	25⅔	22
12	30	60	48	40	32	28	24
13	32½	65	52	43⅓	34⅔	30⅓	26
14	35	70	56	46⅔	37⅓	32⅔	28
15	37½	75	60	50	40	35	30
16	40	80	64	53⅓	42⅔	37⅓	32
17	42½	85	68	56⅔	45⅓	39⅔	34
18	45	90	72	60	48	42	36
19	47½	95	76	63⅓	50⅔	44⅓	38
20	50	100	80	66⅔	53⅓	46⅔	40
21	52½	105	84	70	56	49	42
22	55	110	88	73⅓	58⅔	51⅓	44
23	57½	115	92	76⅔	61⅓	53⅔	46
24	60	120	96	80	64	56	48
25	62½	125	100	83⅓	66⅔	58⅓	50
26	65	130	104	86⅔	69⅓	60⅔	52
27	67½	135	108	90	72	63	54

Three-Column Radiators Table No. 15

No. of Sections	Length 2½"/Sec.	Heating Surface–Sq. Ft.					
		45 In. 6 sq.ft./Sec.	38 In. 5 sq.ft./Sec.	32 In. 4½ sq.ft./Sec.	26 In. 3¾ sq.ft./Sec.	22 In. 3 sq.ft./Sec.	18 In. 2¼ sq.ft./Sec.
3	7½	18	15	13½	11¼	9	6¾
4	10	24	20	18	15	12	9
5	12½	30	25	22½	18¾	15	11¼
6	15	36	30	27	22½	18	13½
7	17½	42	35	31½	26¼	21	15¾
8	20	48	40	36	30	24	18
9	22½	54	45	40½	33¾	27	20¼
10	25	60	50	45	37½	30	22½
11	27½	66	55	49½	41¼	33	24¾
12	30	72	60	54	45	36	27
13	32½	78	65	58½	48¾	39	29¼
14	35	84	70	63	52½	42	31½
15	37½	90	75	67½	56¼	45	33¾
16	40	96	80	72	60	48	36
17	42½	102	85	76½	63¾	51	38¼
18	45	108	90	81	67½	54	40½
19	47½	114	95	85½	71¼	57	42¾
20	50	120	100	90	75	60	45
21	52½	126	105	94½	78¾	63	47¼
22	55	132	110	99	82½	66	49½
23	57½	138	115	103½	86¼	69	51¾
24	60	144	120	108	90	72	54
25	62½	150	125	112½	93¾	75	56¼
26	65	156	130	117	97½	78	58½
27	67½	162	135	121½	101¼	81	60¾

RADIATOR DATA

SINGLE-COLUMN RADIATORS Table No. 16

No. of Sections	Length 2 1/2"/Sec.	Heating Surface – Sq. Ft. 38 In. 3 sq. ft./Sec.	32 In. 2 1/2 sq. ft./Sec.	26 In. 2 sq. ft./Sec.	23 In. 1 2/3 sq. ft./Sec.	20 In. 1 1/2 sq. ft./Sec.
3	7 1/2	9	7 1/2	6	5	4 1/2
4	10	12	10	8	6 2/3	6
5	12 1/2	15	12 1/2	10	8 1/3	7 1/2
6	15	18	15	12	10	9
7	17 1/2	21	17 1/2	14	11 2/3	10 1/2
8	20	24	20	16	13 1/3	12
9	22 1/2	27	22 1/2	18	15	13 1/2
10	25	30	25	20	16 2/3	15
11	27 1/2	33	27 1/2	22	18 1/3	16 1/2
12	30	36	30	24	20	18
13	32 1/2	39	32 1/2	26	21 2/3	19 1/2
14	35	42	35	28	23 1/3	21
15	37 1/2	45	37 1/2	30	25	22 1/2
16	40	48	40	32	26 2/3	24
17	42 1/2	51	42 1/2	34	28 1/3	25 1/2
18	45	54	45	36	30	27
19	47 1/2	57	47 1/2	38	31 2/3	28 1/2
20	50	60	50	40	33 1/3	30
21	52 1/2	63	52 1/2	42	35	31 1/2
22	55	66	55	44	36 2/3	33
23	57 1/2	69	57 1/2	46	38 1/3	34 1/2
24	60	72	60	48	40	36
25	62 1/2	75	62 1/2	50	41 2/3	37 1/2
26	65	78	65	52	43 1/3	39
27	67 1/2	81	67 1/2	54	45	40 1/2

FOUR-COLUMN RADIATORS Table No. 17

No. of Sections	Length 3"/Sec.	Heating Surface – Sq. Ft. 45 In. 10 sq. ft./Sec.	38 In. 8 sq. ft./Sec.	32 In. 6 1/2 sq. ft./Sec.	26 In. 5 sq. ft./Sec.	22 In. 4 sq. ft./Sec.	18 In. 3 sq. ft./Sec.
3	9	30	24	19 1/2	15	12	9
4	12	40	32	26	20	16	12
5	15	50	40	32 1/2	25	20	15
6	18	60	48	39	30	24	18
7	21	70	56	45 1/2	35	28	21
8	24	80	64	52	40	32	24
9	27	90	72	58 1/2	45	36	27
10	30	100	80	65	50	40	30
11	33	110	88	71 1/2	55	44	33
12	36	120	96	78	60	48	36
13	39	130	104	84 1/2	65	52	39
14	42	140	112	91	70	56	42
15	45	150	120	97 1/2	75	60	45
16	48	160	128	104	80	64	48
17	51	170	136	110 1/2	85	68	51
18	54	180	144	117	90	72	54
19	57	190	152	123 1/2	95	76	57
20	60	200	160	130	100	80	60
21	63	210	168	136 1/2	105	84	63
22	66	220	176	143	110	88	66
23	69	230	184	149 1/2	115	92	69
24	72	240	192	156	120	96	72
25	75	250	200	162 1/2	125	100	75
26	78	260	208	169	130	104	78
27	81	270	216	175 1/2	135	108	81

FIGURING RADIATION

TABLE No. 18

WHERE ROOMS HAVE SURFACES EXPOSED TO PREVAILING WINDS, ADDITION TO THE TOTAL RADIATION FIGURED FOR SUCH ROOMS SHOULD BE MADE AS IN THE FOLLOWING TABLE:-

	ADD FOR ROOMS FACING – NORTH	WEST	EAST	SOUTH
PREVAILING WIND FROM NORTH, N.E. OR N.W. —	15%	10%	5%	0
PREVAILING WIND FROM WEST OR S.W. —	10%	15%	0	5%
PREVAILING WIND FROM EAST OR S.E. —	10%	0	15%	5%
PREVAILING WIND FROM SOUTH —	0	10%	5%	15%

(NOTE: IF ROOM IS EXPOSED TO THE NORTH, WEST, AND EAST AND THE PREVAILING WIND IS FROM THE NORTH ADD ONLY FOR THE EXTREME CONDITION, I.E., 15%).

TABLE No. 19

FOR ROOMS OVER 12'-0" IN HEIGHT FIGURE AS FOR LESS THAN 12 FT. AND ADD AS FOLLOWS:-

14 FT.	4%	35 FT.	31%
16 "	8 "	40 "	34 "
18 "	12 "	45 "	36 "
20 "	16 "	50 "	38 "
25 "	22 "	55 "	39 "
30 "	27 "	60 "	40 "

TABLE No. 20

FOR CONDITIONS AS FOLLOWS ADD TO FIGURED RADIATION AS INDICATED:-

FOR ROOMS HEATED IN DAYTIME ONLY ADD 10% TO RADIATION AS FIGURED.

FOR ROOMS HEATED INTERMITTENTLY, WITH LONG INTERVALS OF NON-HEATING, ADD 30% TO RADIATION AS FIGURED.

FOR SEMI-DIRECT RADIATION FIGURE AS FOR DIRECT RADIATION, & ADD 40%.

FOR INDIRECT RADIATION FIGURE AS FOR DIRECT RADIATION & ADD 80%.

TO FIND THE AMOUNT OF RADIATION REQUIRED FOR HOT WATER HEATING FIGURE AS FOR STEAM & ADD 60%.

TABLE Nº 21

CLIMATIC CONDITIONS

COMPILED FROM U.S. WEATHER BUREAU RECORDS

COL. A STATE	COL. B. CITY	COL. C. AVERAGE TEMP. OCT. 1ST–MAY 1ST	COL. D LOWEST TEMPERATURE	COL. E AVERAGE WIND VELOCITY DEC., JAN., FEB., MILES PER HR.	COL. F DIRECTION OF PREVALING WIND DEC., JAN., FEB.
ALA	MOBILE	57.7	– 1	8.3	N
	BIRMINGHAM	53.9	–10	8.6	N
ARIZ.	PHOENIX	59.5	16	3.9	E
	FLAGSTAFF	34.9	–25	6.7	SW
ARK.	FORT SMITH	49.5	–15	8.0	E
	LITTLE ROCK	51.6	–12	9.9	NW
CALIF.	SAN FRANCISCO	54.3	29		N
	LOS ANGELES	58.6	28		NE
COL.	DENVER	39.3	–29	7.4	S
	GRAND JCT.	39.2	–16	5.6	SE
CONN.	NEW HAVEN	38.0	–14	9.3	N
D.C.	WASHINGTON	43.2	–15	7.3	NW
FLA.	JACKSONVILLE	61.9	10	8.2	NE
GA.	ATLANTA	51.4	– 8	11.8	NW
	SAVANNAH	58.4	8	8.3	NW
IDAHO	LEWISTON	42.5	–13	4.7	E
	POCATELLO	36.4	–20	9.3	SE
ILL.	CHICAGO	36.4	–23	17	SW
	SPRINGFIELD	39.9	–24	10.2	NW
IND.	INDIANAPOLIS	40.2	–25	11.8	S
	EVANSVILLE	44.1	–15	8.4	S
IOWA	DUBUQUE	33.9	–32	6.1	NW
	SIOUX CITY	32.1	–35	12.2	NW
KAN.	CONCORDIA	38.9	–25	7.3	N
	DODGE CITY	40.2	–26	10.4	NW
KY.	LOUISVILLE	45.2	–20	9.3	SW
LA.	NEW ORLEANS	61.5	7	9.6	N
	SHREVEPORT	56.2	– 5	7.7	SE
ME.	EASTPORT	31.1	–23	13.8	W
	PORTLAND	33.6	–17	10.1	NW
MD.	BALTIMORE	43.6	– 7	7.2	NW
MASS.	BOSTON	37.6	–13	11.7	W
MICH.	ALPENA	29.1	–27	11.3	W
	DETROIT	35.4	–24	13.1	SW
	MARQUETTE	27.6	–27	11.4	NW
MINN.	DULUTH	25.1	–41	11.1	SW

TABLE Nº 21

CLIMATIC CONDITIONS

COMPILED FROM U.S WEATHER BUREAU RECORDS

COL. A STATE	COL. B CITY	COL. C AVERAGE TEMP. OCT. 1ST–MAY 1ST	COL. D LOWEST TEMPERATURE	COL. E AVERAGE WIND VELOCITY DEC., JAN., FEB., MILES PER HR.	COL. F DIRECTION OF PREVALING WIND DEC., JAN., FEB.
MINN.	MINNEAPOLIS	29.6	–33	11.5	NW
MISS.	VICKSBURG	56.0	– 1	7.6	SE
MO.	ST. JOSEPH	40.3	–24	9.1	NW
	SPRINGFIELD	43.0	–29	11.3	SE
MONT.	BILLINGS	34.7	–49		W
	HAVRE	27.7	–57	8.7	SW
NEB.	LINCOLN	37.0	–29	10.9	N
	NORTH PLATTE	34.6	–35	9.0	W
NEV.	TONOPAH	39.6	– 7	9.9	SE
	WINNEMUCCA	37.9	–28	9.5	NE
N.H.	CONCORD	33.4	–35	6.0	NW
N.J.	ATLANTIC CITY	41.6	– 7	10.6	NW
N.Y.	ALBANY	35.1	–24	7.9	S
	BUFFALO	34.7	–14	17.7	W
	NEW YORK	40.3	– 6	13.3	NW
N.M.	SANTA FE	38.0	–13	7.3	NE
N.C.	RALEIGH	49.7	– 2	7.3	SW
	WILMINGTON	53.1	5	8.9	SW
N.D.	BISMARK	24.5	–45		NW
	DEVIL'S LAKE	18.9	–44	11.4	W
OHIO	CLEVELAND	36.9	–17	14.5	SW
	COLUMBUS	39.9	–20	9.3	SW
OKLA.	OKLAHOMA CITY	48.0	–17	12.0	N
ORE.	BAKER	34.1	–20	6.0	SE
	PORTLAND	45.9	– 2	6.5	S
PA.	PHILADELPHIA	41.9	– 6	11.0	NW
	PITTSBURGH	40.8	–20	13.7	NW
R.I.	PROVIDENCE	37.6	– 9	14.6	NW
S.C.	CHARLESTON	56.9	7	11.0	N
	COLUMBIA	53.7	– 2	8.0	NE
S.D.	HURON	28.1	–43	11.5	NW
	RAPID CITY	32.3	–34	7.5	W
TENN.	KNOXVILLE	47.0	–16	6.5	SW
	MEMPHIS	50.9	– 9	9.6	NW
TEX.	EL PASO	53.0	– 2	10.5	NW
	FORT WORTH	54.7	– 8	11.0	NW

TABLE No. 21

CLIMATIC CONDITIONS

COMPILED FROM U.S. WEATHER BUREAU RECORDS

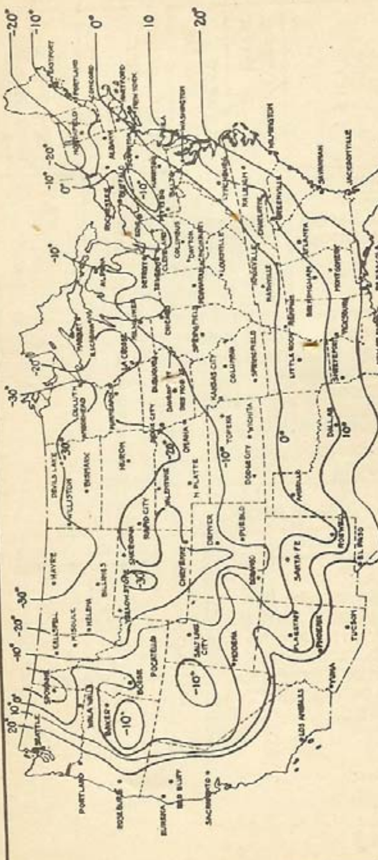
COL. A	COL. B	COL. C	COL. D	COL. E	COL. F
STATE	CITY	AVERAGE TEMP. OCT. 1ST - MAY 1ST	LOWEST TEMPERATURE	AVERAGE WIND VELOCITY DEC., JAN., FEB., MILES PER HR.	DIRECTION OF PREVALING WIND DEC., JAN., FEB.
TEX.	SAN ANTONIO	60.7	4	8.2	N
UTAH	MODENA	38.1	-24	8.9	W
	SALT LAKE CITY	40.0	-20	4.9	SE
VT.	BURLINGTON	29.3	-27	12.9	S
VA.	NORFOLK	49.1	2	9.0	N
	LYNCHBURG	45.2	- 7	5.2	NW
	RICHMOND	47.4	- 3	7.4	S
WASH.	SEATTLE	45.3	3	9.1	SE
	SPOKANE	37.5	-30		SW
W. VA.	ELKINS	38.8	-21	4.8	W
	PARKERSBURG	41.9	-27	6.6	S
WIS.	GREEN BAY	28.6	-36	12.8	SW
	LA CROSSE	31.2	-43	5.6	NW
	MILWAUKEE	33.0	-25	11.7	W
WYO	SHERIDAN	31.0	-45	5.3	NW
	LANDER	28.9	-36	3.0	NE

EFFECT OF WIND VELOCITY.

THE VELOCITY AND DIRECTION OF WIND HAS A BEARING ON THE AMOUNT OF RADIATION TO BE INSTALLED. FACTORS FOR EXPOSURES ARE BASED ON ZERO WEATHER WITH AN AVERAGE WIND VELOCITY OF 10 TO 15 MILES PER HOUR.

DROP IN TEMPERATURE PER MILE WIND VELOCITY IS EQUAL TO APPROXIMATELY 1½ DEGREES.

TEMPERATURE CHART



COMPUTED FROM U.S. WEATHER BUREAU CHART.

AVERAGE OUTSIDE TEMPERATURES AS USED BY ENGINEERS IN FIGURING RADIATION.
EXAMPLE – KNOXVILLE, TENN. USUALLY FIGURES 0° TO DESIRED INSIDE TEMP.
PORTLAND, ME. -10° TO DESIRED INSIDE TEMP.

Enclosures For Radiators.

To Enclose Or Partly Enclose A Radiator Generally Reduces It's Efficiency.

Figs. 1 & 2 Is An Exception And When Installed With Deflectors As Shown Will Be As Efficient As Though Placed In The Open. For Radiators Installed As Shown In Fig's. 3 To 8 On Sheet No. 39, The Amount To Be Added To The Figured Direct Radiation Is Given In Percent.

Examples:-

(A) Figured Direct Radiation = 80 ∮
If Set As Shown In Fig. 3 Add 15% - 12 ∮
Place In Recess ------------------ 92 ∮

(B) Figured Direct Radiation = 90 ∮
If Set As Shown In Fig. 7 Add 30% = 27 ∮
Place In Enclosure ------------- 117 ∮

In Figuring Boiler Capacity Do Not Use Amount Of Radiation Placed In Enclosures. Use The Amount Of Direct Radiation Figured: Like In Example A & B, Use 80 + 90 = 170 Sq. Ft. Radiation Boiler Tax.

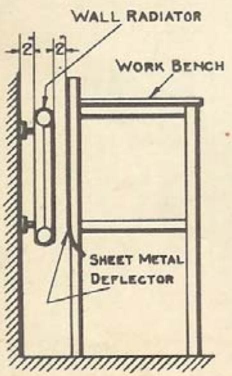


Fig. 1

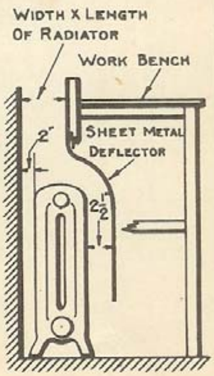


Fig. 2

Enclosures For Radiators.

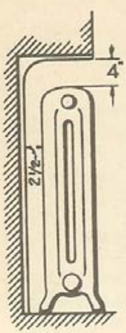


Fig. 3
Add 15%

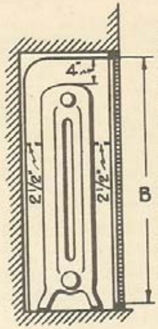


Fig. 4
Add 25%

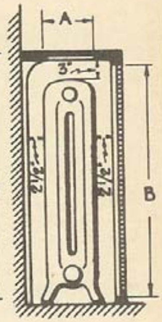


Fig. 5
Add 20%

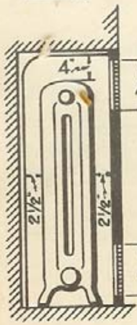


Fig. 6
Add 35%

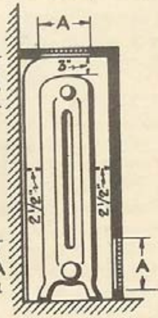


Fig. 7
Add 30%

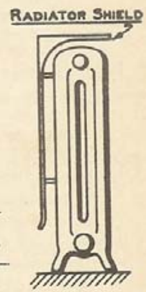


Fig. 8
Add 10%

Allow 2½" Of Space Between The Wall And The Back Of An Enclosed Radiator. "A" To Be At Least The Width Of The Radiator And Also It's Length. "B" To Be The Full Area Of The Opening Of The Recess.

SECTION III

PIPE SIZING DATA

The correct method of computing pipe sizes for vapor or low pressure steam heating is on the pressure drop basis.

The difference in pressure between that at the boiler or source of supply and the farthest radiator is commonly termed "Pressure Drop," and is usually expressed in ounces.

In good practice the pressure drop should not exceed one-half of the minimum constant pressure at which boiler will be operated for longest number of hours without attention.

Water Line Difference is the distance between the lowest point of the steam or dry return main and the water line of the boiler.

A minimum water line difference of 24 inches should be allowed for a 2-oz. pressure drop and 2-inch additional water line difference for each additional ounce pressure drop.

In sizing supply mains and supply risers the drop in pressure between boiler and all of the radiators should be as near the same as possible, so that pressure at each radiator valve is the same when the entire system is in operation. To do this requires various size pipes to supply the same amount of steam to radiators at different distances from boiler.

Valves and fittings of similar sizes but of different manufacture vary in the resistance offered to the flow of steam or water.

In measuring the length of a run to determine its size, it is necessary to add for friction due to elbows, tees and other fittings. It is common practice to measure a run of pipe from the boiler or source of supply to the farthest radiator (see Fig. A), page 41, and then add 50% for friction due to fittings; this total is termed "equivalent length of run." All tables, unless otherwise designated, are based on a *straight* run of pipe and *do not include* any allowance for friction due to fittings.

PIPE SIZING DATA

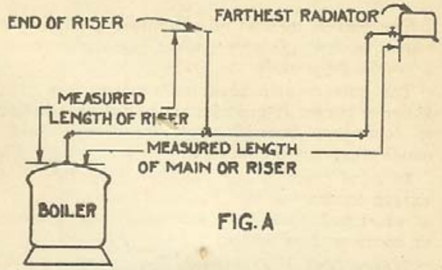


FIG. A

MEASURED LENGTH OF MAINS OR RISERS EQUALS TOTAL DISTANCE FROM BOILER TO LAST RADIATOR.

Capacities given in all tables on pages 43 to 69 are given in terms of sq. ft. of direct cast iron radiation or its equivalent, based on a rate of condensation of ¼ pound per sq. ft. per hour and allowing for condensation in covered piping.

Pipes must grade at least:—

Supply Mains	1″ in 20′-0″
Wet Return Mains	1″ in 20′-0″
Dry Return Mains	1″ in 16′-0″
Horizontal Branches	1″ in 4′-0″

Except in rare cases, supply mains are not to be made less than 2″ in size. Supply mains starting over 2½″ in size not to end less than 2½″.

Pipes to be not less in size than:

Wet Return Main = 1″ Supply Riser .... = 1″
Dry Return Main = 1″ Return Riser .... = ¾″

All supply mains and branches to be properly covered. All return mains and branches, except where unduly exposed are not to be covered.

Radiators to be water type, tapped or bushed at the top for ¾″ No. 7 Hoffman Adjustable Modulating Valve, and at the bottom ½″ eccentric, turned down, for No. 8 Hoffman Return Line Valve. Supply and return connections are usually made at opposite ends, but when desired can be made at same end of radiator.

PIPE SIZING DATA

For residences, medium size apartments, small office buildings, etc., the maximum pressure drop in the system should not exceed two ozs.

In buildings where a constant pressure of 8 ozs. or over is to be maintained at the boiler, with sufficient distance between lowest points of steam and dry return mains, and water line of boiler, piping system can be sized for a pressure drop of up to half the initial pressure.

For the convenience of the Heating Engineer or Contractor designing a vapor heating system, and especially HOFFMAN CONTROLLED HEAT, the data given on pages 40 to 52 were compiled, with proper allowance made for friction due to the usual number of valves, fittings, etc.

As the heating contractor is frequently called upon to design Vapor Heating Systems for small buildings and where the radiation requirements do not exceed 550 sq. ft., all necessary data will be found in tables 22 to 27, page 43.

Drawing 1, page 44, shows a complete HOFFMAN CONTROLLED HEAT installation with all piping sized from these tables.

For HOFFMAN CONTROLLED HEAT installations of over 550 sq. ft., use data and tables on pages 45 to 52.

In designing HOFFMAN CONTROLLED HEAT the end of a supply main, where dripped into wet return, should be vented through ½-in. No. 8 Hoffman Return Line Valve, into nearest dry return.

The lowest point in dry return should be kept above the water line of the boiler at least 24 inches for installations having up to 3500 sq. ft. of direct C. I. radiation, and 30 inches for installations having over 3500 sq. ft. direct C. I. radiation or its equivalent.

Where it is possible to get more than the water line difference specified above, it is advantageous to do so.

HOFFMAN "Controlled Heat"

SIZING PIPES FOR HOFFMAN "CONTROLLED HEAT" FOR SMALL BUILDINGS OF NOT OVER 3 STORIES & REQUIRING NOT OVER 550 SQ.FT. OF DIRECT RADIATION.

SUPPLY MAINS - TABLE Nº 22

UP TO 130	SQ.FT. USE	1 1/2"	SUPPLY MAIN.
131 " 300	" " "	2"	" "
301 " 550	" " "	2 1/2"	" "

DRY RETURN MAINS - TABLE Nº 23

UP TO 130	SQ.FT. USE	1"	DRY RETURN MAIN.
131 " 550	" " "	1 1/4"	" " "

WET RETURN MAINS - TABLE Nº 24

UP TO 550 SQ.FT. USE 1-1 1/4" WET RETURN MAINS.

SUPPLY RISERS - TABLE Nº 25

UP TO 40	SQ.FT. USE	1"	SUPPLY RISER.
41 " 75	" " "	1 1/4"	" "
76 " 150	" " "	1 1/2"	" "

MAKE HORIZONTAL BRANCHES FROM HEEL OF RISERS TO SUPPLY MAIN ONE SIZE LARGER THAN RISER.

RETURN RISERS - TABLE Nº 26

UP TO 300	SQ.FT. USE	3/4"	RETURN RISERS.
301 " 550	" " "	1"	" "

RADIATOR CONNECTIONS - TABLE Nº 27

HORIZONTAL BRANCHES NOT OVER 5'-0" LONG FROM VERTICAL INLET PIPE TO SUPPLY RISER OR SUPPLY MAIN:-

UP TO 24	SQUARE FEET USE	1"
25 " 70	" " "	1 1/4"
71 " 150	" " "	1 1/2"

USE PIPES ONE SIZE LARGER FOR BRANCHES OVER 5'-0" LONG.

USE 3/4" VERTICAL INLET PIPE TO #7 HOFFMAN MOD. VALVE.

HORIZONTAL BRANCHES FROM VERTICAL RETURN PIPE TO RETURN RISER OR DRY RETURN TO BE 3/4".

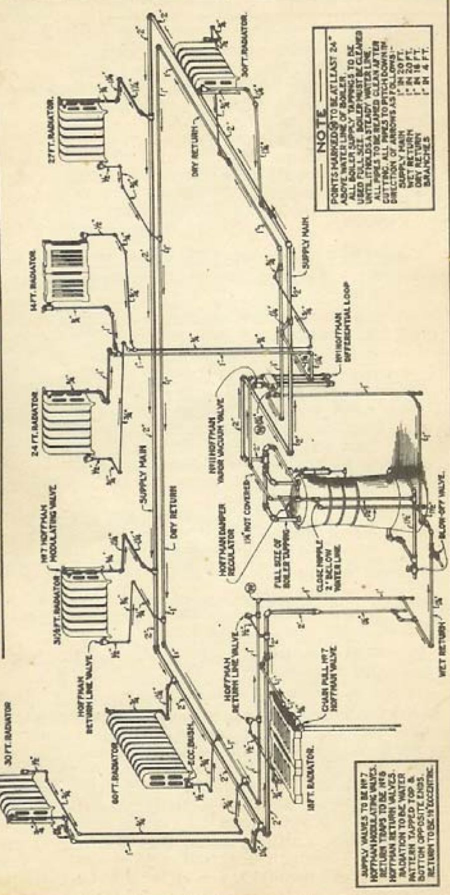
USE 1/2" VERTICAL INLET TO #8 HOFFMAN RETURN LINE VALVE.

RADIATORS TO BE WATER TYPE, TAPPED OR BUSHED AT THE TOP FOR 3/4", #7 HOFFMAN ADJUSTABLE MODULATING VALVE, & AT THE BOTTOM 1/2" ECCENTRIC TURNED DOWN FOR #8 HOFFMAN RETURN LINE VALVE.

SUPPLY & RETURN CONNECTION CAN BE MADE AT SAME OR OPPOSITE ENDS, AS DESIRED.

HOFFMAN Controlled Heat

TYPICAL INSTALLATION SHOWING APPLICATION OF TABLES 22 TO 27 ON PAGE 43



PIPE SIZING DATA

To size a supply main measure total distance in feet along the pipe from boiler to farthest radiator —refer to page 48, Table No. 28, and find column marked B, C, D, E, F or G, which corresponds (the nearest) to this length. This column gives the amount of radiation different size pipes (indicated in column A) will supply for a measured length, and should be used for the various amounts of radiation supplied at different points along the entire main.

EXAMPLE:

Assume a main measuring 240 ft. to the farthest radiator, supplying 2000 sq. ft. of direct radiation as follows:

At and near end of main	280	sq. ft. radiation
40 feet from " " "	650	" " "
180 " " " " "	520	" " "
90 " " " " "	350	" " "
Near the boiler	200	" " "

As main measures 240 ft. all sizing must be done from column "E" and column "A."

A main can be sized starting from boiler or starting at end farthest from boiler. It is customary to start at end farthest from boiler, therefore proceed as follows:

	Col. "E"	Col. "A"
Near end of main	280 sq. ft.	2½" main
40 ft. from end of main...	650 " "	
Total to this point ...	930 " "	3½" main
90 ft. from end of main...	350 " "	
Total to this point ...	1280 " "	4" main
180 ft. from end of main	520 " "	
Total to this point ...	1800 " "	4½" main
Radiation near boiler ...	200 " "	
Total to boiler	2000 " "	5" main

Where main changes in size and branches are taken off the side or top of main, eccentric reducing couplings should be used, or main carried full size to its end. Otherwise branches should be taken from the bottom of main and either dripped into dry return through a Hoffman Return Line Valve, or into wet return.

From this it will be noted that starting at the boiler a 5" main is required, and reduces in size according to amounts taken off at different points.

WET AND DRY RETURN MAINS

Tables No. 29 and No. 30, page No. 49, give the capacities of wet and dry return mains in sq. ft. of direct cast iron radiation for various length of runs.

SUPPLY AND RETURN RISERS

Tables No. 31 and No. 32, page No. 50, give the capacities of supply and return risers in sq. ft. of direct cast iron radiation for various measured lengths.

To determine size of return risers refer to Table No. 32, page No. 50, and select size for amount of radiation to be taken care of regardless of its length.

To determine size of supply risers, measure distance in feet from boiler to end of riser, refer to page No. 50, Table 31, and find column marked B, C, D, E, F or G, which corresponds (the nearest) to this length. This column gives the amounts of radiation different size pipes (indicated in col. A) will supply for a measured length.

EXAMPLE:

Assume a riser measures 100 ft. from boiler to its end, supplying 275 sq. ft. as follows:

At its end .... 70 sq. ft. radiation
Next floor below .... 70 " " "
Next floor below ....135 " " "

As measured distance is 100 ft. all sizing must be done from col. B and col. A.

	Col. B	Col. A
At its end	70 sq. ft.	1¼" pipe
Next floor below	70 " "	
Total to this point ...	140 " "	1½" "
Next floor below	135 " "	
Total for riser	275 " "	2" "

If this riser measured 300 ft. from boiler then sizing would be done from col. F and col. A.

	Col. B	Col. A
At its end	70 sq. ft.	1½" pipe
Next floor below	70 " "	
Total to this point ...	140 " "	2" "
Next floor below	135 " "	
Total for riser	275 " "	2½" "

Horizontal branches to supply risers not over 2½" in size should be made one size larger than the riser.

RADIATOR CONNECTIONS

Table No. 33, page 50, gives sizes of various supply and return connections to water type radiators when connected at top for supply and bottom for return. It also gives the size of horizontal branch connections from main or risers to vertical pipe connecting radiator valves.

EXAMPLE:

Assume a radiator of 65 sq. ft. capacity with branch connection 4'0" long from main to vertical pipe to radiator valve.

Refer to Table No. 33 and find that a ¾" vertical pipe and 1¼" horizontal branch connection are required for the supply, and a ½" vertical pipe and ¾" horizontal branch connection are required for the return.

If this same radiator was located 12 ft. from the main or riser, by referring to Table No. 33 find that the return connections would be as above, but horizontal branch to vertical supply pipe would be 1½".

Page 51 shows a plan of a typical HOFFMAN CONTROLLED HEAT installation sized according to Tables No. 28 to No. 33.

Note that the main is reduced in size through eccentric reducing couplings. In actual practice most fitters would prefer to eliminate the use of eccentric couplings and would make the mains full size from the boiler to the ends.

Page 52 shows details of various connections for plan shown on page 51.

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SUPPLY MAINS

TABLE #28 IS COMPUTED FOR PRESSURE LOSS OF 2 OZ. AT THE FARTHEST RADIATOR FOR LENGTH OF MAIN, ALLOWING FOR AVERAGE AMOUNT OF ELBOWS, TEES, ETC. AND CONDENSATION IN COVERED PIPING-STEAM AND CONDENSATION FLOWING SAME DIRECTION.

TO SIZE A MAIN-MEASURE LENGTH OF PIPING FROM BOILER TO FARTHEST RADIATOR AND USE COLUMN FOR THIS LENGTH FOR SIZING ENTIRE LENGTH-

EXAMPLE:-MEASURED LENGTH FROM BOILER TO FARTHEST RADIATOR = 295'-0"-THEN USE COL. F,

AT END OF MAIN	= 280 # = 2½" MAIN
50'-0" FROM END OF MAIN	= 450 #
TOTAL LOAD TO THIS POINT	= 730 # = 3½" MAIN
NEAR BOILER	= 400 #
TOTAL LOAD TO BOILER	= 1130 # = 4" MAIN

TABLE NO. 28

CAPACITY OF SUPPLY MAINS IN SQ. FT.

COL. A SIZE OF PIPE	MEASURED LENGTH OF PIPE IN FT. FROM BOILER TO FARTHEST RADIATION.					
	COL. B 100'	COL. C 150'	COL. D 200'	COL. E 250'	COL. F 300'	COL. G 400'
2	325	260				
2½	550	450	390	347	310	275
3	1000	810	710	632	578	500
3½	1500	1215	1065	948	860	750
4	2100	1700	1500	1325	1200	1050
4½	2900	2350	2060	1830	1670	1450
5	3700	3000	2600	2340	2140	1850
6	5700	4600	4047	3600	3300	2850
7	8000	6480	5680	5050	4600	4000
8	11000	8900	7810	6950	6350	5500
10	20000	16200	14200	12600	11500	10000
12	30000	24300	21300	18960	17300	15000

FOR STEAM AND CONDENSATION FLOWING IN OPPOSITE DIRECTIONS USE PIPE ONE SIZE LARGER THAN GIVEN IN TABLE.

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TABLE NO. 29

CAPACITY OF WET RETURN MAINS IN SQ. FT.

SIZE OF PIPE	1¼"	1½"	2"	2½"	3"	3½"
LENGTH 100	1500	3000	6000	10000	18000	26000
LENGTH 200	1200	2500	5000	8000	14000	20000
LENGTH 300	1000	2000	4000	6000	11000	16000

TABLE NO. 30

CAPACITY OF DRY RETURN MAINS IN SQ. FT.

COL. A SIZE OF PIPE	LENGTH IN FEET FROM BOTTOM OF RISER TO HOFFMAN DIFFERENTIAL LOOP.					
	COL. B 100'	COL. C 150'	COL. D 200'	COL. E 250'	COL. F 300'	COL. G 400'
1	320	300	288	272	245	210
1¼	670	630	600	570	535	470
1½	1300	1215	1170	1100	1045	910
2	2300	2185	2070	1955	1840	1610
2½	3800	3610	3420	3200	3040	2660
3	7000	6650	6300	5950	5600	4990
3½	10000	9500	9000	8500	8000	7000
4	15000	14250	13500	12750	12000	10500

WHERE POSSIBLE DRY RETURN MAINS ARE TO START HIGH AT HOFFMAN DIFFERENTIAL LOOP AND GRADE DOWN TO LOW POINT AND DRIP INTO WET RETURN MAIN.

STARTING AT THE LOOP PIPE SIZES TO BE AS FOLLOWS:-

JOBS UP TO 1000 # = 1" FROM 3501 TO 7500 # = 1½"
FROM 1001 TO 3500 # = 1¼" FROM 7501 TO 15000 # = 2"

EXAMPLE:- LENGTH OF MAIN 190'-0"- TOTAL RADIATION 2050 #, THEN USE COL. D FOR SIZING.

START AT LOOP WITH------------------1¼"
UP TO 90'-0" FROM LOOP---------560 # = 1¼"
FROM 90'-0" TO 140'-0" FROM LOOP----560 #
TOTAL LOAD TO THIS POINT--------1120 # = 1½"
FROM 140'-0" FROM LOOP TO END-----1000 #
TOTAL LOAD ON MAIN------------2120 # = 2"

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TABLE No. 31						
CAPACITIES OF SUPPLY RISERS IN SQ. FT.						
COL. A	LENGTH IN FT. FROM BOILER TO END OF RISER					
SIZE OF PIPE	COL. B 100'	COL. C 150'	COL. D 200'	COL. E 250'	COL. F 300'	COL. G 400'
1"	40	32	28	25	23	20
1¼	75	60	53	47	43	37
1½	150	120	105	95	86	75
2	300	240	210	190	173	150
2½	500	400	355	315	285	250
3	900	730	630	565	520	450

HORIZONTAL BRANCHES TO RISERS TO BE ONE SIZE LARGER THAN RISER.

RETURN RISERS — TABLE No. 32				
SIZE OF PIPE	3/4"	1"	1¼"	1½"
CAPACITY IN SQ. FT.	300	630	1300	2200

RADIATOR CONNECTIONS TABLE No. 33

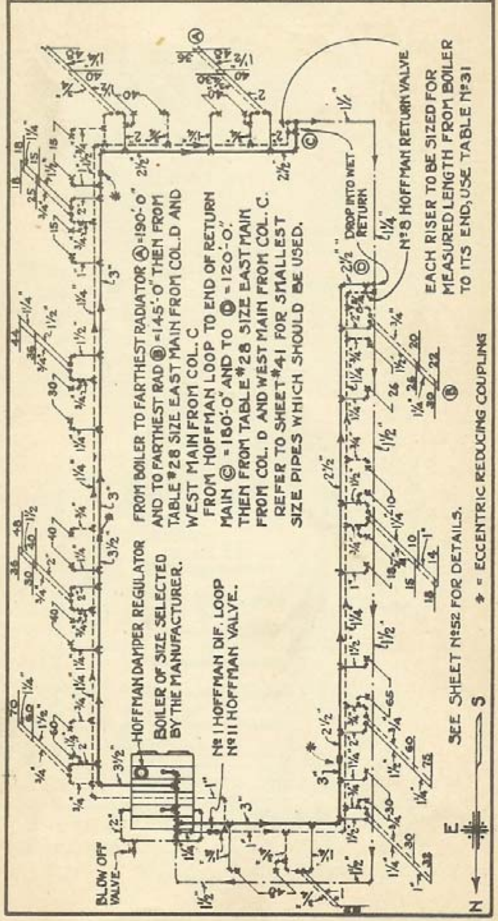
SUPPLY				RETURN		
VALVE No.	VERTICAL INLET PIPE TO VALVE	HORIZONTAL RUNOUT FROM VERTICAL INLET PIPE TO RISER OR MAIN. UP TO 5' LONG	HORIZONTAL RUNOUT FROM VERTICAL INLET PIPE TO RISER OR MAIN. OVER 5' LONG	VALVE No.	STUB TO VALVE	HORIZONTAL RUNOUT TO RISER OR MAIN
7	3/4"	24# = 1" 70# = 1¼ 150# = 1½ 200# = 2	16# = 1" 60# = 1¼ 130# = 1½ 175# = 2	8	1/2"	3/4"

RADIATORS TO BE WATER TYPE OF NOT OVER 200 SQ. FT. CAPACITY, TAPPED OR BUSHED AT THE TOP FOR No. 7 HOFFMAN ADJUSTABLE MODULATING VALVE AND AT THE BOTTOM 1/2" ECCENTRIC TURNED DOWN FOR No. 8 HOFFMAN RETURN VALVE.

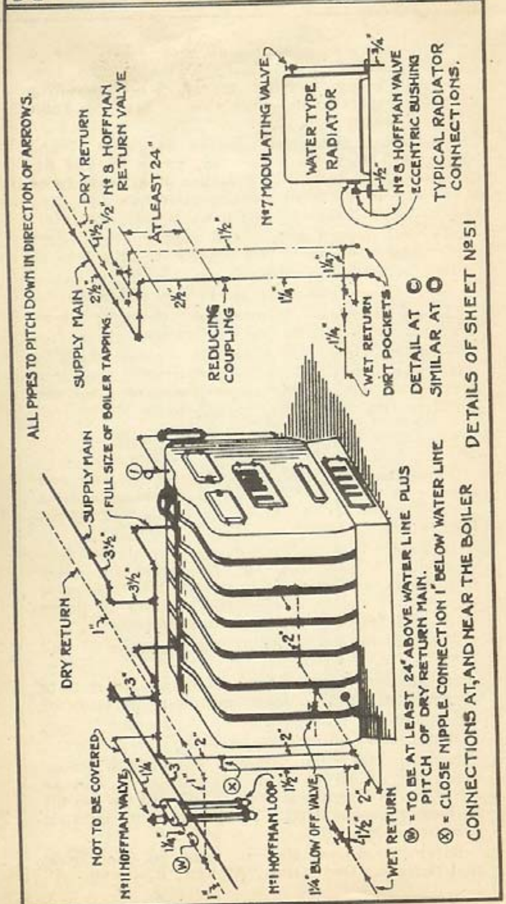
SUPPLY AND RETURN CONNECTIONS CAN BE MADE AT SAME OR OPPOSITE ENDS AS DESIRED.

ALL RADIATORS TO BE WASHED CLEAN OF CORE SAND BEFORE MAKING VALVE CONNECTIONS.

HOFFMAN "Controlled Heat"



HOFFMAN "Controlled Heat"



PIPE SIZING DATA

To size supply mains and risers for a HOFFMAN CONTROLLED HEAT, or a low-pressure steam heating system, when the drop in pressure is to be other than 2 ozs. use Table No. 34, pages 57 and 58.

Capacities given in Table No. 34, pages 57 and 58, and Tables No. 35 to 38, pages 60 and 61, are based on an initial pressure of at least twice the drop in pressure and no allowance has been made for friction due to valves, elbows, tees, etc.

To size supply mains and supply risers, first determine the minimum constant pressure at which boiler is to operate.

Second, determine the water line difference.

Third, from this information determine allowable pressure drop in ozs. for entire system.

Then multiply this allowable pressure drop in ozs. by 100 and divide by total equivalent measured length of pipe. This gives pressure drop per hundred feet of length.

EXAMPLE:

Pipe measures 800 ft. to farthest radiator and system is to be laid out for 4-oz. pressure drop, then $4 \times 100 \div 800 = \frac{1}{2}$ oz. pressure drop per hundred ft. of length.

In Table No. 34 no allowance is made for friction, due to ells, tees, etc. (therefore for quick calculations add 50% to measured length of pipe to determine equivalent length). Refer to pages 63 and 64 for more accurate information.

Example for use of Table No. 34, pages 57 and 58:

Installation in an apartment house, boiler is to be operated at a constant minimum pressure of one pound.

Water line difference to be 26".

A one-pound boiler pressure would, with proper conditions, allow an 8-oz. pressure drop, but as water line difference is only 26" it will not permit an 8-oz. pressure drop. Therefore figure on 4-oz. pressure drop.

Refer to figure No. 1, page 56, and note that there are two mains, "A" and "B"—main "A"

PIPE SIZING DATA

measures 266′-0″ from boiler to farthest radiator with 50% added for friction due to elbows, tees, etc., equals a measured length of 400′. The measured length of any main or riser will be found in the same way.

As Table No. 34 is for lengths of 100 ft. and measured length of main "A" is 400 ft. To use table find pressure drop per hundred feet, i. e., $4 \times 100 \div 400 = 1$-oz. drop per 100 ft., then use capacities given for 1-oz. pressure drop in sizing main "A."

As measured length of main "B" is 200 ft., and 4-oz. pressure drop is desired at its end the same as main "A," find drop in pressure per one hundred ft., in the same way, i. e., $4 \times 100 \div 200 =$ 2 oz., and use capacities given for 2-oz. pressure drop for sizing main "B."

Pressure drop in each riser to be found in the same way, i. e.:

Riser "C" same as main "B."
" "D" $4 \times 100 \div 150 = 2\frac{2}{3}$ oz. pres. drop.
" "E" $4 \times 100 \div 50 = 8$ " " "
" "F" $4 \times 100 \div 100 = 4$ " " "
" "G" $4 \times 100 \div 200 = 2$ " " "
" "H" $4 \times 100 \div 300 = 1\frac{1}{3}$ " " "
" "I" same as main "A."

Then to size main "A" based on total radiation from its end to boiler and for 1-oz. pressure drop, tabulate as follows:

I—425 sq. ft.
H—425 " "
G—425 " "
F—425 " "
1700 " " Total = 4″ Main
(Starting from boiler.)

I—425 sq. ft.
H—425 " "
G—425 " "
1275 " " Total = 3½″ Main

I—425 sq. ft.
H—425 " "
850 " " Total = 3″ Main

PIPE SIZING DATA

I—425 sq. ft. = 2½″ Main. To end of main.

Size main "B" from 2-oz. pressure drop table as follows:

C—425 sq. ft.
D—425 " "
E—425 " "
1275 " " Total = 3″ Main

C—425 sq. ft.
D—425 " "
850 " " Total = 3″ Main

C supplies 425 sq. ft. indicating a 2″ pipe. But as a main starting over 2½″ should not end less than 2½″ in size, use a 2½″ main.

Each riser must be sized for its own length in the same way, i. e.:

Riser C supplying 425 sq. ft. of radiation and being 200 ft. long, must be sized same as main "B."

Fifth floor	105 sq. ft.	= 1¼″	Pipe
Fourth floor	80 " "		
Total to this point	185 " "	= 1½″	"
Third floor	80 " "		
Total to this point	265 " "	= 2″	"
Second floor	80 " "		
Total to this point	345 " "	= 2″	"
First floor	80 " "		
Total on Riser	425 " "	= 2″	"

Horizontal branch to be one size larger or 2½″ in size.

Riser "E" supplies the same amount of radiation, but as determined above must be sized from 8-oz. column of Table No. 34, as follows:

Fifth floor	105 sq. ft.	= 1″	Pipe
Fourth floor	80 " "		
Total to this point	185 " "	= 1¼″	"
Third floor	80 " "		
Total to this point	265 " "	= 1¼″	"
Second floor	80 " "		
Total to this point	345 " "	= 1½″	"
First floor	80 " "		
Total on Riser	425 " "	= 1½″	"

Horizontal branch to be one size larger or 2″ pipe.

· PIPE · SIZING · DATA ·

FIGURES IN ◯ = MEASURED DISTANCE INCLUDING ALLOWANCE FOR ELBOWS, TEES, ETC.
FIGURES IN ▭ = TOTAL RADIATION FOR EACH RISER.

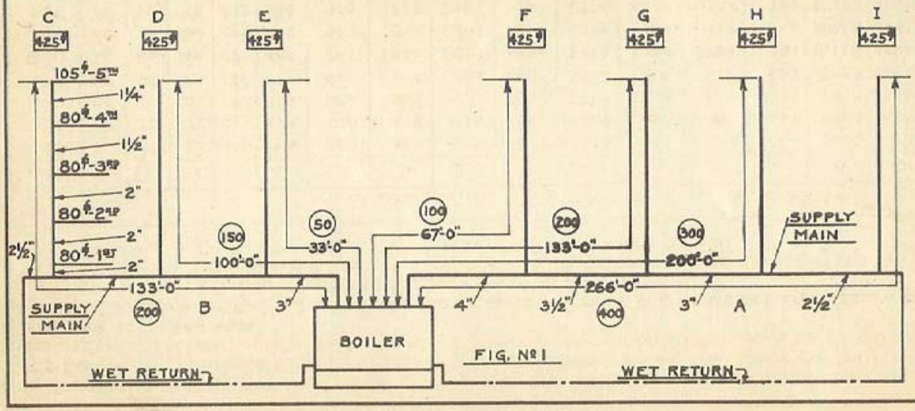


FIG. Nº 1

PRESSURE LOSS TABLE-L.P. STEAM

Capacities Of Pipes For Various Pressure Losses In Ounces Per 100 Ft. Straight Pipe Or It's Equivalent, Allowing For Condensation In Covered Piping, Steam And Condensation Flowing In Same Direction, Given In Terms Of Sq. Ft. Of Direct Radiation Based On 1/4 Lb. Condensation Per Sq. Ft. Per Hour.

For Capacities Of Pipes Other Than 100 Ft. Long, Multiply The Capacities Given Below By The Factor For Required Length As Given On Sheet No 69 Col. No. 4.

To Determine The Pressure Loss In A Pipe Of Given Size, Length And Capacity: Multiply Pressure Loss In Ounces Per 100 Ft. By Length Of Pipe Divided By 100.

Table Nº 34

Press. Loss In Oz: 100'	Commercial Pipe Size													
	¾"	1"	1¼"	1½"	2"	2½"	3"	3½"	4"	4½"	5"	6"	7"	8"	10"
.25	12	23	51	79	158	262	480	717	1014	1379	1887	3078	4559	6408	11631
.50	16	32	71	111	224	370	678	1013	1433	1949	2667	4352	6446	9060	16445
1.00	23	46	101	157	316	524	959	1431	2027	2757	3773	6156	9117	12814	23261
1.50	28	56	124	192	387	641	1174	1754	2481	3374	4618	7535	11159	15685	28471
2.00	32	64	142	222	447	741	1356	2026	2866	3898	5334	8704	12891	18119	32891
2.50	36	73	160	248	500	829	1517	2266	3205	4358	5964	9732	14414	20259	36775
3.00	39	79	175	272	548	908	1662	2482	3511	4774	6534	10662	15790	22194	40610
3.50	43	86	189	293	591	980	1794	2680	3790	5155	7055	11511	17048	24286	44115
4.00	46	91	202	314	632	1048	1919	2866	4054	5513	7543	12312	18231	25631	46520
4.50	48	97	214	333	671	1111	2035	3039	4299	5847	8002	13047	19320	27157	49315

PRESSURE LOSS TABLE—L.P. STEAM

Table No. 34

Press. Loss in Oz.:100'	Commercial Pipe Size 3/4"	1"	1¼"	1½"	2"	2½"	3"	3½"	4"	4½"	5"	6"	7"	8"	10"
5	51	102	226	351	707	1172	2145	3204	4532	6164	8435	13747	20456	28607	51931
6	56	112	247	384	774	1283	2349	3509	4964	6751	9349	15346	22547	31946	58311
7	60	121	267	415	836	1386	2537	3790	5361	7281	9961	16248	24060	33817	61397
8	64	129	286	443	894	1482	2713	4052	5732	7796	10667	17407	25781	36221	65782
9	68	137	303	470	949	1572	2878	4299	6012	8167	11223	18337	27217	38248	69357
10	72	145	319	496	1000	1657	3033	4532	6410	8716	11928	19464	28827	40518	73550
11	76	152	335	520	1049	1738	3181	4721	6707	9101	12211	20317	30039	42351	77012
12	79	159	350	543	1095	1815	3334	4963	7020	9548	13068	21324	31581	44388	81200
13	82	165	364	565	1140	1889	3461	5161	7308	9929	13589	22168	32838	46480	84710
14	85	172	378	587	1185	1960	3588	5360	7580	10310	14110	23012	34096	48572	88221
15	88	178	391	607	1226	2029	3713	5546	7843	10668	14598	23819	35284	49976	90990
16	91	184	404	627	1265	2096	3838	5732	8108	11026	15086	24624	36472	51381	93760
17	94	189	416	647	1304	2159	3954	5904	8353	11410	15544	25350	37560	52847	95685
18	97	195	428	665	1342	2222	4070	6077	8598	11794	16003	26087	38641	54314	98650
19	99	200	440	683	1378	2283	4180	6242	8830	12061	16437	26840	39776	55764	106247
20	102	205	452	701	1414	2344	4290	6407	9063	12328	16870	27594	40912	57214	113862
24	112	225	495	768	1548	2566	4697	7018	9928	13501	18697	30691	45094	63992	116621

PIPE SIZING DATA

Tables No. 35 to 38 on pages 60 and 61 were compiled for use when drop in pressure is 2, 4, 8 or 16 ounces, and eliminates figuring pressure drop per hundred feet.

To size a main or riser refer to table giving desired pressure drop and use capacities given in column for the length of run.

EXAMPLE:

Refer to diagram on page 56 and size mains and risers for a 4-oz. pressure drop as follows:

Main "A" is equivalent to 400 ft. in length, therefore refer to page 60, Table No. 36, and size entire length of main for 400 ft., column, i. e.:

Starting at .... I —425 sq. ft. = 2½" Main
H—425 " "
To this point .....850 " " = 3" "
G—425 " "
To this point ....1275 " " = 3½" "
F—425 " "
Starting at boiler..1700 " " = 4" "

Main "B" would be sized in the same way, from same table, column for 200-ft. length.

Riser "C" would be sized from same column as used for main "B."

All other risers would be sized from column for their respective lengths, i. e., riser "G" from column marked 200 ft., riser "H" from column marked 300 ft., and so on.

Riser "E" is 50 ft. long and Tables No. 35 to 38 are for a minimum length of 100 ft., therefore refer to page 69 and find in column 4 of Table No. 50 factor for changing capacities of Table No. 36 when lengths are other than 100 ft.

EXAMPLE:

Page 69, column 4, gives factor 1.29 as nearest to 50-ft. run. Page 60, Table No. 36, gives capacity of 1" pipe for 100-ft. run as 91 sq. ft. of radiation, then for 50-ft. run find $91 \times 1.29 =$ 117 sq. ft. As end of riser "E" is to supply 105 sq. ft. use 1" pipe. Size balance of riser in same way.

·CAPACITIES·OF·STEAM·MAINS·

PIPE CAPACITIES IN SQ.FT. OF CAST IRON RADIATION FOR EACH LENGTH OF RUN – ALLOWANCE FOR ELBOWS, VALVES, ETC. MUST BE ADDED TO MEASURED DISTANCE TO GET EQUIVALENT LENGTH OF RUN – RADIATION FIGURED TO CONDENSE ¼ LB. STEAM PER HR.

SIZE PIPE	2 OZ. DROP IN PRESSURE – TABLE 35							4 OZ. DROP IN PRESSURE – TABLE 36						
	100'	200'	300'	400'	500'	750'	1000'	100'	200'	300'	400'	500'	750'	1000'
1"	64	45	37	32	28	23	20	91	64	52	45	40	33	28
1¼	142	101	82	71	63	52	44	202	143	117	101	90	74	63
1½	222	158	128	111	99	81	70	314	223	181	157	140	115	99
2	447	317	258	223	201	163	141	632	448	365	312	282	231	199
2½	741	526	428	370	331	271	234	1048	744	605	524	468	383	331
3	1356	963	784	678	606	497	428	1919	1362	1109	959	857	702	606
3½	2026	1438	1171	1013	905	741	640	2866	2034	1656	1433	1281	1049	905
4	2866	2035	1656	1433	1281	1048	905	4054	2878	2343	2027	1812	1483	1281
5	5334	3787	3083	2667	2384	1952	1675	7543	5355	4360	3771	3371	2760	2383
6	8704	6180	5030	4352	3890	3185	2758	12312	3741	7125	6156	5503	4506	3890
7	12891	9152	7551	6445	5762	4718	4073	18231	12944	10537	9115	8149	6672	5760
8	18119	12864	10473	9059	8099	6631	5725	25631	18198	14815	12815	11457	9380	8099
10	32891	23352	19011	16445	14700	12038	10393	46520	33029	26888	23260	20794	17026	14700

·CAPACITIES·OF·STEAM MAINS·

PIPE CAPACITIES IN SQ.FT. OF CAST IRON RADIATION FOR EACH LENGTH OF RUN – ALLOWANCE FOR ELBOWS, VALVES, ETC. MUST BE ADDED TO MEASURED DISTANCE TO GET EQUIVALENT LENGTH OF RUN – RADIATION FIGURED TO CONDENSE ¼ LB. STEAM PER HR.

SIZE PIPE	8 OZ. DROP IN PRESSURE – TABLE 37							1 LB. DROP IN PRESSURE – TABLE 38						
	100'	200'	300'	400'	500'	750'	1000'	100'	200'	300'	400'	500'	750'	1000'
1"	129	90	74	64	56	46	40	184	128	104	92	80	66	56
1¼	286	202	164	143	126	104	88	404	286	234	202	180	148	126
1½	443	316	256	221	198	162	140	627	446	362	313	280	230	198
2	894	634	516	447	402	326	282	1265	896	730	632	564	462	398
2½	1482	1052	856	741	662	542	468	2096	1488	1210	1048	936	766	662
3	2713	1926	1568	1356	1212	994	856	3838	2734	2218	1919	1714	1404	1212
3½	4052	2876	2342	2026	1810	1482	1280	5732	4068	3312	2865	2562	2098	1810
4	5732	4070	3312	2866	2562	2096	1810	8108	5756	4686	4054	3624	2966	2562
5	10667	7574	6166	5333	4768	3904	3350	15086	10710	8720	7543	6742	5520	4766
6	17407	12360	10060	8703	7780	6390	5516	24624	17482	14250	12312	11006	9012	7780
7	25781	18304	15102	12890	11524	9436	8146	36472	25888	21174	18236	16298	13344	11520
8	36221	25728	20946	18110	16198	13262	11550	51381	36396	29630	25640	22914	18760	16198
10	65782	46704	38022	32891	29400	24076	20786	93760	66058	53776	46880	41588	34052	29400

PIPE SIZING DATA

Table No. 39, page 63, gives the equivalent number of feet to be added to a measured length of piping for various kinds of valves and fittings.

EXAMPLE:

A 4″ pipe measures 160′0″ and contains one gate valve, and four elbows, then from Table No. 39 find:

1—4″ Gate Valve .... 5′-0″
6—4″ Elbows .... 6 × 14 = 84′-0″
Length to be added .... 89′-0″
Measured Length ....160′-0″
Equivalent Length ....249′-0″

Table No. 50, page 69, under column 4 gives factors for changing amounts of radiation as given in Table No. 34 (and similar tables) for other lengths than 100′-0″

EXAMPLE:

Example No 1 gives an equivalent length of 249′-0″ for 4″ pipe. To find how many sq. ft. of direct radiation this pipe will supply for any given pressure drop, take sq. ft. of radiation given in Table No. 34, for 4″ pipe, 100′-0″ run and multiply by factor given in column 4, Table No. 50. Factor for 250′-0″ run as taken from column 4, Table No. 50 = .632.

Amount of radiation a 4″ pipe will supply with 2-oz. pressure drop with an initial pressure of at least 4 oz. if 100′-0″ long as taken from Table No. 34 = 2866 sq. ft. Then, 2866 x .632 = 1811 sq. ft. a 4″ pipe will supply if it is an equivalent length of 250′-0″

A main should not end less than 2″ in size and when starting over 2½″ in size should not end less than 2½″ so as to take care of condensation at the far end and air carried along with the steam.

The end of each piece of pipe or nipple should be reamed clean after cutting to remove all burrs.

PIPE SIZING DATA

VALVES & FITTINGS OF SIMILAR SIZES OF DIFFERENT MANUFACTURERS VARY IN THE RESISTANCE THEY OFFER TO THE FLOW OF STEAM OR WATER.

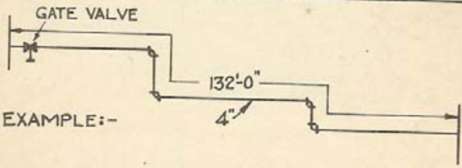
IN ESTIMATING LENGTHS OF PIPES IT IS NECCESSARY TO INCLUDE THE RESISTANCE OFFERED BY THE VARIOUS FITTINGS. THE FOLLOWING TABLE GIVES THIS IN UNITS OF LENGTH, IN FEET, TO BE ADDED TO THE MEASURED LENGTH OF PIPE FOR A GIVEN KIND OF FITTING.

TABLE № 39

LENGTH IN FEET OF PIPE TO BE ADDED TO ACTUAL LENGTH OF RUN.

SIZE OF PIPE	LENGTH IN FEET TO BE ADDED IN RUN				
	ST'D ELBOW	SIDE OUTLET TEE	GATE VALVE	GLOBE VALVE	ANGLE VALVE
2"	5	16	2	18	9
2½	7	20	3	25	12
3	10	26	3	33	16
3½	12	31	4	39	19
4	14	35	5	45	22
5	18	44	7	57	28
6	22	50	9	70	32
7	26	55	10	82	37
8	31	63	12	94	42
9	35	69	13	105	47
10	39	76	15	118	52
12	46	90	18	140	63
14	52	105	20	160	72

EXAMPLE:-



MEASURED LENGTH = 132'-0"
4" GATE VALVE = 5'-0"
4-4" ELBOWS = 56'-0"
EQUIVALENT LENGTH = 193'-0"

PIPE SIZING DATA

Tables Nos. 40 to 44, pages 65 and 66, are for sizing pipes for vacuum heating systems and include allowance for friction due to the usual number of valves, elbows, etc., which would be installed.

These tables are to be used exactly in the same way as Tables Nos. 28 to 33, as shown on pages 48 to 50.

Table No. 45, page 67, is for sizing pipes for one-pipe steam heating systems. Table is based on mains not over 100 ft. long and includes allowance for the usual number of valves, elbows, which would be installed.

When mains are other than 100 ft. long refer to column No. 4 of Table 50, page 69, and multiply capacities given in Table 45, by factor given in Table 50, for the desired length.

Tables 46 to 49, page 68, are for sizing pipes for open tank gravity hot-water heating systems. Where closed tank gravity hot-water heating systems are to be used, smaller sizes than shown in these tables are not recommended.

Table 50, page 69, gives a short method for computing flow of steam in pipes in accordance with the Babcock formula.

PIPE SIZES FOR VACUUM HEATING.

SUPPLY MAINS

TABLE Nº 40 IS COMPUTED FOR PRESSURE LOSS OF 16 OZ. AT THE FARTHEST RADIATOR FOR A GIVEN LENGTH OF MAIN, & INCLUDES ALLOWANCE FOR FRICTION FOR AVERAGE AMOUNT OF ELBOWS, TEES, ETC., & CONDENSATION IN COVERED PIPING. STEAM & CONDENSATION FLOWING IN SAME DIRECTION.

TO SIZE A MAIN – MEASURE LENGTH OF PIPING FROM BOILER OR PRESSURE REDUCING VALVE TO FARTHEST RADIATOR AND USE COL. FOR THIS LENGTH FOR SIZING ENTIRE LENGTH.

TABLE Nº 40

CAPACITY OF SUPPLY MAINS IN SQ. FT.

COL. A	MEASURED LENGTH OF PIPE IN FT. FROM BOILER OR PRESS. REDUCING VALVE TO FARTHEST RADIATOR						
SIZE OF PIPE	COL. B 100'	COL. C 200'	COL. D 300'	COL. E 400'	COL. F 500'	COL. G 750'	COL. H 1000'
2	940	667	543	470			
2½	1570	1115	800	785			
3	2800	1988	1610	1400	1250	1090	880
3½	4200	2982	2427	2100	1877	1638	1320
4	6000	4260	3480	3000	2680	2340	1895
4½	8250	5857	4770	4125	3687	3215	2607
5	11000	7810	6360	5500	4917	4290	3475
6	17300	12280	10000	8650	7733	6745	5465
7	25500	18100	14750	12750	11398	9945	8055
8	36000	25560	20800	18000	16080	14040	11375
10	65590	46570	38000	32795	29320	25580	20730
12	94500	67095	54600	47250	42240	36850	29860

TABLE Nº 41

CAPACITY OF SUPPLY RISERS IN SQ.FT.

LENGTH IN FT. FROM BOILER OR P.R.V. TO END OF RISER.

COL. A	COL. B	COL. C	COL. D	COL. E	COL. F
SIZE OF PIPE	200'	400'	600'	1000'	2000'
1"	73	52	42	33	23
1¼	160	114	92	72	57
1½	248	177	145	112	80
2	500	357	290	225	160
2½	830	592	480	374	264
3	1500	1040	845	657	463
3½	4750	3240	2630	2045	1450

HORIZONTAL BRANCHES TO RISERS TO BE ONE SIZE LARGER THAN RISER.

Pipe Sizes For Vacuum Heating.

TABLE № 42

CAPACITY OF RETURN MAINS IN SQ.FT.

* LENGTH	SIZE OF PIPE 1"	1¼"	1½"	2"	2½"	3"	3½"
300'	600	1200	3000	8200	15000	28500	40000
800	375	750	1875	5200	9700	17000	25000
1750		600	1300	3750	6700	12000	18000
2500			1125	3000	5600	9425	15000

TABLE № 43

CAPACITY OF RETURN RISERS IN SQ.FT.

* LENGTH	SIZE OF PIPE 3/4"	1"	1¼"		
200'	700	1400	3150		
400	560	1120	2480		
600	420	840	1750		
1000	350	700	1470		
2000	230	460	1050		

* LENGTH EQUALS MEASURED DISTANCE FROM VACUUM PUMP TO END OF MAIN.

RADIATOR CONNECTIONS TABLE № 44

SUPPLY				RETURN		
VALVE №	VERTICAL INLET PIPE TO VALVE	HORIZONTAL RUNOUT FROM VERTICAL INLET PIPE TO RISER OR MAIN. UP TO 6'-0" LONG	OVER 6'-0" LONG	VALVE №	STUB TO VALVE	HORIZONTAL RUNOUT TO RISER OR MAIN
7	3/4"	40$^{\phi}$ = 1" 100$^{\phi}$ = 1¼ 200$^{\phi}$ = 1½	25$^{\phi}$ = 1" 80$^{\phi}$ = 1¼ 150$^{\phi}$ = 1½ 200$^{\phi}$ = 2	8	½"	3/4"

RADIATORS TO BE WATER TYPE OF NOT OVER 200 SQ. FT. CAPACITY, TAPPED OR BUSHED AT THE TOP FOR № 7 HOFFMAN ADJUSTABLE MODULATING VALVE AND AT THE BOTTOM ½" ECCENTRIC TURNED DOWN FOR № 8 HOFFMAN RETURN VALVE.

SUPPLY AND RETURN CONNECTIONS CAN BE MADE AT SAME OR OPPOSITE ENDS AS DESIRED.

ALL RADIATORS TO BE WASHED CLEAN OF CORE SAND BEFORE MAKING VALVE CONNECTIONS.

PIPE SIZES — ONE PIPE STEAM

STEAM & CONDENSATION FLOWING SAME DIRECTION

TABLE № 45

CAPACITIES GIVEN IN SQ.FT. OF DIRECT CAST IRON RADIATION, FOR COVERED PIPING NOT OVER 100 FT. LONG. ALLOWANCE HAS BEEN MADE FOR ELLS, TEES, & ETC. FOR MAINS OVER 100 FT. LONG SEE SHEET № 69, TABLE № 50, COL. 4

PIPE SIZE	SUPPLY MAIN	WET RETURN	DRY RETURN	SUPPLY RISER	BRANCHES TO RADIATORS 5 FT. OR LESS IN LENGTH	BRANCHES TO RADIATORS OVER 5 FT. IN LENGTH	RADIATOR VALVE SIZES
1"			300	40	24	40	24
1¼		1500	650	75	60	90	60
1½		3000	1000	150	100	180	100
2	245	6000	2100	300	220	300	220
2½	405	10000	3500	500			
3	725	18000	6400	900			
3½	1220	26000	9800	1500			
4	1625		14000				
5	2895						
6	4830						
7	7235						
8	10450						
10	18500						

HORIZONTAL BRANCHES TO SUPPLY RISERS TO BE ONE SIZE LARGER THAN RISER. — SUPPLY MAINS AND WET RETURNS TO PITCH AT LEAST 1" IN 20'-0" — DRY RETURNS 1" IN 10'-0". — BRANCHES 1" IN 4'-0". — WHEN MAINS ARE PITCHED SO THAT STEAM AND CONDENSATION FLOW IN OPPOSITE DIRECTIONS USE PIPES ONE SIZE LARGER THAN GIVEN IN TABLE.

PIPE SIZES FOR OPEN TANK TWO PIPE GRAVITY HOT WATER HEATING.

THE AREA OF THE MAIN MUST EQUAL OR EXCEED THE COMBINED AREA OF THE VALVES IT IS TO SUPPLY. BOTH SUPPLY & RETURN PIPING TO BE THE SAME SIZE. NEVER MAKE A MAIN LESS THAN 1½" IN SIZE & AVOID ENDING IT IN A RISER. THE VALVE ON THE LAST RADIATOR TO BE ONE SIZE LARGER THAN TABLE CALLS FOR. RISERS OR HORIZONTAL BRANCHES RUN TO ½" VALVES TO BE MADE ¾"; ALL OTHER BRANCHES & RISERS TO EQUAL THE AREA OF THE VALVES THEY SUPPLY.

TABLE Nº 46

CAPACITIES GIVEN IN SQ. FT. DIRECT C. I. RADIATION

SIZE OF VALVE	FIRST FLOOR	SECOND FLOOR	THIRD FLOOR	FOURTH FLOOR
½"	UP TO 16□'	UP TO 20	UP TO 24□'	UP TO 28□'
¾	17 " 40	21 " 50	25 " 65	29 " 75
1	41 " 70	51 " 85	66 " 100	76 " 115
1¼	71 " 110	86 " 125	101 " 145	116 " 135
1½	111 " 190	125 " 200	146 " 225	136 " 250

TABLE Nº 47

EXPANSION TANK

SIZE OF TANK	CAPACITY GALLONS	SQ. FT. C. I. RADIATION	SIZE OF TANK	CAPACITY GALLONS	SQ. FT. C. I. RADIATION
10" X 20"	8	320	16" X 36"	32	1300
12 X 20	10	400	16 X 48	42	2000
12 X 30	15	600	18 X 60	66	3000
14 X 30	20	800	20 X 60	82	5000
16 X 30	26	1000	22 X 60	100	6000

TABLE Nº 48

VALVE AREAS

SIZE VALVE	AREA	SIZE VALVE	AREA
½"	.20	3"	7.06
¾	.44	3½	9.62
1	.78	4	12.52
1¼	1.22	5	19.63
1½	1.76	6	28.27
2	3.14	8	50.26
2½	4.90		

TABLE Nº 49

VALVE SIZES INDIRECT RADIATORS

UP TO 55□'	1¼"
56 " 80	1½"
81 " 150	2"
151 " 250	2½"
251 " 450	3"

EXAMPLE:-

6 RADS - ¾" VALVE = 2.64 AREA
2 " - 1" " = 1.56 "
1 " - 1¼" " = 1.22 "
1 INDIRECT 2" " = 3.14 "
3½" MAIN REQUIRED = 8.56 "
545 □' RADIATION TAKES A 12"X30" EXPANSION TANK.

FLOW OF STEAM IN PIPES

P = LOSS IN PRESSURE IN LBS.
d = INSIDE DIA. PIPE IN INCHES
L = LENGTH OF PIPE IN FEET
D = WEIGHT OF 1 CU. FT. STEAM
W = LBS. OF STEAM PER MINUTE

$$W = 87\sqrt{\frac{PDd^5}{\left(1+\frac{3.6}{d}\right)L}}$$

$$P = .000131\left(1+\frac{3.6}{d}\right)\frac{W^2L}{Dd^5}$$

Table Nº 50

PRESS LOSS IN OZ.	COL. 1 $87\sqrt{\frac{P}{100}}$	INSIDE DIA. PIPE	COL. 2 $\sqrt{\frac{d^5}{1+\frac{3.6}{d}}}$	STEAM PRESS BY GAUGE	COL. 3 $\sqrt{D}$	LENGTH PIPE IN FEET	COL. 4 $\sqrt{\frac{100}{L}}$
1	2.175	1	.522	.0	.193	20	2.240
2	3.076	1¼	1.177	.3	.195	40	1.580
3	3.767	1½	1.828	1.3	.201	60	1.290
4	4.350	2	3.709	2.3	.207	80	1.120
5	4.863	2½	6.109	5.3	.223	100	1.000
6	5.328	3	11.183	10.3	.248	120	.912
7	5.754	3½	16.705	15.3	.270	140	.841
8	6.152	4	23.630	20.3	.290	160	.793
10	6.878	4½	32.098	30.3	.326	180	.741
12	7.532	5	43.719	40.3	.358	200	.710
14	8.138	6	69.718	50.3	.388	250	.632
16	8.700	7	105.35	60.3	.415	300	.578
20	9.727	8	150.33	75.3	.452	350	.538
24	10.655	9	205.37	100.3	.507	400	.500
28	11.509	10	271.16	125.3	.557	450	.477
32	12.290	12	437.51	150.3	.603	500	.447
40	13.756	14	733.90	175.3	.645	600	.407
48	15.069	16	925.19	200.3	.648	700	.378
80	19.454					800	.354
160	27.512					900	.333
320	38.863					1000	.316
480	47.652					1400	.267

COLUMN 1 x 2 x 3 x 4 = LBS. STEAM PER MINUTE WILL FLOW THRU A STRAIGHT PIPE FOR A GIVEN CONDITION.
EXAMPLE:- 1 OZ. DROP - 2" PIPE - 1.3 LBS. PRESS. - 100'-0" LONG 2.175 x 3.709 x .201 x 1 = 1.615 LBS. PER MINUTE, THEN 1.615 X 60 MINUS 20% = 77.28 LBS PER HOUR.
ABOVE TABLE DOES NOT ALLOW FOR ENTRAINED WATER IN L.P. STEAM, CONDENSATION IN COVERED PIPE AND ROUGHNESS IN COMMERCIAL PIPE, THEREFORE REDUCE CALCULATED CAPACITIES APPROXIMATELY 20%.

SECTION IV

GENERAL INFORMATION AND DATA

The Vacuum Pump data on pages 71 to 73 will be found useful in laying out vacuum systems of heating.

Drawings on pages 74 to 77 show typical methods of making connections to vacuum pumps, pressure-reducing valves, lift pockets, etc.

The data given on pages 78 to 81 are for use in designing ventilating systems.

The data given on pages 82 and 83 will be found useful in determining the amount of pipe or coil to be installed in hot-water storage tank to heat a given amount of water in a given time.

The miscellaneous data on pages 84 to 90 is as quoted by standard authorities, and will be found of value in making heating and ventilating calculations.

Pages 91 and 92 give a method for cleaning steam boilers, and as this is very important it should prove invaluable to the steamfitter.

Pages 93 and 94 give heating symbols commonly used in laying out heating and ventilating plans.

Page 95 gives the reason why there should always be at least 24" between the lowest point of the main and the water line of the boiler.

Page 96 gives data on how to figure chimney size.

Page 97 will be found valuable to the fitter in making an approximate estimate of the amount of fuel a heating system will consume during a heating season.

STEAM DRIVEN VACUUM PUMPS

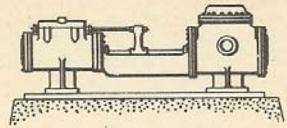


TABLE №51

MINIMUM STEAM PRESS.	SIZE PUMP			SQ. FT. OF RADIATION SETTING IN 70° F.	STEAM	EXHAUST	SUCTION	DISCHARGE
	STEAM CYLINDER	WATER CYLINDER	LENGTH STROKE					
10 LB	8	3	6	1500	¾"	1"	2"	1½"
"	8	3½	6	2200	"	"	"	"
"	8	4	6	2800	"	"	"	"
"	12	5	8	5600	1¼	2	2½	2
"	12	6	8	7900	1¼	2	3	2½
20 LB	6⅛	3	6	1500	¾	1	2	1½
"	6⅛	3½	6	2200	"	"	"	"
"	6⅛	4	8	3600	"	"	"	"
"	8½	5	8	3600	1	1½	2½	2
"	8½	6	8	7900	1	"	3	2½
"	12	6	10	8800	1¼	2	3	"
"	12	8	10	15600	1¼	"	4	3½
"	12	8	12	18800	"	"	"	"
60 LB	3	3½	4	1800	⅜	½	2	1½
"	4	3½	5	2200	½	¾	"	"
"	4	3½	6	2500	"	"	"	"
"	4	4	6	2800	"	"	"	"
"	4½	4	8	3600	"	"	"	"
"	5	5	6	4300	"	"	2½	2
"	5	6	6	6100	"	"	3	2½
"	6	6	8	7900	¾	1	"	"
"	6	6	10	8800	"	"	"	"
"	7	7	10	12000	"	"	3½	3
"	8½	8	10	15600	1	1½	4	3½
"	8½	9	10	19830	"	"	5	4
"	8½	10	10	24500	"	"	"	"
"	10	10	12	29400	1¼	2	"	"
"	12	12	12	42300	"	"	"	"

RECIPROCATING VACUUM PUMPS

TABLE Nº 52

MAXIMUM SPEED FOR STEAM DRIVEN PUMPS

LENGTH OF STROKE INCHES	NUMBER OF SINGLE STROKES PER MIN.	PISTON SPEED FT PER MIN. S.	LENGTH OF STROKE INCHES	NUMBER OF SINGLE STROKES PER MIN.	PISTON SPEED FT. PER MIN. S.
3	100	25	12	60	60
4	90	30	14	57	66½
5	84	35	15	56	70
6	80	40	16	55	73
7	69	40	18	53	80
8	67½	45	20	51	85
10	60	50	22	49	90

TABLE Nº 53

MAXIMUM SPEED FOR POWER DRIVEN PUMPS

LENGTH OF STROKE INCHES	REV. PER MINUTE CRANK SHAFT	SINGLE STROKES PER MINUTE	PISTON SPEED FT. PER MIN. S.	LENGTH OF STROKE INCHES	REV. PER MINUTE CRANK SHAFT	SINGLE STROKES PER MINUTE	PISTON SPEED FT. PER MIN. S.
3	80	160	40	10	40	80	67
5	50	100	42	12	40	80	80
6	50	100	50	16	30	60	80
8	50	100	67	20	25	50	83

USE MFG. SPEED WHEN EQUAL OR LESS THAN ABOVE

TABLE Nº 54

GROSS CAPACITY IN GALLONS OF PUMP CYLINDERS PER FT. PISTON SPEED.

DIA. CYLINDER INCHES	GAL. PER FOOT G.	DIA. CYLINDER INCHES	GAL. PER FOOT G	DIA. CYLINDER INCHES	GAL. PER FOOT G
2	.1632	6½	1.724	13	6.895
2½	.2550	6¾	1.859	13½	7.436
3	.3672	7	1.999	14	7.996
3¼	.4309	7¼	2.145	14½	8.578
3½	.4998	7½	2.295	15	9.180
3¾	.5738	7¾	2.450	15½	9.801
4	.6528	8	2.611	16	10.44
4¼	.7369	8½	2.948	17	11.79
4½	.8263	9	3.305	18	13.32
4¾	.9206	9½	3.682	19	14.73
5	1.020	10	4.080	20	16.32
5¼	1.125	10½	4.498	21	17.99
5½	1.234	11	4.937	22	19.75
5¾	1.349	11½	5.396	23	21.58
6	1.469	12	5.875	24	23.50
6¼	1.594	12½	6.375	25	25.50

MISCELLANEOUS PUMP DATA

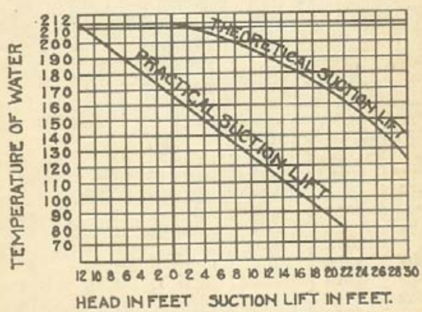
TABLE Nº 55

SUCTION LIFT OF PUMPS WITH BAROMETRIC PRESSURE AT DIFFERENT ALTITUDES & EQUIVALENT HEAD OF WATER IN FEET.

ALTITUDE	BAROMETRIC PRESSURE	EQUIVALENT HEAD OF WATER IN FT.	PRACTICAL SUCTION LIFT
SEA LEVEL	14.70 LBS. ☐	33.95	22 FT.
¼ MILE ABOVE	14.02 " "	32.38	21 "
½ " "	13.33 " "	30.79	20 "
¾ " "	12.66 " "	29.24	18 "
1 " "	12.02 " "	27.76	17 "
1¼ " "	11.42 " "	26.38	16 "
1½ " "	10.88 " "	25.13	15 "
2 " "	9.88 " "	22.82	14 "

TABLE Nº 56

PUMP SUCTION LIFTS AT SEA LEVEL AT VARIOUS TEMPERATURES OF WATER.

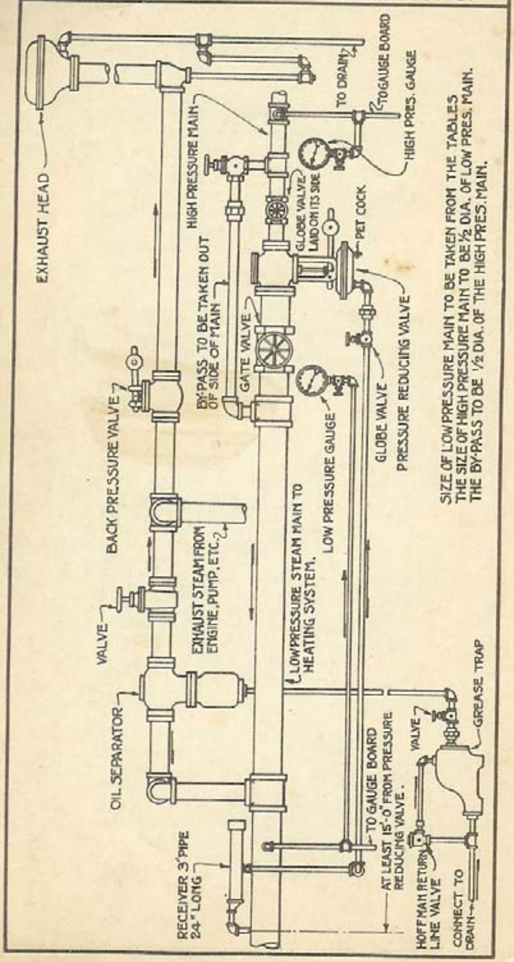


FOR DETERMINING RECIPROCATING VACUUM PUMP SIZES

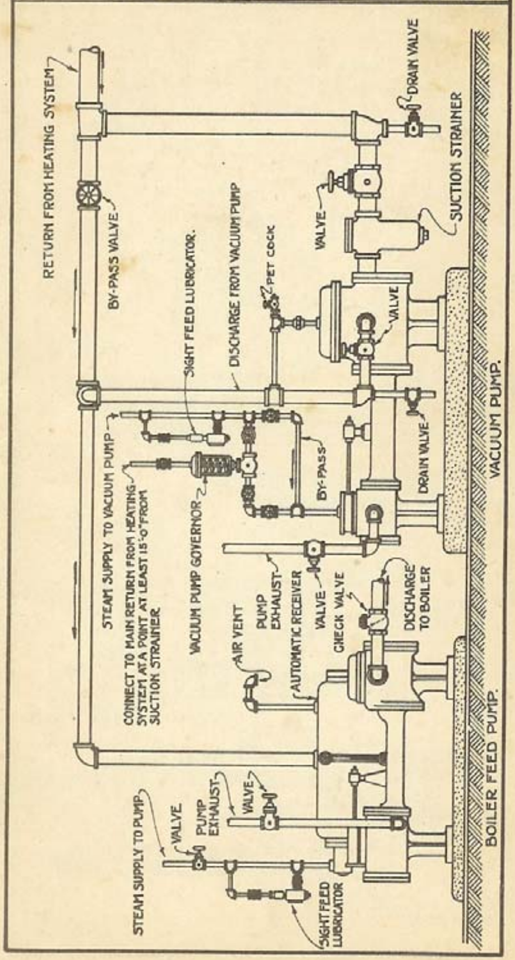
EMPIRICAL FORMULA

G × S × W = CAPACITY SQ.FT. DIRECT RADIATION
G = CAPACITY WATER CYLINDER IN GAL. PER FT. LENGTH
S = PISTON SPEED IN FEET PER MINUTE
W = CONSTANT:-105 FOR 6" & LESS -120 FOR OVER 6" CYL.

TYPICAL VACUUM CONNECTIONS.



TYPICAL VACUUM CONNECTIONS.



TYPICAL VACUUM CONNECTIONS.

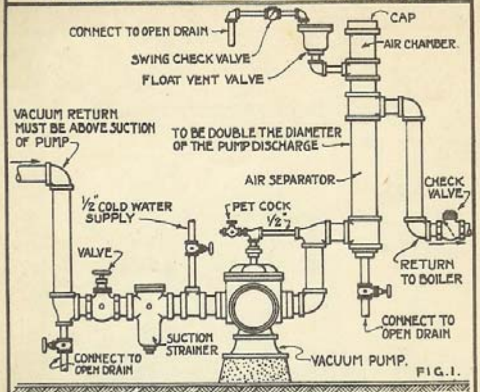
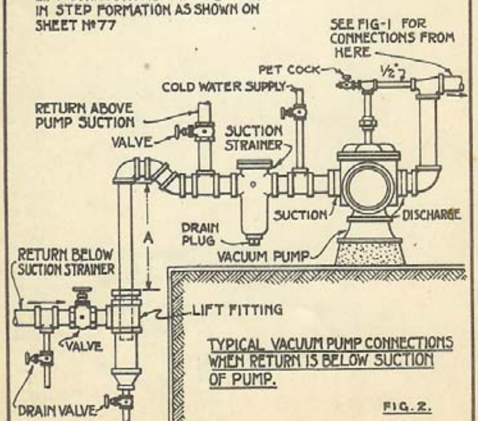


FIG. 1.

VACUUM PUMP DISCHARGING RETURN DIRECT INTO BOILER.

WHEN DISTANCE A IS MORE THAN 5'-0" LIFT CONNECTIONS ARE TO BE MADE IN STEP FORMATION AS SHOWN ON SHEET Nº 77



TYPICAL VACUUM PUMP CONNECTIONS WHEN RETURN IS BELOW SUCTION OF PUMP.

FIG. 2.

·TYPICAL·VACUUM·CONNECTIONS·

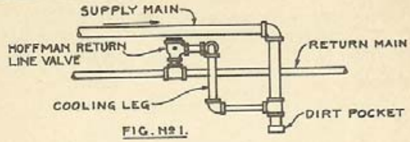


FIG. Nº 1.

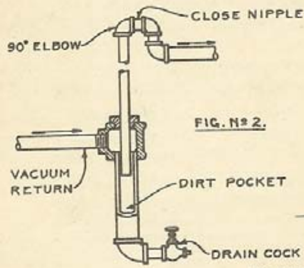


FIG. Nº 2.

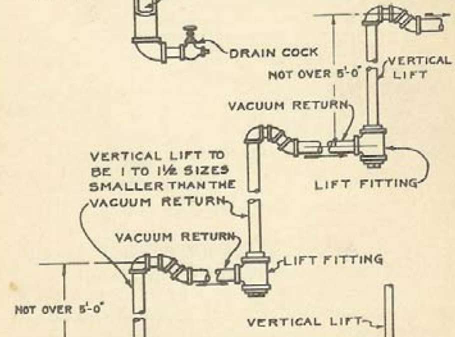
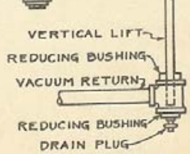


FIG. Nº 3



RUN OF TEE TO BE TWO SIZES LARGER THAN THE VACUUM RETURN.

FIG. Nº 4

HEATING & VENTILATING DATA

PRACTICAL AIR VELOCITIES—PUBLIC BLDGS.

AIR SUPPLY SYSTEM — TABLE No. 57

COLD-AIR INTAKE	600 TO 900 FT. PER MIN.
AIR WASHERS	500 " " "
VENTO HEATERS	800 TO 1300 " " "
HORIZONTAL MAIN DUCTS	1000 " 1200 " " "
HORIZONTAL BRANCH DUCTS	600 " 900 " " "
VERTICAL RISERS (SHEET METAL)	550 " 700 " " "
VERTICAL RISERS (MASONRY)	450 " 550 " " "
REGISTER OUTLETS	250 " 350 " " "

EXHAUST AIR SYSTEM — TABLE No. 58

FAN DISCHARGE OUTLET	800 TO 1000 FT. PER MIN.
HORIZONTAL MAIN DUCTS	900 " 1000 " " "
HORIZONTAL BRANCH DUCTS	600 " 700 " " "
VERTICAL RISERS (SHEET METAL)	500 " 600 " " "
VERTICAL RISERS (MASONRY)	350 " 450 " " "
REGISTER OUTLETS	300 " 400 " " "

RESISTANCE OF 90 DEGREE ELBOWS—TABLE No. 59

COL. A	COL. B	COL. A	COL. B	COL. A	COL. B	COL. A	COL. B
1/4	67.0	1 1/4	7.5	2 1/2	4.5	4 1/2	5.5
1/2	30.0	1 1/2	6.0	3	4.8	5	5.8
3/4	16.0	1 3/4	5.0	3 1/2	5.0	5 1/2	6.0
1	10.0	2	4.3	4	5.2	6	6.2

COL. A = RADIUS OF THROAT OF ELBOW IN DIA'S. OF PIPE.

COL. B = NUMBER OF DIAMETERS OF STRAIGHT PIPE OFFERING EQUIVALENT RESISTANCE.

THE RESISTANCE OFFERED BY AN ELBOW OF A GIVEN RADIUS OF THROAT IS GIVEN IN EQUIVALENT DIAMETERS OF LENGTH OF STRAIGHT PIPE.
EXAMPLE:- 90° ELBOW OF 30" PIPE, HAVING A THROAT RADIUS EQUAL TO 1 1/2 DIAMETERS.—REFER TO COL. A—FIND 1 1/2 DIAMETERS IS EQUIVALENT TO 6 DIAMETERS OF STRAIGHT PIPE, THEN — 30" X 6 = 180" OR 180 ÷ 12 = 15'-0" OF STRAIGHT PIPE.

HEATING & VENTILATING DATA.

SIZE OF REGISTERS & RISERS FOR FAN SYSTEMS IN PUBLIC BUILDINGS. TABLE No. 60

CU. FT. AIR PER MIN.	SIZE OF REGISTER	VEL. THRU REG. FACE	SIZE RISER IN INCHES	RISER VEL. FT. PER MIN.
150	8x14	300	6x 8	447
220	10x16	300	8x 8	510
300	12x18	300	8x 10	540
350	14x18	300	8x 12	525
425	14x22	300	9x 12	565
500	16x22	300	9x 14	570
575	18x24	290	10x 14	572
675	18x26	305	10x 17	572
800	18x32	300	12x 16	604
925	24x28	300	12x 18	615
1025	24x30	307	12x20	615
1150	24x32	300	12x22	630
1300	24x36	325	12x24	650
1450	24x38	325	14x24	620
1625	30x36	325	14x26	645
1800	30x40	325	14x28	660
1975	36x36	330	16x26	675
2150	36x40	330	16x28	685
2300	36x42	330	16x30	690
2500	36x44	340	16x32	700

$$\frac{\text{VOLUME}}{\text{VELOCITY}} = \text{SQ. FT. FREE AREA}$$

$$\text{SQ. FT. FREE AREA} \times \text{VELOCITY} = \text{VOLUME}$$

$$\frac{\text{VOLUME}}{\text{SQ. FT. FREE AREA}} = \text{VELOCITY}$$

AIR REQUIREMENTS FOR BUILDINGS — TABLE No. 61

TYPE OF BUILDING	CU. FT. OF AIR PER OCCUPANT PER HOUR.
SCHOOL HOUSES	1800
THEATRE & ASSEMBLY HALLS	1200 TO 1500
CHURCHES	1000 " 1500
FACTORIES	1800 " 3000
OFFICE BLDGS.	1500 " 2000
RESIDENCES	1500 " 2000
PRISONS	1800 " 2100
HOSPITALS — CONTAGIOUS	5000 " 6000
HOSPITALS — WOUNDED	3000 " 3500
HOSPITALS — ORDINARY	2200 " 2600

HEATING & VENTILATING DATA.

WEIGHT OF ROUND GALVANIZED IRON PIPE AND ELBOWS OF GAUGES AS USED FOR HEATING AND VENTILATING SYSTEMS. TABLE No. 62

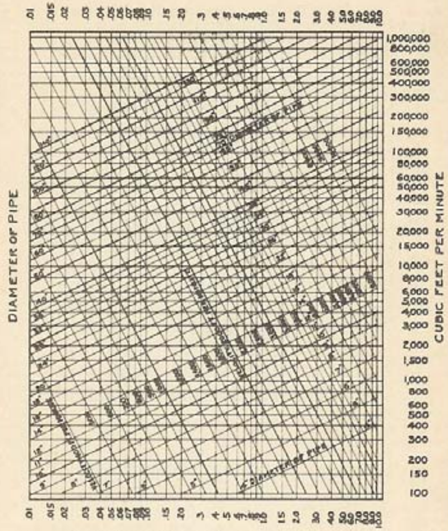
GAGE & WT. PER SQ. FT.	DIA. OF PIPE	AREA IN SQ. INS.	WT. PER RUNNING FOOT	WT. OF FULL ELBOW
No. 28 0.78	4	12.6	1.1	0.9
	5	19.6	1.2	1.2
	6	28.3	1.4	1.7
	7	38.5	1.7	2.3
	8	50.3	1.9	2.9
No. 26 0.91	9	63.6	2.4	4.3
	10	78.5	2.7	5.3
	12	113.1	3.2	7.6
	14	153.9	3.7	10.4
	15	176.7	4.5	13.5
	16	201.1	4.7	15.1
	18	254.5	5.3	19.1
No. 24 1.16	19	283.5	5.6	21.4
	20	314.2	6.0	23.9
	21	346.4	7.0	29.6
	22	380.1	7.3	32.3
	23	415.5	7.7	35.6
	24	452.4	8.0	38.6
	25	490.9	8.3	41.7
	26	530.9	8.7	45.1

GAGE & WT. PER SQ. FT.	DIA. OF PIPE	AREA IN SQ. INS.	WT. PER RUNNING FOOT	WT. OF FULL ELBOW
No. 22 1.41	28	615.7	11.4	64.2
	30	706.9	12.2	73.4
	32	804.3	13.0	83.4
	34	907.9	13.9	94.3
No. 20 1.66	36	1017.9	17.2	124.4
	38	1134.1	18.2	139.4
	40	1256.6	19.1	152.9
	42	1385.4	20.1	168.6
	44	1520.5	21.0	185.0
	46	1661.9	22.0	202.2
No. 18 2.16	48	1809.6	29.8	286.6
	50	1963.5	31.0	309.9
	52	2123.7	32.2	335.1
	54	2290.2	33.6	363.4
	56	2463.0	34.9	390.7
	58	2642.1	36.1	418.8
	60	2827.4	37.4	448.6
No. 16 2.66	62	3019.1	47.5	589.0
	64	3217.0	49.1	628.5
	66	3421.2	50.5	666.6

GAUGES USED FOR RECTANGULAR DUCTS

WIDTH-INCHES	GAUGE	WIDTH-INCHES	GAUGE
4 To 15	26	51 To 90	20
16 " 30	24	91 - 120	18
31 " 50	22	OVER 120	16

CHART FOR DETERMINING PRESSURE LOSS IN DUCTS



EXAMPLES FOR USE OF CHART.

No. 1 — TO FIND DIAMETER OF DUCT AND FRICTION LOSS FOR 20,000 C.F.M. AT 1000 FT. VELOCITY:—
READ 20,000 C.F.M. ON HORIZONTAL LINE AND 1000 FT. VELOCITY ON DIAGONAL, AND AT POINT WHERE THEY INTERSECT, ALSO FIND ANOTHER DIAGONAL LINE READING 60" DIA. DUCT, AND A VERTICAL LINE READING .03 INCHES FRICTION LOSS PER 100'-0" OF LENGTH.

No. 2 — PASSING 5000 C.F.M. THRU A 30" DIA. DUCT, — TO FIND VELOCITY AND FRICTION LOSS PER 100'-0":—
READ WHERE HORIZONTAL LINE 5000 INTERSECTS DIAGONAL LINE FOR 30" DIA. DUCT, 1000 FT. VELOCITY AND .06 INCHES FRICTION LOSS.

No. 3 — HOW MANY C.F.M. WILL PASS THRU A 70" DIA. DUCT, AT 1500 FT. VELOCITY?
AT INTERSECTION OF 1500 FT. VELOCITY LINE AND 70" DIA. DUCT LINE, FIND HORIZONTAL LINE READING 40,000 C.F.M. AND FRICTION LOSS CAN BE READ FROM THE INTERSECTING VERTICAL LINE AS .058 INCHES PER 100'-0" OF LENGTH.

Storage Tanks

Table No.63.
Number Of Gallons In Round Tanks

Depth Or Length	Inside Diameter In Inches									
	18	24	30	36	42	48	54	60	66	72
1 Inch	1.10	1.96	3.06	4.41	5.99	7.83	9.91	12.24	14.81	17.62
2 Ft.	26	47	73	105	144	188	238	294	356	424
2½	33	59	91	131	180	235	298	367	445	530
3	40	71	100	158	216	282	357	440	534	635
3½	46	83	129	184	252	329	416	513	623	740
4	53	95	147	210	288	376	475	586	712	846
4½	59	107	165	238	324	423	534	660	800	952
5	66	119	181	264	360	470	596	734	890	1057
5½	73	130	201	290	396	517	655	808	978	1163
6	79	141	219	315	432	564	714	880	1066	1268
6½	88	155	236	340	468	611	770	954	1156	1374
7	92	165	255	368	504	658	832	1028	1244	1480
7½	99	179	278	396	540	705	889	1101	1335	1586
8	106	190	291	423	576	752	949	1175	1424	1681
9	119	212	330	476	648	846	1071	1322	1599	1903
10	132	236	366	529	720	940	1189	1463	1780	2114
12	157	282	440	634	864	1128	1428	1762	2133	2537
14	185	329	514	740	1008	1316	1666	2056	2490	2960
16	211	376	587	846	1152	1504	1904	2350	2844	3383
18	238	423	660	952	1296	1692	2140	2640	3200	3806
20	264	470	734	1057	1440	1880	2380	2932	3556	4230

Capacity Of Rectangular—Tanks.

To Find How Many U.S. Gallons Any Rectangular Tank Will Hold:—Multiply The Inside Length By The Width And The Product By The Depth And Find Contents In Cubic Inches. Divide This By 1728 To Find Contents In Cu. Ft.—Then Mutiply The Result By 7.4805 And Have Answer In U.S. Gallons—

Example:—Tank—56" Long x 32" Wide x 20" Deep, Then—56x32x20 = 35,840 Cu. In. ÷ 1728 = 20.74 Cu. Ft. x 7.4805 = 155.+ Gallons Capacity.

Note:—The Average Increase In Pressure In A Closed Tank Due To Heating The Water, Is 6 Lbs. Per Sq. In Per Degree Rise In Temperature.

Heating Power Of Low Pressure Steam Pipes In Water For Average Working Conditions.

Brass Pipe — Table No.64

Col. A	Col. B	Col. C	Col. A	Col. B	Col. C
Temp. Diff.	B.T.U.	Pounds	Temp. Diff.	B.T.U.	Pounds
6° F	192	.20	70	13000	13.55
7	240	.25	75	15000	15.62
8	300	.31	80	17000	17.70
9	400	.42	85	19000	20.00
10	480	.50	90	21000	21.77
15	800	.63	95	23000	24.00
16	960	1.00	100	25000	26.05
20	1440	1.50	110	30000	31.25
25	2300	2.40	120	35000	36.45
30	3100	3.23	130	40000	41.60
35	4000	4.16	140	45000	46.90
40	5000	5.23	150	50000	52.10
45	6000	6.25	160	55000	57.30
50	7200	7.50	170	61000	63.54
55	8500	8.85	180	67000	70.00
60	10000	10.50	190	73500	76.60
65	11500	12.00	200	80000	83.23

Col. A = Temp. Difference Between Steam In Pipe And Average Temp. Of The Water In The Tank In Degrees F.

Col. B = B.T.U. Transmitted Per Sq. Ft. Per Hr.

Col. C = Lbs. Of Steam Condensed Per □' Per Hr.

Iron Pipe Will Condense ½ As Much Steam As Given In Table For Brass Pipe.

Example:—Heat 200 Gals. Water Per Hr. From 50° To 164°F. With Brass Pipe & Steam At 5 Lbs Gauge Press.

Temp. Of Steam 5 Lbs. Press.—————— = 227°F
Average Temp. Of Water (50+164)÷2——— = 107°F
Temp. Difference—————————— = 120°F
200 Gals. Water By Weight—200x8⅓—— = 1667 Lbs.
Temp. Rise = 164°—50°—————————— = 114°F

B.T.U. Required Per Hr. = 1667 x 114 = 190,038 From Col. A—120° F.—Find In Col. B. That 1□' Brass Pipe Will Give Up 35000 B.T.U. And In Col. C This Equals 36.45 Lbs. Of Steam Per Hour.—Then:— 190,038 ÷ 35,000 = 5.43 Sq. Ft. Brass Pipe And As Each Sq. Ft. Will Condense 36.45 Lbs.,— 36.45 x 5.43 = 198 Lbs. Steam Required Per Hour.

Pipe Data Table Nº 65

Nominal Size	Actual Outside Dia.	Area-Sq.In. Inside	Area-Sq.Ft. Inside	3600 x Area In Sq. Ft. For Computing Velocity.	Lineal Ft. Per Sq. Ft. Of External Surface	Sq. Ft. Of Heating Surface Per Lineal Ft.	Gals. Of Water Per 100 Ft. Length	Safe Velocity In Ft. Per Second
1/8"	.41	.06			9.43		.3	
1/4	.54	.10			7.08		.5	
3/8	.68	.19			5.66		1.0	
1/2	.84	.30			4.55		1.6	
3/4	1.05	.53			3.64	.275	2.7	
1	1.32	.86	.006	21.60	2.90	.346	4.5	16
1 1/4	1.66	1.50	.010+	37.08	2.30	.434	7.7	20
1 1/2	1.90	2.04	.014−	50.04	2.01	.494	10.6	23
2	2.38	3.36	.023+	84.24	1.61	.622	17.4	29
2 1/2	2.88	4.78	.033+	119.52	1.33	.753	24.8	35
3	3.50	7.38	.051+	185.40	1.09	.916	38.4	40
3 1/2	4.00	9.89	.068+	246.60	.96	1.041	51.3	44
4	4.50	12.73	.088−	318.24	.85	1.175	66.1	49
4 1/2	5.00	15.96	.110	396.00	.76	1.316	82.9	55
5	5.56	19.99	.138	496.80	.69	1.455	103.8	58
6	6.63	28.89	.200	720.00	.58	1.739	150.0	66
7	7.63	38.74	.270	972.00	.50	2.000	202.0	75
8	8.63	50.02	.347	1249.20	.44	2.272	260.0	80
9	9.63	62.73	.435	1566.00	.40	2.500	326.0	90
10	10.75	78.82	.550	1980.00	.36	2.778	410.0	95

Velocity Of Steam

To Find The Approximate Velocity Of Low Pressure Steam Multiply The Condensation In Pounds By The Volume In Cu. Ft. Corresponding To The Pressure, Which Gives Volume Of Steam Passing Thru The Pipe Per Hour. Dividing This Product By 3600 Times The Area Of The Pipe In Sq. Ft. Gives Velocity In Ft. Per Second.

Safety Valve Sizes. Low Pressure Boilers. A.S.M.E. Std.

Up To 3.25 # Grate	= 1 1/4"	12.51 To 17.75 # Grate	= 3"
3.26 - 4.50 # "	= 1 1/2"	17.76 " 24.00 # "	= 3 1/2"
4.51 - 8.00 # "	= 2"	Over 24 # "	Use 2 Or More
8.01 - 12.50 # "	= 2 1/2"		

Properties Of Saturated Steam

Vacuum In Ins. Of Mercury Or Gage Pres. In Lbs.	Absolute Pressure In Lbs. Per Sq. In.	Temp. In Deg. Fahr.	Total Heat Above 32° Fahr.		Latent Heat Of Steam In B.T.U.	Volume In Cu. Ft. Of 1 Lb. Of Steam
			B.T.U. In The Water	B.T.U. In The Steam		
27.88	1.	101.83	69.8	1104.4	1034.6	333.0
25.85	2.	126.15	94.0	1115.0	1021.0	173.5
23.81	3.	141.52	109.4	1121.6	1012.3	118.5
21.78	4.	153.01	120.9	1126.5	1005.7	90.5
19.74	5.	162.28	130.1	1130.5	1000.3	73.33
17.70	6.	170.06	137.9	1133.7	995.8	61.89
15.67	7.	176.85	144.7	1136.5	991.8	53.56
13.63	8.	182.86	150.8	1139.0	988.2	47.27
11.60	9.	188.27	156.2	1141.1	985.0	42.36
9.56	10.	193.22	161.1	1143.1	982.0	38.38
7.52	11.	197.75	165.7	1144.9	979.2	35.10
5.49	12.	201.96	169.9	1146.5	976.6	32.36
3.45	13.	205.87	173.8	1148.0	974.2	30.03
1.42	14.	209.55	177.5	1149.0	971.9	28.02
0.00	14.70	212.00	180.0	1150.4	970.4	26.79
0.3	15.	213.00	181.0	1150.7	969.7	26.27
1.3	16.	216.3	184.4	1152.0	967.6	24.79
2.3	17.	219.4	187.5	1153.1	965.6	23.38
3.3	18.	222.4	190.5	1154.2	963.7	22.16
4.3	19.	225.2	193.4	1155.2	961.8	21.07
5.3	20.	228.0	196.1	1156.2	960.0	20.08
6.3	21.	230.6	198.8	1157.1	958.3	19.18
7.3	22.	233.1	201.3	1158.0	956.7	18.37
8.3	23.	235.5	203.8	1158.8	955.1	17.62
9.3	24.	237.8	206.1	1159.6	953.5	16.93
10.3	25.	240.1	208.4	1160.4	952.0	16.30
15.3	30.	250.3	218.8	1163.9	945.1	13.74
20.3	35.	259.3	227.3	1166.8	938.9	11.89
25.3	40.	267.3	236.1	1169.4	933.3	10.49
31.3	46.	275.8	244.8	1172.0	927.2	9.20
35.3	50.	281.0	250.1	1173.6	923.5	8.51
41.3	56.	288.2	257.5	1175.7	918.2	7.65
45.3	60.	292.7	262.1	1177.0	914.9	7.17
51.3	66.	299.0	268.5	1178.8	910.2	6.56
61.3	76.	308.5	278.3	1181.4	903.0	5.74
71.3	86.	317.1	287.2	1183.6	896.4	5.10
81.3	96.	324.9	295.3	1185.6	890.3	4.60
90.3	105.	331.4	302.0	1187.2	885.2	4.25
100.3	115.	338.1	309.0	1188.8	879.8	3.88
125.3	140.	353.1	324.6	1192.2	867.6	3.219
140.3	155.	361.1	332.9	1194.0	861.0	2.920
150.3	165.	366.1	338.2	1195.0	856.8	2.753
165.3	180.	373.1	345.6	1196.4	850.8	2.533
175.3	190.	377.6	350.4	1197.3	846.9	2.406
200.3	215.	388.0	361.4	1199.2	837.9	2.138

· AREA · OF · CIRCLES · TABLE · №67

SIZE	AREA	SIZE	AREA	SIZE	AREA	SIZE	AREA
⅛	0.0123	10	78.54	30	706.86	65	3318.3
¼	0.0491	½	86.59	31	754.76	66	3421.2
⅜	0.1104	11	95.03	32	804.24	67	3525.6
½	0.1963	½	103.86	33	855.30	68	3631.6
⅝	0.3067	12	113.09	34	907.92	69	3739.2
¾	0.4417	½	122.71	35	962.11	70	3848.4
⅞	0.6013	13	132.73	36	1017.8	71	3959.2
1	0.7854	½	143.13	37	1075.2	72	4071.5
⅛	0.9940	14	153.93	38	1134.1	73	4185.3
¼	1.227	½	165.13	39	1194.5	74	4300.8
⅜	1.484	15	176.71	40	1256.6	75	4417.8
½	1.767	½	188.69	41	1320.2	76	4536.4
⅝	2.073	16	201.06	42	1385.4	77	4656.0
¾	2.405	½	213.82	43	1452.2	78	4778.3
⅞	2.761	17	226.98	44	1520.5	79	4901.6
2	3.141	½	240.52	45	1590.4	80	5026.5
¼	3.976	18	254.46	46	1661.9	81	5153.0
½	4.908	½	268.80	47	1734.9	82	5281.0
¾	5.939	19	283.52	48	1809.5	83	5410.6
3	7.068	½	298.64	49	1885.7	84	5541.7
¼	8.295	20	314.16	50	1963.5	85	5674.5
½	9.621	½	330.06	51	2042.8	86	5808.8
¾	11.044	21	346.36	52	2123.7	87	5944.6
4	12.566	½	363.05	53	2206.1	88	6082.1
½	15.904	22	380.13	54	2290.2	89	6221.1
5	19.635	½	397.60	55	2375.8	90	6361.7
½	23.758	23	415.47	56	2463.0	91	6503.8
6	28.274	½	433.73	57	2551.7	92	6647.6
½	33.183	24	452.39	58	2642.0	93	6792.9
7	38.484	½	471.43	59	2733.9	94	6939.7
½	44.178	25	490.87	60	2827.4	95	7088.2
8	50.265	26	530.93	61	2922.4	96	7238.2
½	56.745	27	572.55	62	3019.0	97	7389.8
9	63.617	28	615.75	63	3117.2	98	7542.9
½	70.882	29	660.52	64	3216.9	99	7697.7

TO FIND THE CIRCUMFERENCE OF A CIRCLE WHEN DIAMETER IS GIVEN, MULTIPLY THE GIVEN DIAMETER BY 3.1416. TO FIND THE DIAMETER OF A CIRCLE WHEN CIRCUMFERENCE IS GIVEN, MULTIPLY THE GIVEN CIRCUMFERENCE BY .31831

· USEFUL · DATA · TABLE · №68

DIAMETER	× 3.1416	= CIRCUMFERENCE
CIRCUMFERENCE	× .3183	= DIAMETER
DIAMETER^2	× .7854	= AREA OF CIRCLE
AREA OF CIRCLE	× 1.2732	= AREA OF CIRCUMSCRIBED SQUARE
AREA OF CIRCLE	× .63662	= AREA OF INSCRIBED SQUARE
DIA. OF CIRCLE	× .88623	= SIDE OF EQUAL SQUARE
DIA. OF CIRCLE	× .7071	= SIDE OF INSCRIBED SQUARE
CIRCUMFERENCE OF CIRCLE	× 1.1284	= PERIMETER OF EQUAL SQUARE
SIDE OF SQUARE	× 1.4142	= DIA. OF CIRCUMSCRIBED CIRCLE
SIDE OF SQUARE	× 1.1284	= DIA. OF EQUAL CIRCLE
PERIMETER OF SQUARE	× .88623	= CIRCUMFERENCE OF EQUAL CIRCLE
DIAMETER^2	× 3.1416	= SURFACE OF SPHERE
DIAMETER^3	× .5236	= VOLUME OF SPHERE
DIA. OF SPHERE	× .806	= DIMENSIONS OF EQUAL CUBE
DIA. OF SPHERE	× .6667	= LENGTH OF EQUAL CYLINDER
AREA OF BASE	× ⅓ HEIGHT	= VOLUME OF PYRAMID OR CONE
BASE	× ½ HEIGHT	= AREA OF TRIANGLE
RADIUS	× 1.1547	= SIDE OF INSCRIBED CUBE
SQ. INS.	× 1.2732	= CIRCULAR INCHES
SQ. INS.	× .00695	= SQ. FT.
SQ. FT.	× .111	= SQ. YD.
SQ. YDS.	× .0002066	= ACRES
CU. IN.	× .00058	= CU. FT.
CU. FT.	× .03704	= CU. YD.
CU. IN.	× .004329	= U.S. GAL.
CU. FT.	× 7.4805	= U.S. GAL.
CU. IN.	× .000466	= U.S. BU.
CU. FT.	× .8036	= U.S. BU.
U.S. BU.	× 2150.42	= CU. IN.
U.S. BU.	× 1.242	= CU. FT.
U.S. BU.	× .046	= CU. YD.
U.S. GAL.	× 231.0	= CU. IN.
U.S. GAL.	× .13368	= CU. FT.
CU. IN. WATER	× .036127	= POUNDS (AVOIRDUPOIS)
CU. FT. WATER	× 62.4283	= POUNDS (AVOIRDUPOIS)
U.S. GALS. WATER	÷ 268.8	= TONS
COLUMN OF WATER 1" DIA. × 12" HIGH		= .34 LB. (AVOIRDUPOIS)
CU. IN.	× .263	= LB. AV. CAST IRON
CU. IN.	× .281	= LB. AV. WROUGHT IRON
CU. IN.	× .283	= LB. AV. CAST STEEL
CU. IN.	× .3225	= LB. AV. COPPER
CU. IN.	× .3037	= LB. AV. BRASS
CU. IN.	× .26	= LB. AV. ZINC
CU. IN.	× .4103	= LB. AV. LEAD
CU. IN.	× .2636	= LB. AV. TIN
CU. IN.	× .4908	= LB. AV. MERCURY
12 × WEIGHT OF PINE PATTERN		= IRON CASTING
13 × WEIGHT OF PINE PATTERN		= BRASS CASTING
14 × WEIGHT OF PINE PATTERN		= LEAD CASTING
1 CALORIE		= 3.968 B.T.U.
1 B.T.U.		= 0.252 CALORIE
1 LB. PER SQ. IN.		= 703.08 KILOGRAMMES PER M^2
1 KILOGRAMME PER M^2		= 0.00142 LBS. PER SQ. IN.
1 CALORIE PER M^2		= 0.3687 B.T.U. PER SQ. FT.
1 B.T.U. PER SQ. FT.		= 2.712 CALORIES PER M^2
1 CALORIE PER M^2 PER DEG. DIFFERENCE CENT.		= 0.2048 B.T.U. PER SQ. FT. PER DEG. DIFFERENCE FAHR.
1 B.T.U. PER SQ. FT. PER DEG. DIFFERENCE FAHR.		= 4.882 CALORIES PER M^2 PER DEG. DIFFERENCE CENT.
1 B.T.U. PER LB.		= 0.556 CALORIES PER KILOG.
1 CALORIE PER KILOG.		= 1.8 B.T.U. PER LB.
1 LITRE OF COKE AT 26.3 LB. PER CU. FT.		= 0.93 LBS.
1 LB. OF COKE AT 26.3 LB. PER CU. FT.		= 1.076 LITRES
WATER EXPANDS IN BULK FROM 40 DEG. TO 212 DEG.		= ONE TWENTY-THIRD

· MISCELLANEOUS · DATA ·

Weight of One Cubic Foot of Pure Water — Table Nº 69

At 32 Deg. Fahr. (Freezing Point)	62.418	Lb.
At 39.1 Deg. Fahr. (Maximum Density)	62.425	Lb.
At 62 Deg. Fahr. (Standard Temperature)	62.355	Lb.
At 212 Deg. Fahr. (Boiling Point, Under 1 Atmosphere)	59.76	Lb.
Imperial Gal. = 277.274 Cu. In. of Water at 62 Deg. Fahr. —	10.0	Lb.
American Gal. = 231 Cu. In. of Water at 62 Deg. Fahr. —	8.3356	Lb.

Boiling Points of Various Fluids — Table Nº 70

	Degrees Fahr.		Degrees Fahr.
Water, Atmospheric Pressure	212	Refined Petroleum	316
Alcohol	173	Turpentine	315
Sulphuric Acid	240	Sulphur	570
		Linseed Oil	597

Melting Points of Different Metals — Table Nº 71

	Degrees Fahr.		Degrees Fahr.
Aluminum	1400	Iron (Cast)	2450
Antimony	810	Iron (Wrought)	2912
Bismuth	476	Lead	608
Brass	1900	Platinum	3080
Bronze	1692	Silver (Pure)	1873
Copper	1996	Steel	2500
Glass	2377	Tin	446
Gold (Pure)	2590	Zinc	680

Specific Gravity of Bodies — Table Nº 72

Body	Specific Gravity	Weight per Cu. Ft. in Lb.
Water	1.00	62.5
Aluminum	2.50	156.3
Tin (Cast)	7.29	455.6
Steel	7.84	490.0
Cast Iron	7.21	450.6
Wrought Iron	7.68	480.0
Brass	8.38	523.8
Copper	8.79	549.4
Lead (Cast)	11.35	709.4
Mercury	13.60	850.0
Platinum	21.50	1343.8

Specific Heat of Bodies — Table Nº 73

Material	Specific Heat	Material	Specific Heat	Material	Specific Heat
Cast Iron	0.12980	Gold	0.03244	Glass	0.19768
Wrought Iron	0.11379	Platinum	0.03243	Burnt Clay	0.18500
Lime	0.09555	Lead	0.03140	Brickwood	0.20000
Copper	0.09515	Bismuth	0.03084	Water at 32°	1.00000
Brass	0.09391	Nickel	0.10860	Alcohol (S.G.793)	0.62200
Silver	0.05701	Ice	0.50400	Petroleum	0.43400
Tin	0.05695	Coal	0.27770	Olive Oil	0.30960
Mercury	0.03332	Coke	0.20085	Air	0.24

Electrical Equivalents

One Watt — A rate of doing work:
- 1. Ampere at one Volt
- .7373 Foot-Pounds per Second
- 44.238 Foot-Pounds per Minute
- 2654.28 Foot-Pounds per Hour
- .5027 Mile-Pounds per Hour
- .00134 Horse-Power
- 1/746 Horse-Power

One Kilowatt — A rate of doing work:
- 737.3 Foot-Pounds per Second
- 44238. Foot-Pounds per Minute
- 502.7 Mile-Pounds per Hour
- 1.34 Horse-Power

One Horse Power — A rate of doing work:
- 550. Foot-Pounds per Second
- 33000. Foot-Pounds per Minute
- 375. Mile-Pounds per Hour
- 746. Watts
- .746 Kilowatts

One Watt Hour — A quantity of work:
- 2654.28 Foot Pounds
- .503 Mile-Pounds
- 1. Ampere Hour X One Volt
- .00134 Horse-Power-Hour

One Horse-Power Hour — A quantity of work:
- 1,980,000. Foot-Pounds
- 375. Mile-Pounds
- 746. Watt-Hour
- .746 Kilowatt-Hour

One Ampere Hour — A quantity of current:
One Ampere flowing for one hour, irrespective of the voltage.
Watt-Hour ÷ Volts

Torque — Force moving in a circle.
A force of one pound at a radius of one foot.

Metric & English Measures

Metric			English	
Measures Of Length				
1.	Metre	=	39.37	Inches
			3.28	Feet
.3048	Metre	=	1.	Foot
1.	Centimetre	=	.3937	Inch
2.54	Centimetres	=	1.	Inch
1.	Millimetre	=	.03937	Inch
25.4	Millimetres	=	1.	Inch
1.	Kilometre	=	1093.61	Yards
Measures Of Surface				
1.	Sq. Metre	=	10.764	Sq. Ft.
.0929	Sq. Metre	=	1.	Sq. Ft.
1	Sq. Centimetre	=	.155	Sq. In.
6.452	Sq. Centimetres	=	1.	Sq. In.
1.	Sq. Millimetre	=	.00155	Sq. In.
645.2	Sq. Millimetres	=	1.	Sq. In.
Measures Of Volume				
1.	Cu. Metre	=	35.314	Cu. Ft.
.02832	Cu. Metre	=	1.	Cu. Ft.
1.	Cu. Decimetre	=	61.023	Cu. Ins.
			.0353	Cu. Ft.
28.32	Cu. Decimetres	=	1.	Cu. Ft.
16.387	Cu. Centimetres	=	1.	Cu. In.
1.	Cu. Centimetres	=	1.	Millimetre
			.061	Cu. In.
Measures Of Capacity				
1.	Litre = 1 Cu. Decimetre	=	61.023	Cu. Ins.
			.0353	Cu. Ft.
			.2202	Gal. (Imperial)
			2.202	Lbs. Of Water At 62° Fahr.
28.317	Litres	=	1.	Cu. Ft. (6.25 Imperial Gals.)
4.543	Litres	=	1.	Gal. (Imperial)
3.785	Litres	=	1.	Gal. (American)
Measures Of Weight				
28.35	Grammes	=	1.	Oz. Avoirdupois
1.	Kilogramme	=	2.2046	Lbs.
.4536	Kilogramme	=	1.	Lb.
1.	Metric Ton	=	.9842	Ton Of 2240 Lbs.
1000.	Kilogrammes		19.68	Cwts. Or 2204.6 "
1.016	Metric Tons	=	1.	Ton Of 2240 Lbs.
1016.	Kilogrammes			
Miscellaneous				
1.	Gramme Per Sq. Millimetre	=	1.442	Lbs. Per Sq. In.
1.	Kilogramme Per Sq. "	=	1422.32	Lbs. Per Sq. In.
1.	Kilogramme Per Sq. Centimetre	=	14.223	Lbs. Per Sq. In.
1.0335	Kg. Per Sq. Centimetre 1 Atmosphere	=	14.7	Lbs. Per Sq. In.
0.070308	Kilogramme Per Sq. Centimetre	=	1.	Lb. Per Sq. In.

Cleaning Steam Boilers.

After A Steam Or Vapor Boiler Has Been In Operation For A Short Time, Grease, Oil, Scale, Core Sand And Other Foreign Matter Will Accumulate In The Boiler, Causing Water To Leave The Boiler In Suspension With The Steam. This Will Invite Various Kinds Of Trouble Which Can Only Be Eliminated By Thorough Cleaning.

The Following Method Of Cleaning A Steam Boiler Has Been Successfully Used And Is Recommended By Many Boiler Manufacturers.

1st.–Close All Radiator Supply Valves And Remove The Thermostatic Member Of All Return Line Valves, Or If Boiler Is Valved Close Both Supply And Return. Blow Down The Boiler Thru Bottom Blow-Off Under A Pressure Of At Least 5 Pounds.

2nd.–Remove The Safety Valve And Put Acid Vinegar (Acetic Acid) In The Boiler As Follows:-

Boilers Up To	1000#	Capacity	– 3	Gallons.
" "	2000#	"	4	"
" "	4000#	"	5	"
" "	6000#	"	7	"

Replace The Safety Valve, Refill Boiler With Water To Proper Level And Operate The Entire Plant For At Least 30 Hours.

3rd–Again Remove The Safety Valve, And Connect A Pipe With Gate Valve To The Outside Or Convenient Drain. This Pipe To Be Not Less Than Size Of Safety Valve. With Water In Boiler At Proper Level And Valve In Top Blow-Off Pipe Closed Build A Very Hot Coal Fire Creating A Pressure Of 5 To 10 Lbs.–Open Top Blow-Off Valve And Let Water And Steam Pass Thru The Blow-Off Line To Drain–Keep Up A Pressure Between 5 And 10 Lbs.–Supply Cold Water Constantly Into Bottom Of Boiler So As To Keep Gauge Glass Filled To Top–Keep This Up Without Interruption For 6 To 8 Hours. During The Last 2 Hours Fill Boiler Full Of Water Allowing The Hot Water To Flow Thru, And Out Of Top Blow-Off Pipe To Drain.

Cleaning Steam Boilers.

4th-Close The Cold Water Feed Valve And Let Steam And Water Flow Thru Top Blow-Off Line Until Water Level In Boiler Is At Top Of Gauge Glass-Close The Gate Valve In Top Blow-Off Line And With At Least 10 Lbs. Steam Pressure Open The Bottom Blow-Off Valve,-Draw The Fire Quickly And Entirely Drain The Boiler. Allow The Boiler To Cool - Replace Thermostatic Members In Return Line Valves - Replace Safety Valve-Close Bottom Blow-Off Valve And Fill Boiler With Fresh Water To Proper Level.

Sometimes One Blowing Off Will Not Give The Desired Results In Which Case The Operation Must Be Repeated Or Continued Until The Boiler Is Thorougly Free From All Foreign Matter.

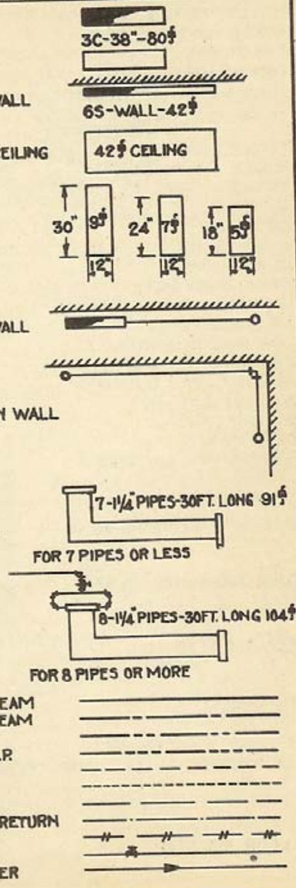
With Plants Using Vacuum & Boiler Feed Pump The Return To Pump Should Be Closed Off And All Condensation Passed To Drain For At Least A Week And Then The Boiler Should Be Cleaned As Above.

Water Hammer

Water Hammer In Steam Pipes Is Caused By Condensation In The Pipe Forming Waves And Allowing Pockets To Form Holding Steam — Similar To "A". The Air Around The Pipe Being Cooler Than The Steam Causes The Steam To Condense, Thereby Making A Vacuum Which Pulls The Water "B-B" Together With A Slap Or Bang. If The Pipe Is Large Enough To Permit The Steam To Travel At A Low Velocity It Will Not Pick Up The Water And Form Waves Like The Above Drawing, And Water Hammer Will Not Occur.

Heating Symbols

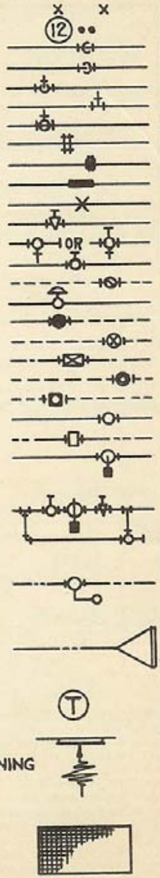
NEW RADIATOR
OLD RADIATOR
WALL RADIATOR ON WALL
WALL RADIATOR ON CEILING
WALL RADIATION APPROXIMATE SIZES
HARP PIPE COIL ON WALL
CORNER PIPE COIL ON WALL
HARP PIPE COIL ON CEILING
HARP PIPE COIL ON CEILING
LOW PRESSURE STEAM
HIGH PRESSURE STEAM
EXHAUST STEAM
OLD STEAM PIPE L.P.
DRY RETURN PIPE
OLD RETURN PIPE
DRY DRIP PIPE
WET DRIP OR WET RETURN
OLD DRIP PIPE
PLUGGED TEE
ECCENTRIC REDUCER



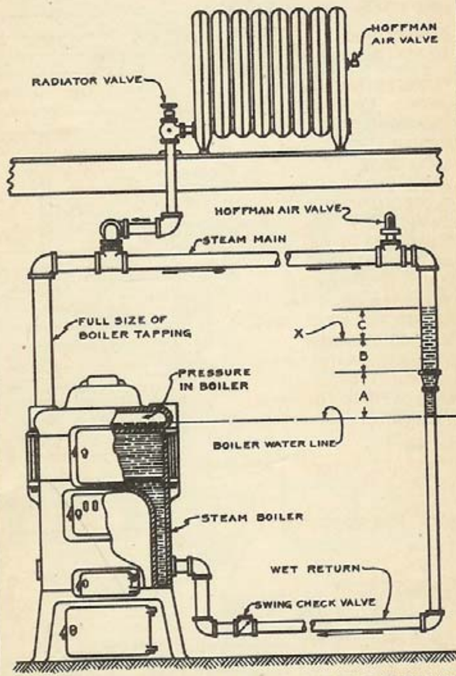
HEATING SYMBOLS

1ST FLOOR RADIATOR CONNECTION
RISER & NUMBER OF RISER
RISE IN MAIN
DROP IN MAIN
CONNECTIONS TO MAINS: FROM TOP; FROM SIDE; FROM BOTTOM
FLANGES (BOLTED)
UNIONS (SCREWED)
EXPANSION JOINT
ANCHOR
GATE VALVE
ANGLE VALVE
GLOBE VALVE
SWING CHECK VALVE
DIAPHRAGM VALVE
AIR LINE VALVE
LOW PRESSURE TRAP
HIGH PRESSURE TRAP
AIR VENT OR AIR ELIMINATOR
SUCTION STRAINER
STEAM SEPARATOR
OIL SEPARATOR
VACUUM PUMP GOVERNOR
PRESSURE REDUCING VALVE
BACK PRESSURE VALVE
EXHAUST HEAD
THERMOSTAT
HEAT OPENING

VENT OPENING
FLOOR REGISTER



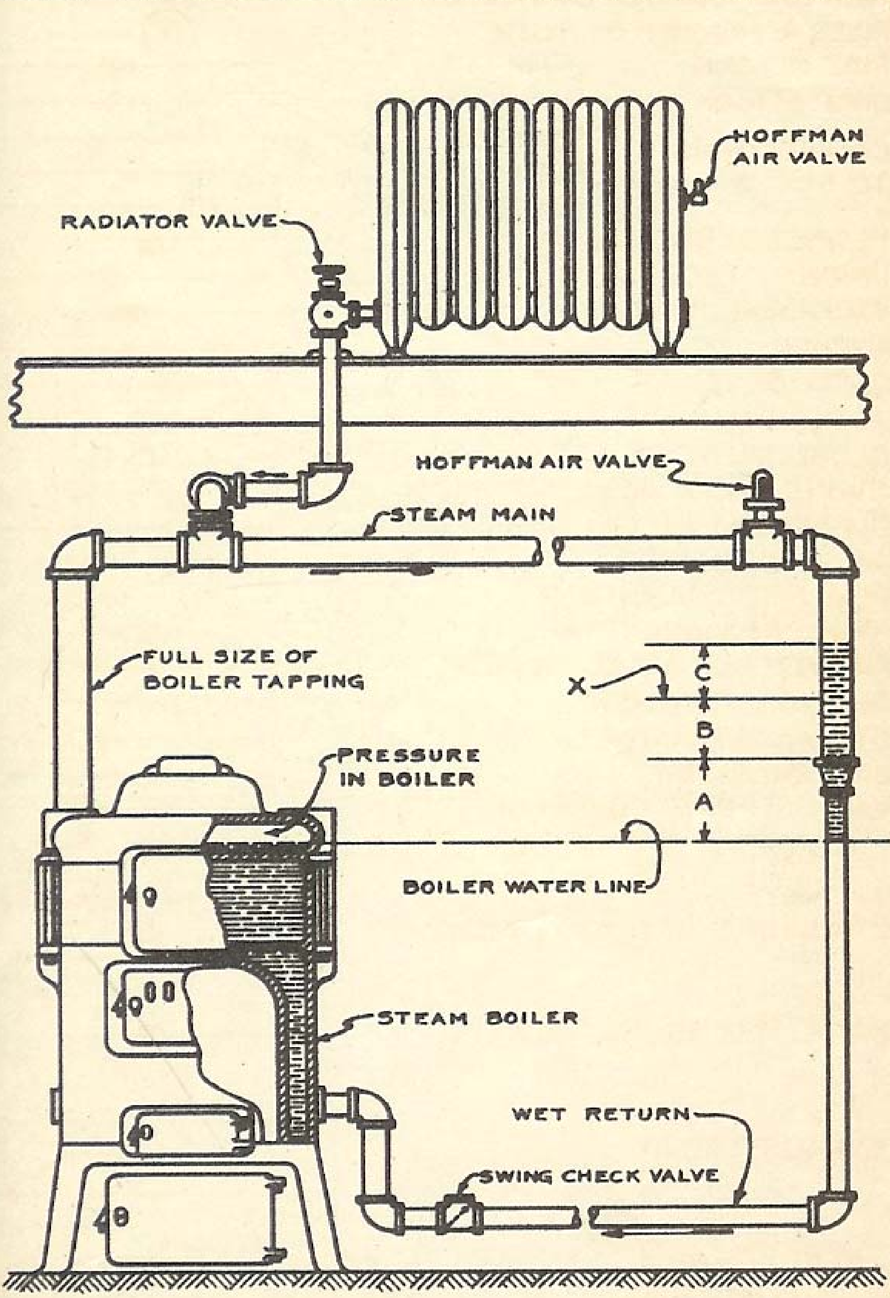
· WATER · LINE · CONDITION ·



ONE OF THE COMMON CAUSES OF TROUBLE AT ENDS OF STEAM MAINS AND DRY RETURNS IS INSUFFICIENT DISTANCE BETWEEN THE NORMAL WATER LINE OF THE BOILER AND THE END OF MAINS.

A = STATIC HEAD TO OVERCOME LOSS IN PRESSURE IN PIPING AND SYSTEM.
B = STATIC HEAD TO OPEN CHECK VALVE.
C = STATIC HEAD TO MAKE WATER FLOW BACK INTO BOILER.
X = POINT AT WHICH WATER IS IN BALANCE AND MORE STATIC HEAD IS REQUIRED TO FORCE THE WATER BACK TO BOILER.

· WATER · LINE · CONDITION ·



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X = POINT AT WHICH WATER IS IN BALANCE AND MORE STATIC HEAD IS REQUIRED TO FORCE THE WATER BACK TO BOILER.

CHIMNEY DATA

AN IDEAL TOP FOR CHIMNEY.
FIG. 1.

FIG. 2

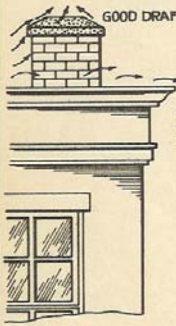


FIG. 3

FIG. 4

SHAPES OF FLUES

IDEAL

GOOD

FAIR

POOR

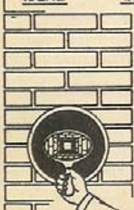
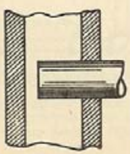


FIG. 9
EXAMINING FLUE WITH MIRROR.



SMOKE PIPE CUTTING OFF THE DRAFT.
FIG. 10

CHIMNEY SIZE FORMULA.

S = AREA FLUE IN SQ. FT.
A = AREA GRATE
H = HEIGHT IN FEET

CAST IRON HEATING BOILERS

$$S = .75 \times \frac{A}{\sqrt{H}}$$

$$H = \frac{(.75 \times A)^2}{S^2}$$

STEEL POWER BOILERS.

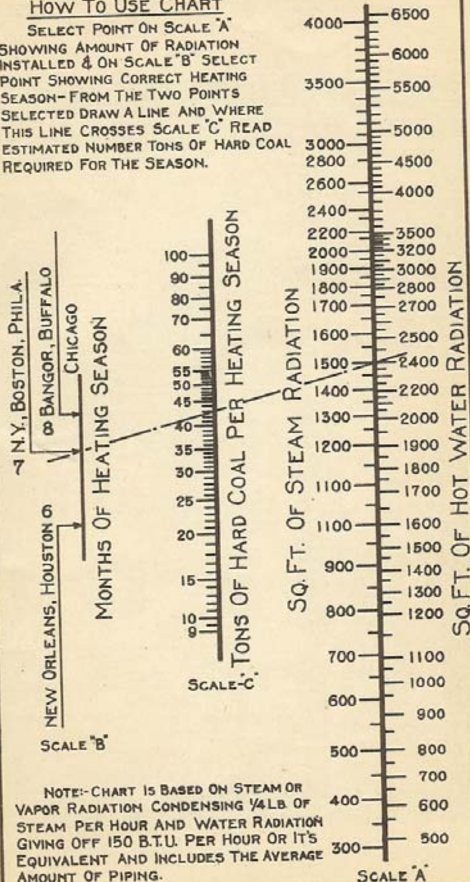
$$S = 1.25 \times \frac{A}{\sqrt{H}}$$

$$H = \frac{(1.25 \times A)^2}{S^2}$$

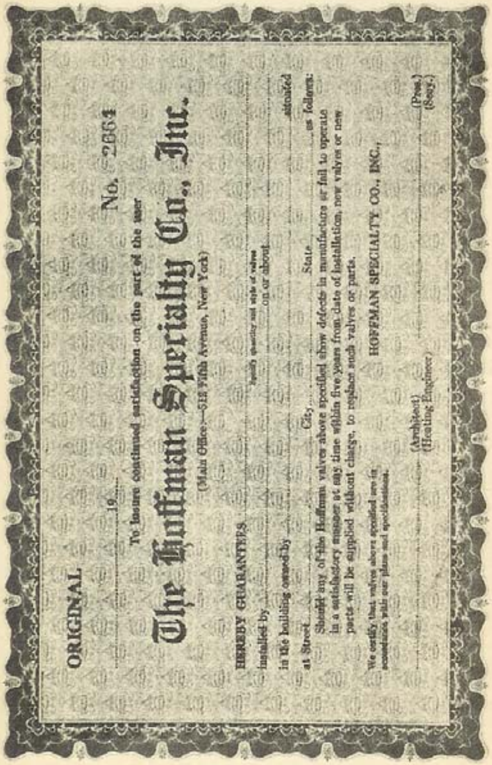
LOW PRESSURE HEATING – FUEL CHART

HOW TO USE CHART

SELECT POINT ON SCALE "A" SHOWING AMOUNT OF RADIATION INSTALLED & ON SCALE "B" SELECT POINT SHOWING CORRECT HEATING SEASON – FROM THE TWO POINTS SELECTED DRAW A LINE AND WHERE THIS LINE CROSSES SCALE "C" READ ESTIMATED NUMBER TONS OF HARD COAL REQUIRED FOR THE SEASON.



NOTE:– CHART IS BASED ON STEAM OR VAPOR RADIATION CONDENSING ¼ LB. OF STEAM PER HOUR AND WATER RADIATION GIVING OFF 150 B.T.U. PER HOUR OR IT'S EQUIVALENT AND INCLUDES THE AVERAGE AMOUNT OF PIPING.



ORIGINAL

................................19....   No. 2664

To insure continued satisfaction on the part of the user

The Hoffman Specialty Co., Inc.

(Main Office:—512 Fifth Avenue, New York)

HEREBY GUARANTEES ....
Specify quantity and style of valves

installed by .... on or about ....

in the building owned by .... situated

at Street .... City .... State .... as follows:

Should any of the Hoffman valves above specified show defects in manufacture or fail to operate in a satisfactory manner at any time within five years from date of installation, new valves or new parts will be supplied without charge, to replace such valves or parts.

We certify that valves above specified are in accordance with our plans and specifications.

HOFFMAN SPECIALTY CO., INC.,

.... (Architect) (Heating Engineer)

.... (Pres.) (Secy.)

SECTION V.

HOFFMAN PRODUCTS

SALES POLICY.

It has always been the policy of this Company to distribute its products through the recognized jobber of Heating and Plumbing Supplies. Under such a plan there is a wide distribution of HOFFMAN VALVES and a ready and convenient source of supply for heating contractors which would not be possible if we marketed our products direct to the trade.

HOFFMAN ADVERTISING.

Hoffman Valves, "More Heat from Less Coal" and Hoffman "Controlled Heat" are known to magazine readers throughout the country as the result of a national advertising campaign which has been carried on for the past five years. The trade has long recognized Hoffman merit and has used Hoffman products for their high-grade work.

House owners are now familiar with the satisfactory results obtained through the use of Hoffman Valves and request the heating contractor to install them. The contractor thus benefits from Hoffman advertising.

GUARANTEE.

The proper functioning of Hoffman Valves is guaranteed for five years. Architects mention this guarantee in their specifications. The protection afforded the architect, the heating contractor and the owner stimulates confidence in the merit of Hoffman Valves and their performance in actual service furnishes further proof of the Company's ability to supply the heating trade with specialties of the highest grade.

In making such an unqualified guarantee the Company is obliged to exercise utmost care in manufacture, test every individual Valve before shipment, and allow such a factor of safety that the user has every reason to expect that the life of the Valve will greatly exceed the period covered by the guarantee.

HOFFMAN SPECIALTY COMPANY,
Waterbury, Conn.

MORE HEAT FROM LESS COAL.

To secure for the user maximum heat and comfort from fuel burnt is—and should be—the aim of every architect, engineer and heating contractor. The amount consumed beyond that necessary to maintain indoor heating comfort is waste.

Heating Systems in general are wasteful due to improper combustion and to heat losses up the flue, in addition to waste within the system proper. Prevention of these latter losses is within the province of Hoffman Valves, as they eliminate nearly all the losses due to improper functioning of the system.

The correct handling of steam, air and water, through the use of Hoffman Valves, results in the economical and satisfactory performance of the system and the reduction of fuel waste and heating troubles.

The Hoffman Specialty Company trusts that the descriptive matter covering its various products appearing on the pages following will explain to the reader the operation of Hoffman Valves and the reasons they produce the results in economy and durability that are claimed for them.

It is impossible, within the limited space, to give descriptions in the fullest detail. Catalogues on each individual item are available for distribution to anyone desiring further information, and will be gladly furnished on request.

VENTING AND THERMOSTATIC VALVES.

Hoffman Valves are automatic, non-adjustable and guaranteed to properly function for a period of five years. They are made entirely of metal and each part of a special alloy best adapted for its particular purpose.

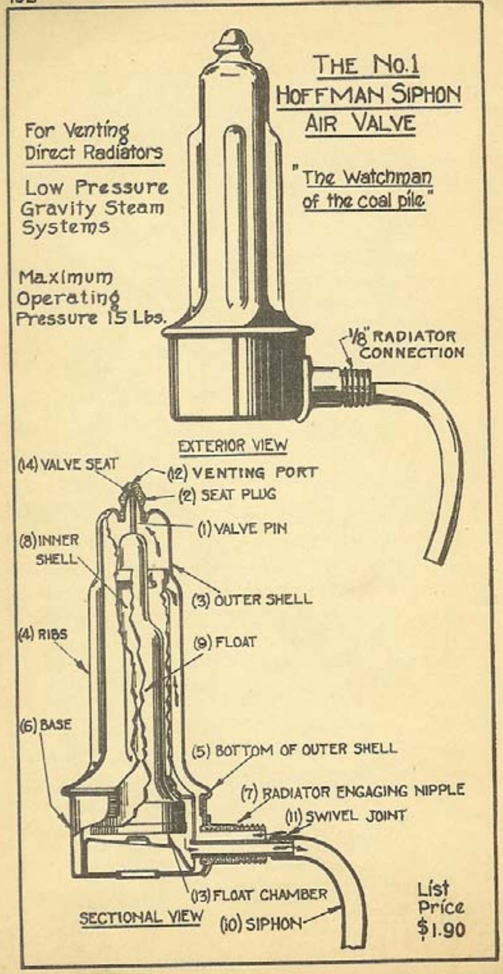
The basic principle used in the design of all of these Valves is that of an all-metal thermostatic member, with one or more flexible diaphragms, containing a volatile or heat sensitive fluid which causes valve action upon slight temperature changes.

They have a wide range in which they operate with the same degree of accuracy, for the internal fluid pressure in the thermostatic member maintains a constant relationship with the external steam pressure throughout the whole range for which each Valve is intended.

The well-informed architect, engineer and heating contractor will acknowledge that heat service obtainable from a steam heating apparatus is largely dependent upon the operation of valves of this kind.

They are so designed and constructed that, without thought or attention of the user, they automatically insure flexibility and economy of operation.

The trade recognizes from their service record that there are no other valves which positively and consistently produce such satisfactory results. The fact that over four million have been used during the past ten years, and that less than one-tenth of one per cent. have been returned for any cause whatsoever, has been evidence to the most skeptical that they have a virtue distinctly their own.



THE NO. 1 HOFFMAN SIPHON AIR VALVE.

"The Watchman of the Coal Pile."

Construction Features.

The principle of separate channels for air and water is basic for the successful operation of an air valve. This principle applied to air valves is *patented* and may be used only in the Hoffman Valve.

The Valve consists of an Outer Shell and Base, an Inner Shell, a Float, Valve Pin, Vent Port and Siphon.

The Float, which is likewise the thermostatic member, is a sealed chamber, containing a *heat sensitive* fluid and has a flexible diaphragm bottom. There is always a wide open venting port through which air escapes until steam comes in contact with the float, when its action is so positive that the expanding diaphragm instantly closes the venting port. There is *no* premature closing with the resultant loss in radiator heat efficiency.

The sensitiveness of this Valve in distinguishing between steam and heated air assures maximum heat with minimum fuel consumption. Its action under water conditions is equally positive and prevents any possibility of water leaking or spitting.

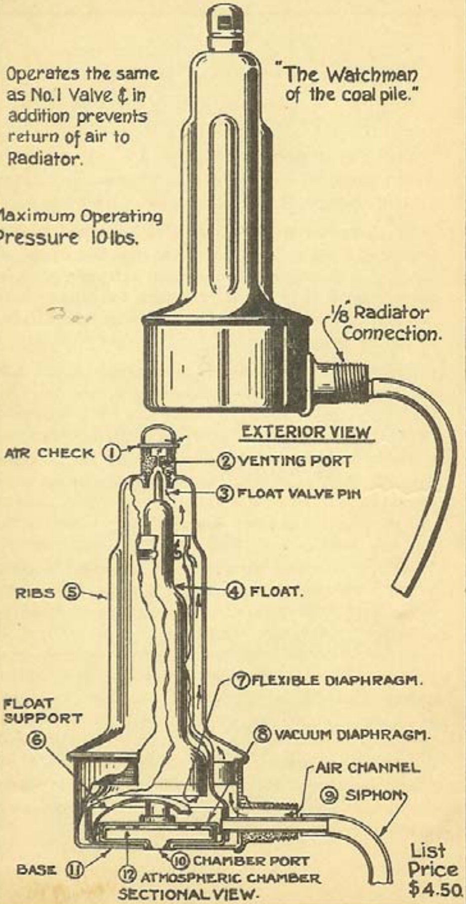
In all its operations the No. 1 Hoffman Valve is the *perfect* venting valve.

THE No 2 HOFFMAN SIPHON AIR & VACUUM VALVE

Operates the same as No. 1 Valve & in addition prevents return of air to Radiator.

"The Watchman of the coal pile."

Maximum Operating Pressure 10 lbs.



SECTIONAL VIEW.

List Price $4.50

THE NO. 2 HOFFMAN SIPHON AIR AND VACUUM VALVE

The No. 2 Hoffman Siphon Air and Vacuum Valve installed on an ordinary one-pipe steam system changes it into a one-pipe Vacuum type.

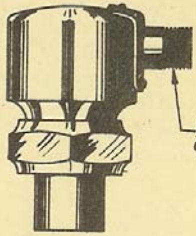
In operation the No. 2 Valve functions under steam and water conditions exactly the same as the No. 1 Valve, but, in addition, after air is once vented from the system, through the instantaneous and automatic closing of this port, **the intake of air is prevented.**

Normaly venting port (2) through which air escapes is wide open until steam comes in contact with the float (4). Then the heat sensitive fluid in the float, the thermostatic member, is changed to gaseous state expanding the flexible diaphragm (7), raising the float and closing vent port. If the radiator is shut off or for any reason steam contact ceases, the diaphragm contracts, and the float drops. But no air can re-enter the valve because the air check (1) makes the port a one-way street—air can go out but none can come back. So with the continuation of condensation of steam and prevention of air return, a vacuum is formed in the system. Atmospheric pressure exerted through chamber port (10) causes diaphragm (8) to lift the float (4) and keep port closed. In other words, the air check prevents return of air for a short period until the vacuum formed in the valve permits atmospheric pressure, acting in chamber (12) to force diaphragm (8) upward, raising the float and doubly closing the vent port.

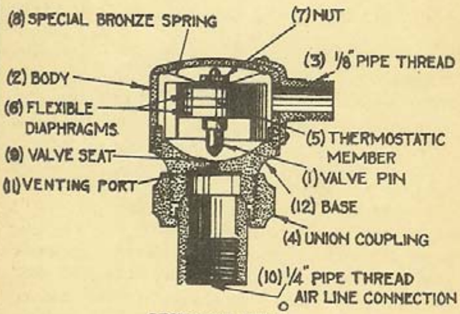
THE No. 3 HOFFMAN AIR LINE VALVE

FOR USE IN AIR LINE SYSTEMS

Maximum Operating Pressure 10 Lbs.



EXTERIOR VIEW



SECTIONAL VIEW

List Price $2.50

THE NO. 3 HOFFMAN AIR LINE VALVE.

For use in venting radiators in heating systems where the outlet of the Valve is piped to some central point, and vented to atmosphere or connected to suction line of an Air Line Vacuum Pump.

Also for venting blast heaters, "Vento" stacks, and drying drums in conjunction with vacuum systems, etc.

These Valves are permanently adjusted at the factory and are always open when the Valve is cold, for free passage of air, but as soon as steam reaches the Valve the volatile fluid in the sealed metal chamber (5) vaporizes, generating a sufficient pressure to distend the flexible diaphragms (6) on the top and bottom of the chamber (5), thus pushing the valve pin (1) to its seat (9) and closing the venting port (11) and preventing the passage of steam into the air line.

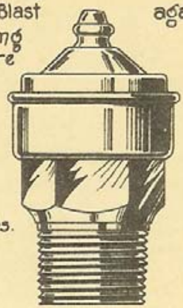
When the temperature at the Valve drops slightly below that of steam the volatile vapor in the sealed metal chamber condenses and the diaphragms (6) react, thus opening the Valve. As long as steam is against the Valve it remains closed, but the instant steam ceases it is wide open for the free passage of air. The port (11) is either wide open or closed.

Through its use a hot radiator and a cold-air line are assured. It is absolutely automatic and non-adjustable.

THE No. 4 HOFFMAN QUICK VENT AIR VALVE

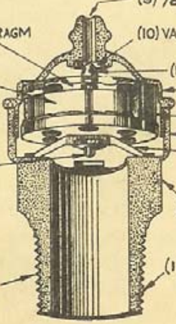
For Mains, Risers, Vento Stacks, Blast Coils, Etc., Using Low Pressure Steam

Does not close against water.



Maximum Operating Pressure 10 Lbs.

EXTERIOR VIEW



SECTIONAL VIEW

List Price $2.80

THE NO. 4 HOFFMAN QUICK VENT VALVE.

DOES NOT CLOSE AGAINST WATER.

For quick vent service *where water is not a factor.* Especially well adapted for use in venting:

The ends of steam mains.

The tops of risers.

Indirect radiators.

Blast or "Vento" stacks.

Low-pressure feed water heaters.

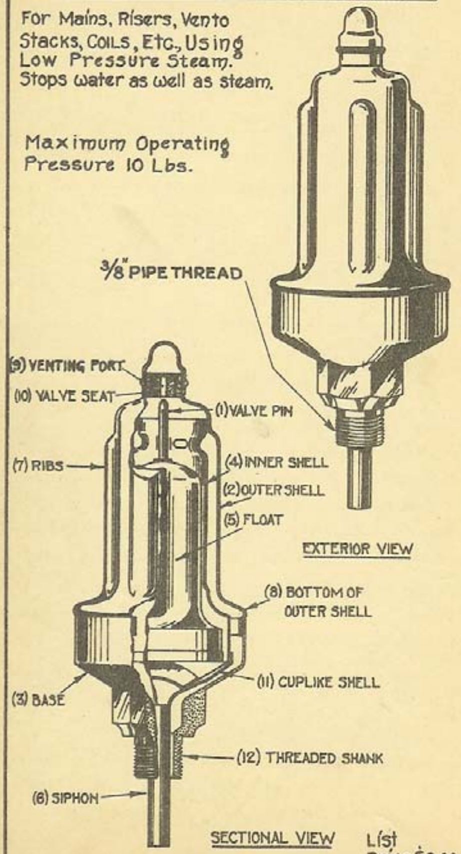
Low-pressure dryers and drums, etc.

The Valve is permanently adjusted at the factory and is always open, when the Valve is cold, for the free passage of air, but the instant steam reaches the Valve the volatile fluid in the sealed metal chamber vaporizes, generating a sufficient pressure to distend the flexible diaphragms (6) on the top and bottom of the chamber, thus pushing the valve pin to its seat and closing the valve port (9) against the passage of steam. A slight fall in temperature at the Valve causes the volatile fluid to condense, the flexible diaphragms (6) to react and the Valve to open.

THE No. 5 HOFFMAN QUICK VENT FLOAT AIR VALVE

For Mains, Risers, Vento Stacks, Coils, Etc., Using Low Pressure Steam. Stops water as well as steam.

Maximum Operating Pressure 10 Lbs.



List Price $8.00

THE NO. 5 HOFFMAN QUICK VENT FLOAT AIR VALVE.

For quick venting where water may be a factor. Especially well adapted for use in venting:

The ends of steam mains.

The ends of dry return mains.

Indirect radiators.

Blast or "Vento" stacks.

Hot-water generators.

Low-pressure feed water heaters.

Dryers and drums, etc

Installed on the end of return mains in one-pipe gravity systems, this Valve causes steam to first flow to the end of the main, then into the radiators at a uniform rate, so that radiators distant from the boiler will receive their supply of steam as quickly as those close to boiler.

The basic principle is the same as the No. 1 Valve, having separate channels for air and water which are only found in Hoffman Valves.

In its functioning it distinguishes between steam and heated air, and closes instantly when steam or water comes in contact with the float.

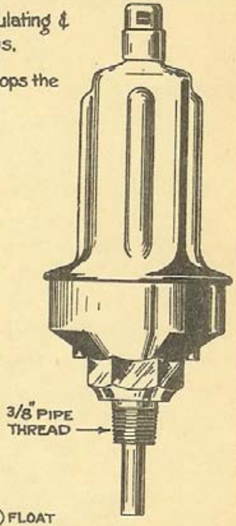
Valve is furnished with 3/16" port for pressures below 3 lbs.; 1/16" port for 3 lbs. or over.

THE No.6 HOFFMAN QUICK VENT FLOAT AIR & VACUUM VALVE.

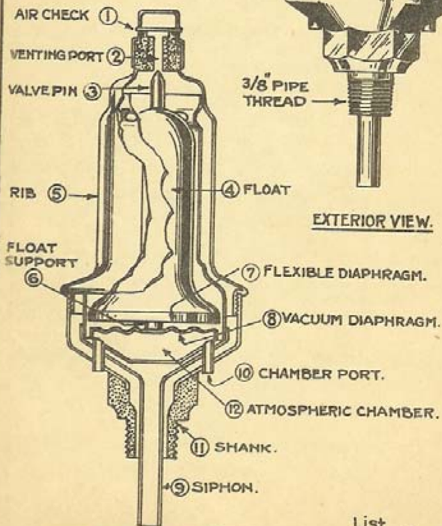
For Vapor. Vacuum, Modulating & Gravity Vacuum Systems.

Stops steam & water & stops the return of air.

Maximum Operating Pressure 10 lbs.



EXTERIOR VIEW.



SECTIONAL VIEW.

List Price $12.00.

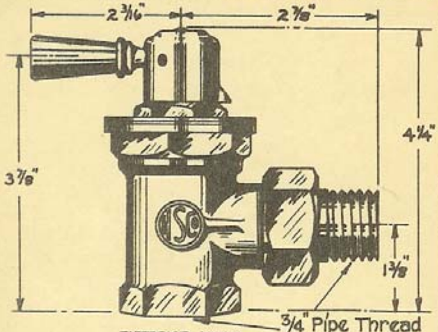
THE NO. 6 HOFFMAN QUICK VENT FLOAT AIR AND VACUUM VALVE.

This Valve is used for venting return mains of one-pipe gravity vacuum systems or wherever the return of air to the system should be prevented.

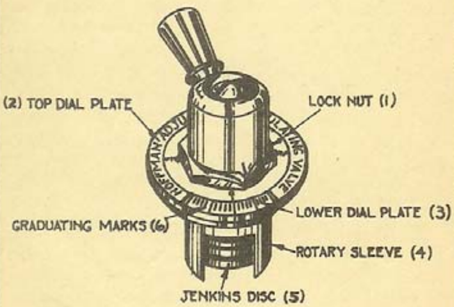
The No. 6 Hoffman Quick Vent Float Air and Vacuum Valve is similar in design to the No. 5 Valve with the addition of the diaphragm (2) in the base of the Valve which holds the venting port (5) closed when venting ceases and prevents intake of air through the port.

Valve is furnished with 3/16" venting port for pressures less than 3 lbs.; for 3 lbs. and over 1/16" port.

THE No. 7 HOFFMAN MODULATING VALVE



EXTERIOR VIEW



LIST PRICE

Lever Handle, Wood Wheel, Lock Shield or Closed Top Types	$6.00
Valve with Extension Stem and Handle, complete	10.00
Valve with Chain Wheel, complete	12.00
Extension Stem only	4.00
Chain Wheel Attachment only	6.00

THE NO. 7 HOFFMAN ADJUSTABLE MODULATING VALVE.

The chief feature of the No. 7 Hoffman Valve is the easy and accurate setting of the Valve port to fit radiators of various sizes.

The use of a valve of one size (¾" only) on radiators from 10 to 200 sq. ft. and the ability to visibly adjust the valve port for different radiator requirements makes a special appeal to the heating contractor.

On the valve bonnet there are two dial plates, the lower rigidly fixed to the bonnet and marked with 20 graduations, each of which represents a port area equivalent to 10 sq. ft. of radiation.

To adjust the Valve for the radiator requirements it is only necessary to loosen the lock nut and turn the valve handle, which likewise turns the top dial plate and rotary sleeve. This varies the port area in accordance with dial graduations. Thus with 20 graduations visible the port area is sufficient for a 200 sq. ft. radiator, with 15 graduations for 150 sq. ft., etc.

By means of the precise port adjustment coupled with sensitive damper regulation, the user may accurately control the amount of steam admitted to the radiator and so modulate or control the amount of heat given off by each radiator.

There is no valve of its type on the market that possesses these exclusive Hoffman features.

The No. 7 Valve is regularly supplied with lever handle. It can, however, be supplied with wood wheel, lock shield, closed top, extended stem, or chain operated.

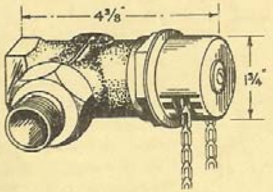
Nº 7 Hoffman Modulating Valve.

WOOD WHEEL HANDLE TYPE

FIG. Nº1

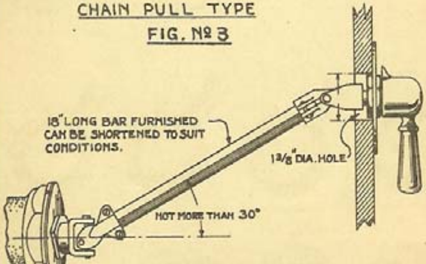
LOCKSHIELD TYPE

FIG. Nº 2



CHAIN PULL TYPE

FIG. Nº 3

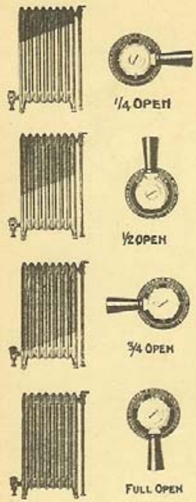


ADJUSTABLE EXTENSION HANDLE.

FIG. Nº 4

THE Nº 7 HOFFMAN MODULATING VALVE IS MADE IN 3/4" SIZE ONLY HAVING A RANGE UP TO 200 SQ.FT. OF DIRECT RADIATION.

Adjustment of No.7 Hoffman Valve



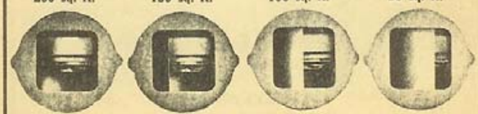
VALVES ARE SHIPPED WITH PORTS AT MAXIMUM OPENING

AFTER SYSTEM HAS BEEN THOROUGHLY CLEANED ADJUST EACH VALVE FOR IT'S PARTICULAR RADIATOR.

TO ADJUST VALVE LOOSEN LOCKNUT ABOVE TOP DIAL PLATE TURN VALVE HANDLE TO LEFT UNTIL ONE MARK ON LOWER DIAL PLATE IS EXPOSED FOR EACH 10 SQ.FT. OF RADIATION, THEN HOLDING VALVE HANDLE TO PREVENT TURNING, TIGHTEN LOCKNUT.

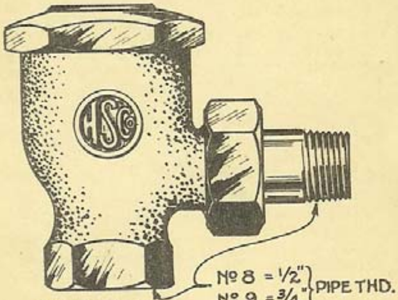
TO TEST ADJUSTMENT SET ALL VALVE HANDLES AT 1/2 OPEN AND RAISE STEAM TO PRESSURE AT WHICH SYSTEM IS TO OPERATE RADIATORS THAT HEAT HALF WAY ARE PROPERLY ADJUSTED. THE BALANCE OF THEM TO BE READJUSTED SO THAT THEY WILL ALSO HEAT HALF WAY.

All Marks exposed	15 Marks exposed	10 Marks exposed	5 Marks exposed
200 sq. ft.	150 sq. ft.	100 sq. ft.	50 sq. ft.

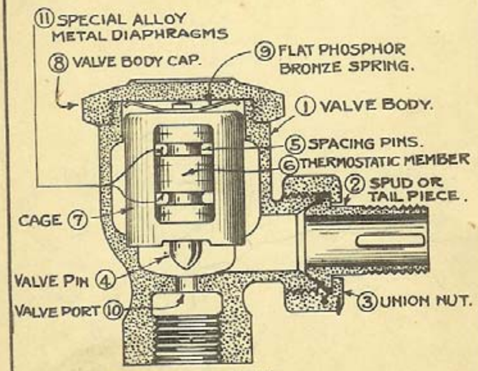


Nº 8 OR 9 HOFFMAN RETURN LINE VALVE

For Vapor, Vapor-Vacuum, Modulating and Vacuum Systems.



EXTERIOR VIEW



SECTIONAL VIEW

For roughing in dimensions See page Nº 145.

LIST PRICE Nº 8 = $ 6.00, Nº 9 = 8.00

THE NOS. 8 AND 9 HOFFMAN RETURN LINE VALVES.

These Valves are automatic, non-adjustable, thermostatic and relieve all air and condensation without the loss of steam from radiators, pipe côils, indirect radiation, steam mains and risers, steam kettles, sterilizers and other devices where it is desired to get full efficiency and economy without waste of steam.

In service, they have established a reputation for efficiency and consistency of operation with the same degree of sensitiveness under either high or low pressure.

The body of the Valve is made of cast steam metal; cap and tail piece are hot brass forgings; the thermostat of a special Hoffman alloy. In continued operation the thermostats will not break, stretch or lose their tension, giving long life and perfect operation.

CHIEF FEATURES.

The Valve consistently operates under a pressure range from 13" of vacuum to 50 lbs. steam pressure. Water at a temperature of approximately 12° less than the temperature corresponding to the steam pressure causes full valve opening and free discharge of condensation.

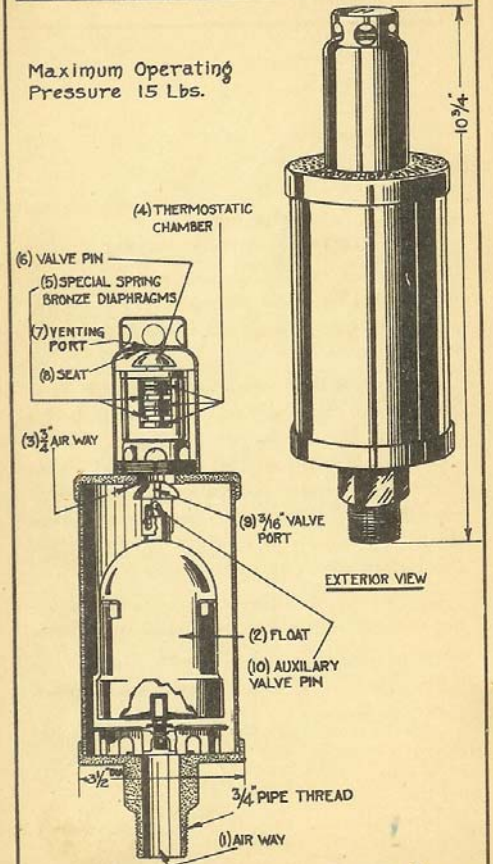
The thermostatic member is removable anu may be changed from one Valve to another of the same size without adjustment. This feature is appreciated by engineers who require the removal of the thermostat from the Valves until the system is thoroughly cleaned, and likewise by contractors complying with this practice.

The No. 8 Valve has ½" pipe connections, ¼" port and is furnished in Angle, Straightway, Right and Left-hand Offset Patterns. The normal capacity is 200 sq. ft. of cast iron radiation.

The No. 9 Valve with ¾" connection is made in Angle Pattern only. and is suitable for 600 sq. ft. of cast iron radiation. For pressures up to 15 lbs. Valve has ⅜" port, for higher pressures 3/16" port.

THE No.10 HOFFMAN VAPOR VALVE

Maximum Operating Pressure 15 Lbs.



List Price $25.00

THE NO. 10 HOFFMAN VAPOR VALVE.

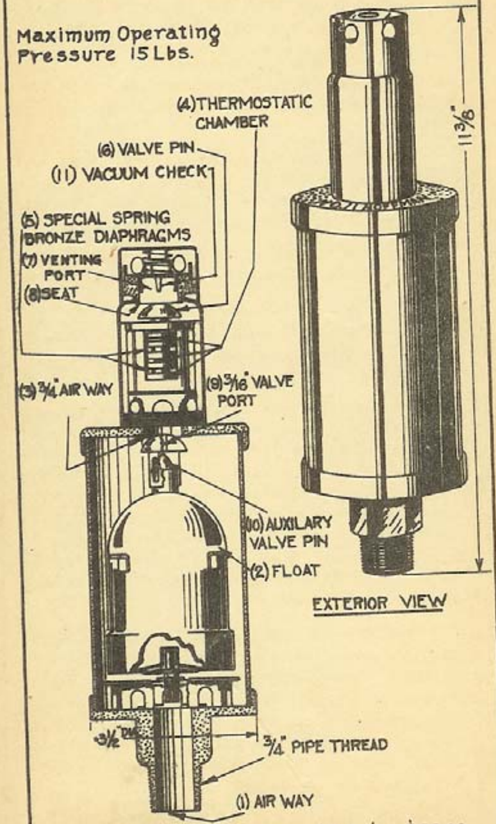
It is used for venting the return mains in vapor systems or for other conditions where a large venting capacity is required. The vent port is ¾" in diameter.

For preventing the escape of water the Valve has a large buoyant float which has a double valve, one disc controlling a ¾" port and the other an auxiliary port 3/16" diameter. When water recedes from the Valve and pressure is maintained the 3/16" port is first opened and as the air pressure is relieved, the ¾" port opens and full venting area is obtained.

The thermostat is located above the float chamber and controls the vent port upon contact with steam.

The Valve is of rugged construction, nickel-plated all over.

THE No.11 HOFFMAN VAPOR VACUUM VALVE



SECTIONAL VIEW

List Price $28.00

THE NO. 11 HOFFMAN VAPOR VACUUM VALVE.

Its construction is similar to the No. 10, but with the addition of a vacuum check which prevents the return of air to the system through the vent port.

When cold the vent port is always closed. As soon as a pressure of approximately 1½ ozs. is exerted the vacuum check is lifted from its seat allowing air to vent freely.

When pressure drops, valve check reseats, vent port closes and prevents intake of air.

This Valve is designed especially for HOFFMAN CONTROLLED HEAT, but can be used on any vapor vacuum system equipped with thermostatic return line valves.

When the fire is banked and generation of steam slows down or ceases entirely, condensation of steam continues in the radiators, but by preventing the return of air to the system, a vacuum forms and with increase in vacuum a corresponding decrease in the vaporizing temperature of the water takes place. Thus approximately with a 5″ vacuum, vapor will be given off at a temperature of 201° F., with a 10″ vacuum at 190° F. and with 15″ vacuum at 176° F.

It will therefore be seen that through the use of a No. 11 Valve vapor will be delivered to the radiators for a longer period when the fire is banked or dampers closed than in a vapor system and also when the fire is brightened the response at the radiators will take place sooner because of the lower vaporizing point of the water under vacuum conditions.

The No. 11 Valve has ¾″ vent port.

No. 12 Hoffman Blast Trap

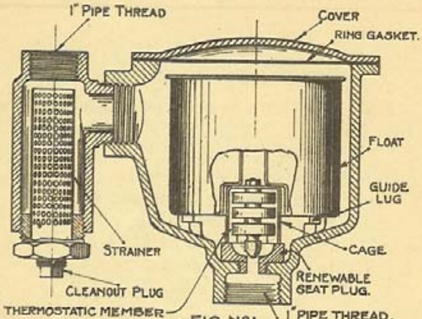


FIG. No. 1.

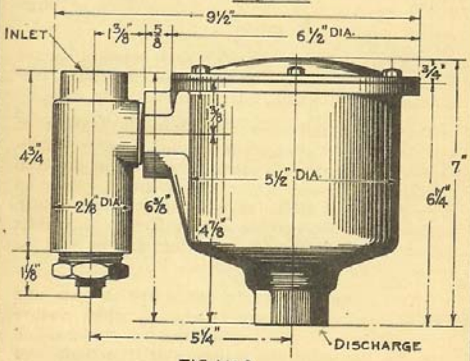


FIG. No. 2

TABLE OF NOMINAL CAPACITIES.

STEAM PRES. IN LBS. PER SQ. IN.	½	1	2	3	4	5
CAPACITY, LBS WATER PER HR.	800	1000	1500	1800	2000	2500
CAPACITY IN SQ. FT. OF DIRECT RADIATION-¼ LB. CONDENSATION PER SQ. FT. PER HOUR.	3200	4000	6000	7200	8000	10000.
	MAXIMUM OPERATING PRES. 30 LBS.					

Capacities for over 5 lb. pressure furnished on application.

WITH STRAINER, LIST PRICE $30.00 INLET CONNECTION 1" OUTLET 1"	WITHOUT STRAINER, LIST PRICE $25.00 INLET CONNECTION 1¼" OUTLET 1"

THE NO. 12 HOFFMAN BLAST TRAP.

Especially well adapted for draining condensation from:

- Indirect Radiators
- Blast or "Vento" Stacks
- Ends of Steam Mains and Risers
- Dryers and Drums
- Hot-Water Generators
- Laundry Machinery
- Unit Heaters, etc.

Where the operating pressure is not in excess of 30 pounds this valve will take care of large amounts of condensation.

In functioning it distinguishes between steam, heated air and water of condensation, giving free discharge of air and condensation.

This Trap embodies the desirable feature of open bucket or float traps in that it relieves condensation immediately upon its arrival at the trap regardless of the water temperature. Coupled with the float is a thermostatic member which positively overcomes the chief difficulty with float traps by automatically relieving air as well as condensation from the system.

The normal position of the valve is open and this is held until steam reaches it when closure takes place. If small quantities of condensation flow to the trap the thermostat functions and relieves the water, but if large amounts of condensation, beyond the capacity of the thermostat reach the trap, the float lifts the thermostat from its seat and maximum capacity is obtained.

As a part of the trap, a strainer is supplied, having a heavy brass screen. Trap is made of Cast Iron; float of drawn brass, seat of bronze, and thermostat of special Hoffman alloy.

HOFFMAN DIFFERENTIAL LOOP.

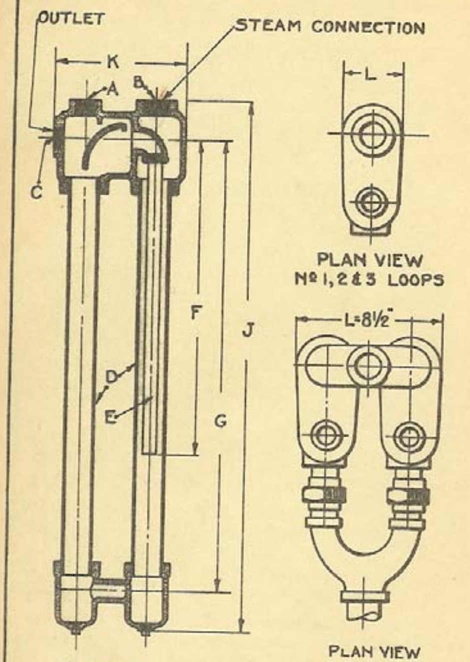


FIG. Nº 1

TABLE Nº

DIMENSIONS & CAPACITIES OF LOOPS

LOOP NO.	A	B	C	D	E	F	G	J	K	L	CAPACITY SQ. FT. RAD.
1	¾"	1¼"	1¼"	1½"	½"	18¼"	26"	30⅝"	7⅝"	3"	2000
2	¾	1¼	1¼	1½	¾	18¼	26	30⅝	7⅝	3	3500
3	¾	1½	1½	2	1	25	32	37¾	10	3¾	7500
4	¾	2	2	2	1	25	32	37¾	10	8½	15000

THE HOFFMAN DIFFERENTIAL LOOP.

The Hoffman Differential Loop is a device designed especially for HOFFMAN CONTROLLED HEAT, and is usually installed at the boiler.

Connections are made as follows:

A –to Hoffman Venting Valve.
B—to boiler, steam main or header.
*C—to high end of dry return main.
*Important: At least 24" above water line.

It maintains a constant pressure differential between the steam main and the return line. In other words, there is always sufficiently greater pressure at the inlet end of each radiator than there is at the outlet end, so that steam instantly enters the radiator whenever the Modulating Valve is opened.

It also safeguards the boiler by insuring a steady water line and absolutely eliminates the possibility of a burned out or damaged boiler, which often happens when the water is forced out by too high steam pressure.

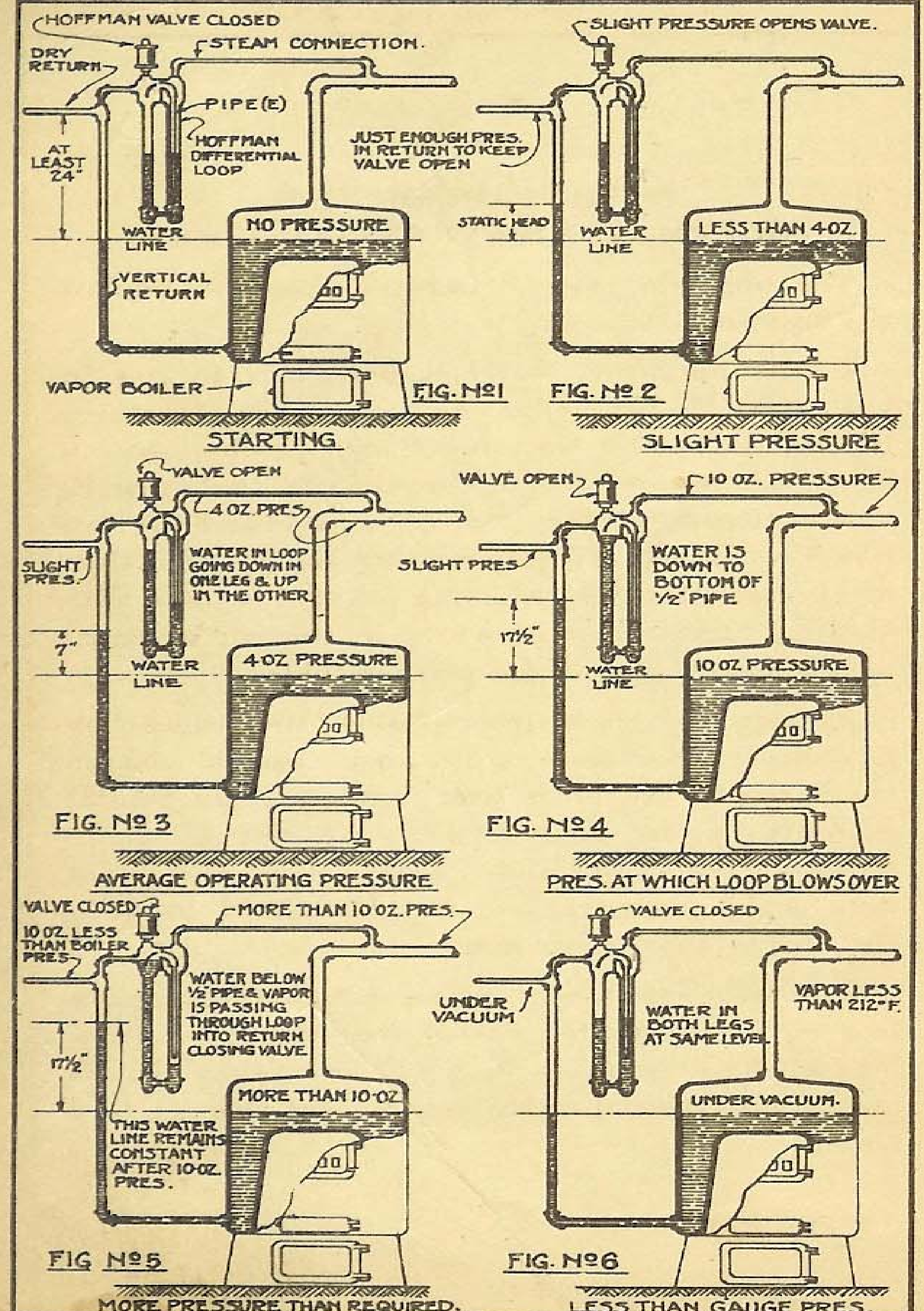
Differential loops are made in four sizes, having a capacity up to 15,000 sq. ft. of radiation. For larger systems the No. 4 Loops can be installed in a battery or the return mains divided so as to have their load come within the capacity of standard loops.

No. 1 and No. 2 Loops should not be used where the low point in the dry return is less than 24" above boiler water line; with the No. 3 and No. 4 Loops this distance must be at least 30".

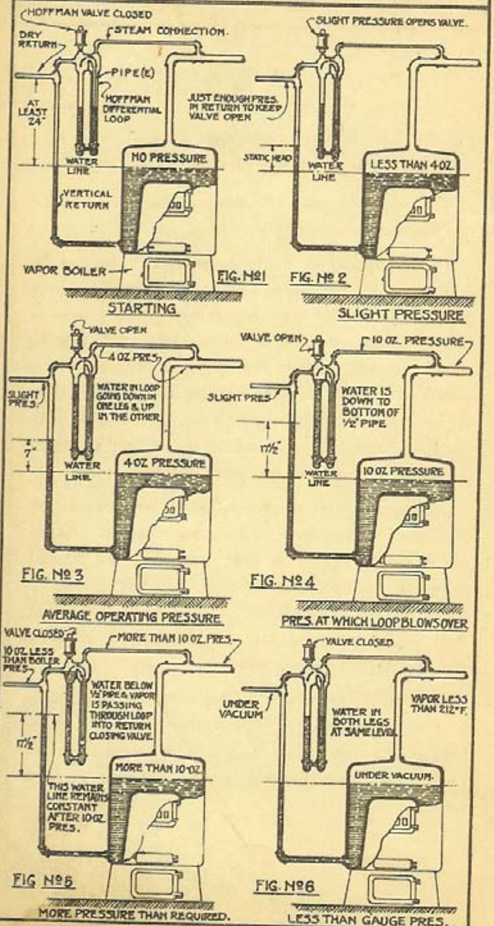
List Price.

No. 1..........$50.00 No. 3.........$100.00
No. 2.......... 75.00 No. 4......... 225.00

OPERATION OF HOFFMAN DIFFERENTIAL LOOP.



OPERATION OF HOFFMAN DIFFERENTIAL LOOP



OPERATION OF THE HOFFMAN DIFFERENTIAL LOOP.

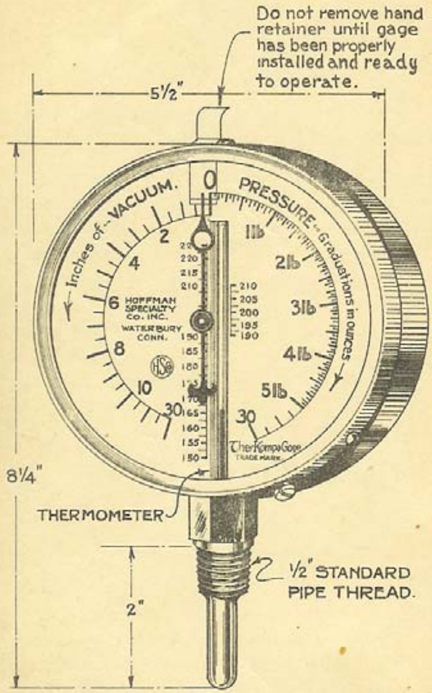
The opposite page illustrates the operation of the Differential Loop.

By its operation water is permitted to rise in the vertical return mains to a predetermined height, when the loop functions, blowing over a small quantity of steam through internal tube E, which closes venting port of the Hoffman Valve installed on the loop for venting the system, then compresses the air, building up a pressure preventing further rise of water in the vertical part of the return above the predetermined height.

As soon as this is accomplished, and the action is almost instantaneous, the loop reseals, and no more steam is blown over until the differential pressure is not maintained. By the alternate blowing over and resealing of the loop, a constant differential pressure will be maintained between the steam and return mains.

By the maintenance of this differential, regardless of how high the boiler pressure goes, circulation will take place in a radiator when turned on, with the return main vent closed through loop action.

HOFFMAN THER-KOMPO GAGE.



Connect gage directly into steam chamber
do not use siphon, pigtail, or seal.

See drawing page 131. For connections.

HOFFMAN THER-KOMPO GAGE

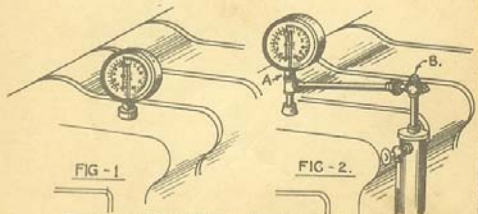
The Hoffman Ther-Kompo Gage was designed for the purpose of indicating the great efficiency of Hoffman "Controlled Heat" and one pipe, low pressure, gravity steam heating systems, which have been "vacuumized" by the use of Hoffman No. 2 Valves on the radiators and No. 6 Valves on the mains.

Systems operated under vacuum for long periods indicate maximum economy, but frequently the fact is overlooked that the system is being supplied with vapor at temperatures below 212 degrees.

The Ther-Kompo Gage not only registers the pressure or vacuum, but also indicates the steam or vapor temperature variations to correspond with changes in pressure or vacuum.

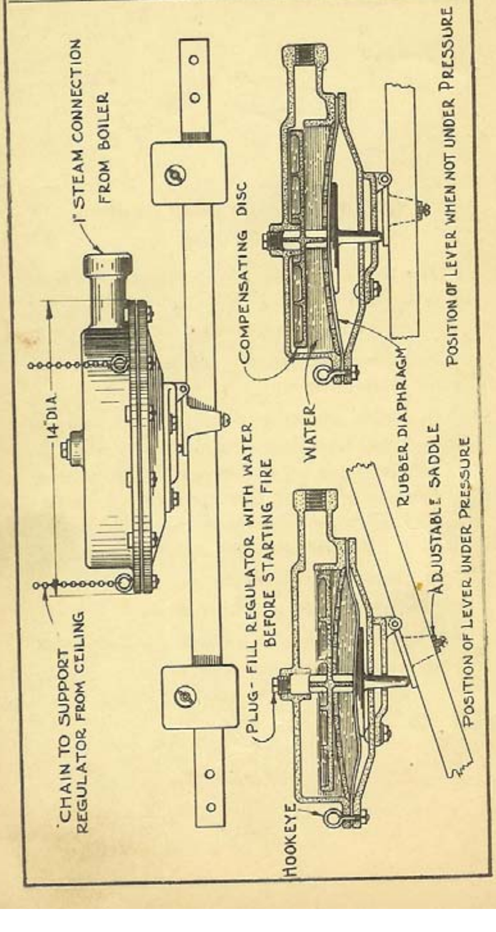
The Ther-Kompo Gage shows pressure up to 30 lbs. registered in ounces up to 5 lbs., vacuum to 30 in., shown in ½ in. up to 10 in., while the temperature range is from 150 to 225 degrees shown on the scale with ample tube length to permit the thermometer to withstand a temperature of 274 degrees (corresponding to 30 lbs. pressure) without breakage.

To prevent movement of the gage hand while in transit, a guard or holder is inserted between the case and cover, so that the handle will be held stationary. After installing the gage on the boiler, the guard should be removed.



TYPICAL CONNECTIONS TO BOILER.
CONNECTIONS MAY BE MADE AT A OR B AS CONDITIONS REQUIRE.

HOFFMAN DAMPER REGULATOR



THE HOFFMAN VAPOR DAMPER REGULATOR

The Damper Regulator is automatic in operation and after it has once been set at the correct pressure requires no attention.

It controls the dampers and maintains a constant boiler pressure.

Extremely sensitive in its action, it responds immediately when any radiator-valve is turned on or off, retarding or accelerating the fire to meet the change and so not only assures heat, but conversely conserves fuel when there is little or no demand for steam from the radiators.

The Fulcrum Adjustment makes it applicable for use from ounces to pounds pressure.

It will fit any type boiler, and is equipped with lever, weights, chain and pulleys.

HOFFMAN "CONTROLLED HEAT EQUIPMENT.

The following specialties in various combinations are used in "Controlled Heat" installations:

No. 7 Adjustable Modulating Valve for controlling amount of steam admitted to the radiators.

Nos. 8 and 9 Return Line Valves for controlling the return side of the radiator.

No. 10 Vapor Valve for relieving air from return mains in Vapor Systems.

No. 11 Vapor Vacuum Valve for venting air from return mains in Vapor Vacuum Systems and preventing return of air through vent port.

No. 12 Blast Trap for handling large quantities of water in Blast Coil Work, draining long steam mains into dry returns and dripping large risers.

Differential Loop for controlling and maintaining a steady boiler water line in Vapor or Vapor Vacuum Systems.

Damper Regulator for controlling boiler drafts and causing them to instantly respond to radiator demands.

Ther-Kompo Gage for accurately measuring pressure in ounces.

For the convenience of the engineer in specifying and the heating contractor in estimating, the specialties have been grouped into two distinct classifications, viz.: Radiator Specialties and Basement Specialties.

RADIATOR SPECIALTIES.

One ¾" Hoffman Adjustable Modulating Valve (capacity up to 200 sq ft. radiation).

One ½" Hoffman Return Line Valve (capacity up to 200 sq. ft. radiation).

List price per radiator, $12.00

BASEMENT SPECIALTIES.

Class "A" Basement Specialties.

For installations up to 2000 sq. ft. direct radiation consists of:

Two No. 8 Hoffman Return Line Valves, for venting steam mains.

One No. 1 Hoffman Differential Loop.

One No. 11 Hoffman Vapor Vacuum Valve.

One Hoffman Damper Regulator.

One Hoffman Ther-Kompo Gage.

List price $112.00

Class "B" Basement Specialties.

For installations of 2001 to 3500 sq. ft. direct radiation consists of:

Three No. 8 Hoffman Return Line Valves for venting steam mains.

One No. 2 Hoffman Differential Loop.

One No. 11 Hoffman Vapor Vacuum Valve.

One Hoffman Damper Regulator.

One Hoffman Ther-Kompo Gage.

List price $133.00

Class "C" Basement Specialties.

For installations of 3501 to 7500 sq. ft. direct radiation consists of:

Four No. 8 Hoffman Return Line Valves for venting steam mains.

One No. 3 Hoffman Differential Loop.

One No. 11 Hoffman Vapor Vacuum Valve.

One Hoffman Damper Regulator.

One Hoffman Ther-Kompo Gage.

List price $165.00

Class "D" Basement Specialties.

For installation of 7501 to 15,000 sq. ft. direct radiation consists of:

Six No. 8 Hoffman Return Line Valves for venting steam mains.

One No. 4 Hoffman Differential Loop.

Two No. 11 Hoffman Vapor Vacuum Valves.

One Hoffman Damper Regulator.

One Hoffman Ther-Kompo Gage.

List price $242.00

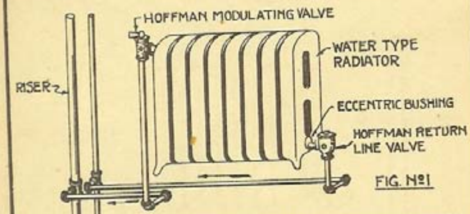
Extra Equipment.

Where 50 ft. risers or ends of 100 ft. steam mains are dripped through Return Line Valves, add $6.00 list for each No. 8, or $8.00 list for each No. 9 Valve. For longer risers or steam mains add $30.00 list for each No. 12 Valve.

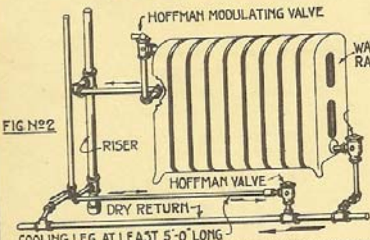
Where more than one boiler is used, add $37.00 per boiler for additional specialties required.

Special or larger installations than indicated above quoted on application.

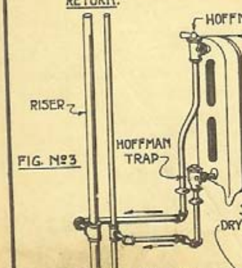
HOFFMAN "Controlled Heat"



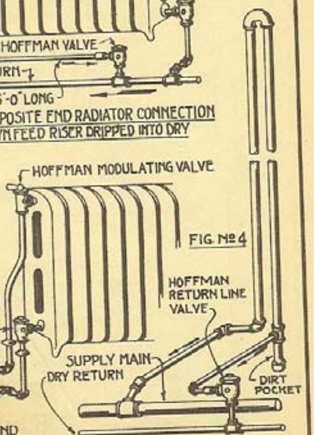
TOP & BOTTOM OPPOSITE END RADIATOR CONNECTION FROM UP OR DOWN FEED RISER.



TOP & BOTTOM OPPOSITE END RADIATOR CONNECTION WITH HEEL OF DOWN FEED RISER DRIPPED INTO DRY RETURN.

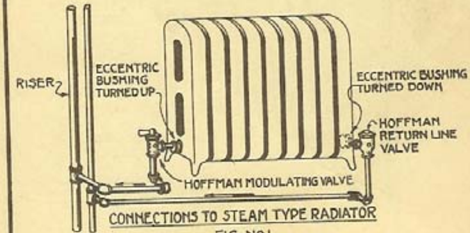


TOP & BOTTOM SAME END RADIATOR CONNECTION FROM UP OR DOWN FEED RISERS.



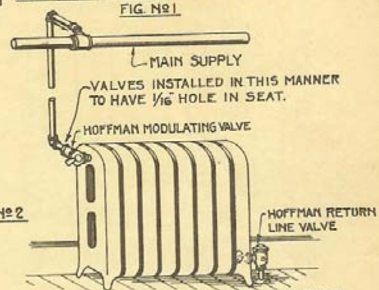
CONNECTIONS FOR HEATING RISER.

HOFFMAN "Controlled Heat"

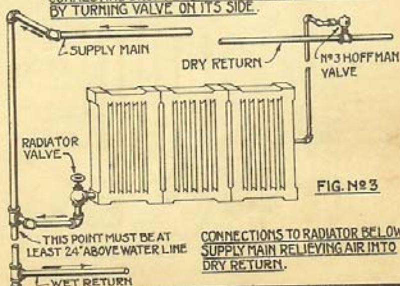


CONNECTIONS TO STEAM TYPE RADIATOR

FIG. No 1

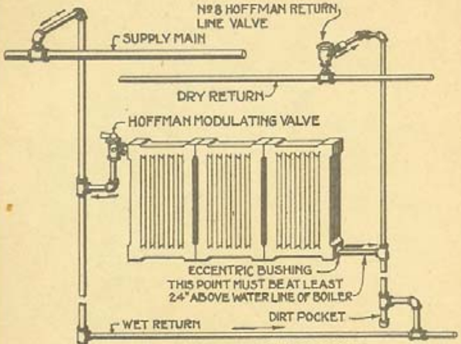


CONNECTING DROP FEED RISER DIRECT TO RADIATOR BY TURNING VALVE ON ITS SIDE.



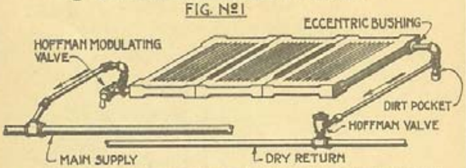
CONNECTIONS TO RADIATOR BELOW SUPPLY MAIN RELIEVING AIR INTO DRY RETURN.

HOFFMAN "Controlled Heat"



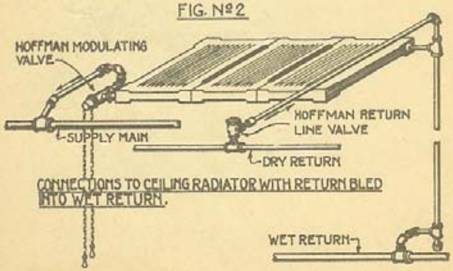
CONNECTIONS TO RADIATOR HUNG ON WALL.

FIG. Nº 1



CONNECTIONS TO CEILING RADIATOR ABOVE SUPPLY & RETURN MAINS.

FIG. Nº 2



CONNECTIONS TO CEILING RADIATOR WITH RETURN BLED INTO WET RETURN.

NOTE: GRADE PIPE DOWN IN DIRECTION OF ⟶

FIG. Nº 3

Nº 7 HOFFMAN MODULATING VALVE

CHAIN PULL TYPE

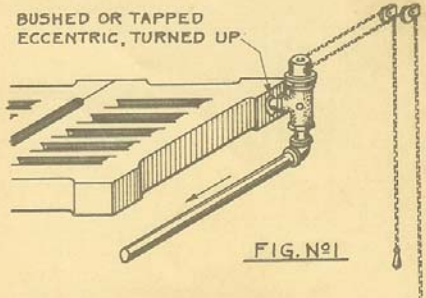


FIG. Nº 1

TYPICAL CONNECTION TO CEILING RADIATOR WITH CHAIN PULL ON SIDE WALL

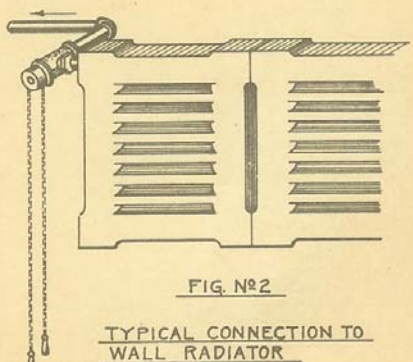
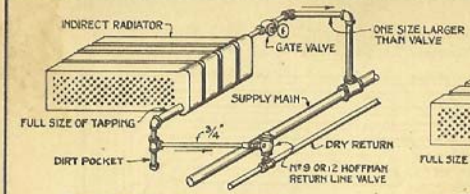


FIG. Nº 2

TYPICAL CONNECTION TO WALL RADIATOR

Indirect Radiator Connections.



CONNECTIONS TO INDIRECT RADIATOR DRIPPING RETURN INTO DRY RETURN.

FIG. Nº 1

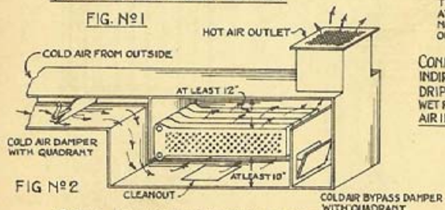
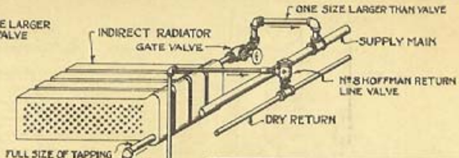


FIG Nº 2

TYPICAL ARRANGEMENT OF INDIRECT CASING WITH CLEANOUT AND DAMPERS.

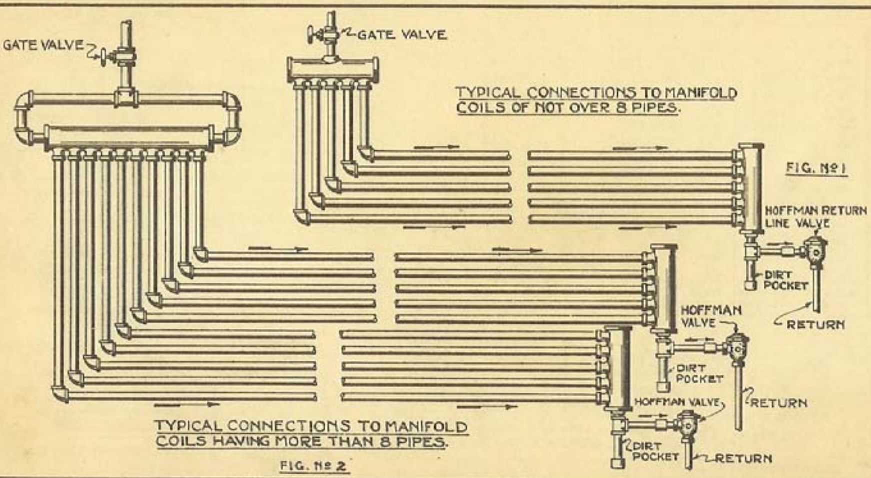


CONNECTIONS TO INDIRECT RADIATOR DRIPPING RETURN INTO WET RETURN VENTING AIR INTO DRY RETURN.

FIG. Nº 3

SIZE STEAM RAD 50 FT.	SIZE RAD. VALVE	AREA COLD AIR DUCT	AREA HOT AIR DUCT	SIZE OF REGISTER
40	1"	50□"	60□"	8"× 12"
50	1"	62	75	10"× 12"
60	1"	67	90	10"× 15"
80	1"	88	120	12"× 15"
100	1¼"	112	150	12"× 18"
110	1¼"	124	165	14"× 18"
120	1¼"	135	180	16"× 18"
130	1¼"	145	195	14"× 20"
140	1¼"	155	210	16"× 20"
150	1¼"	165	225	18"× 20"
160	1½"	175	240	16"× 24"
170	1½"	185	255	18"× 24"
180	1½"	195	275	20"× 24"
190	1½"	210	285	22"× 24"
200	1½"	220	295	24"× 24"

Hoffman "Controlled Heat"



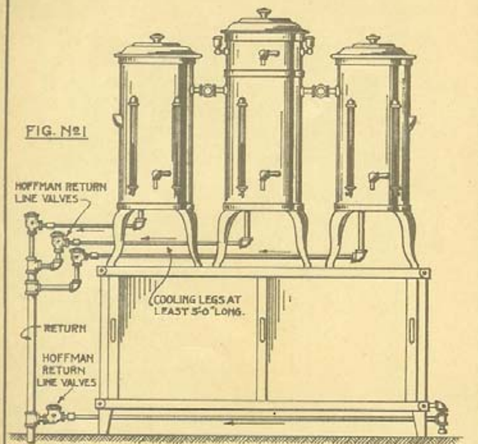
TYPICAL CONNECTIONS TO MANIFOLD COILS OF NOT OVER 8 PIPES.

FIG. Nº 1

TYPICAL CONNECTIONS TO MANIFOLD COILS HAVING MORE THAN 8 PIPES.

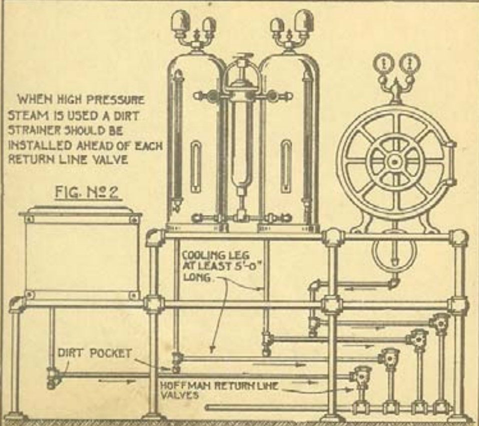
FIG. Nº 2

TYPICAL RETURN CONNECTIONS TO URNS & STERILIZERS



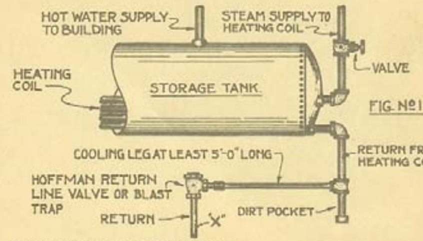
CONNECTIONS TO KITCHEN & RESTAURANT FIXTURES.

WHEN HIGH PRESSURE STEAM IS USED A DIRT STRAINER SHOULD BE INSTALLED AHEAD OF EACH RETURN LINE VALVE

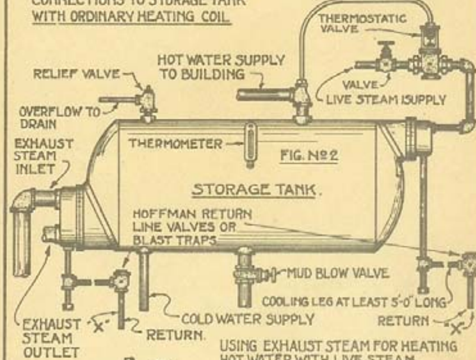


CONNECTIONS TO HOSPITAL STERILIZER.

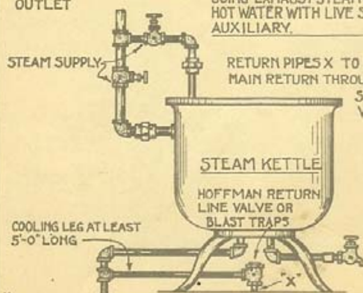
CONNECTIONS TO COILS IN TANKS.



CONNECTIONS TO STORAGE TANK WITH ORDINARY HEATING COIL



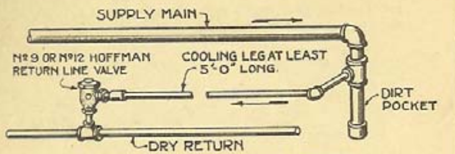
USING EXHAUST STEAM FOR HEATING HOT WATER WITH LIVE STEAM AUXILIARY.



RETURN PIPES X TO DROP INTO MAIN RETURN THROUGH HORIZONTAL SWING CHECK VALVE.

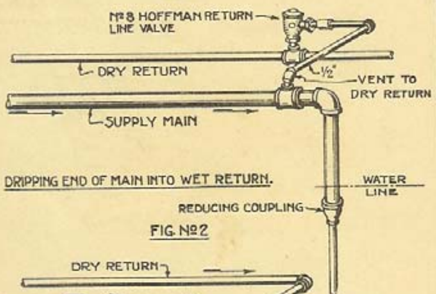
FIG. No 3

HOFFMAN "Controlled Heat"



DRIPPING END OF MAIN INTO DRY RETURN

FIG. No 1



DRIPPING END OF MAIN INTO WET RETURN.

FIG. No 2

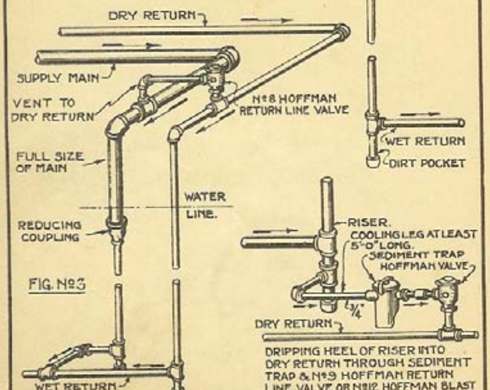


FIG. No 3

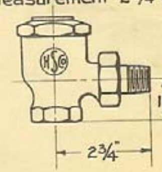
DRIPPING ENDS OF SUPPLY & DRY RETURN MAINS.

DRIPPING HEEL OF RISER INTO DRY RETURN THROUGH SEDIMENT TRAP & No 9 HOFFMAN RETURN LINE VALVE OR No 12 HOFFMAN BLAST TRAP

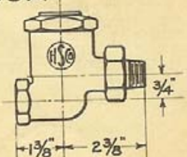
FIG. No 4

No 8 & No 9 HOFFMAN RETURN LINE VALVE

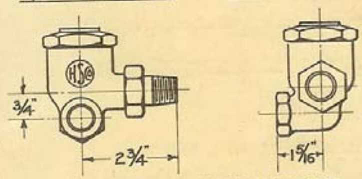
NOTE: On Special Order the No 8 Valve can be furnished with spuds increasing measurement 2¾" up to 3¾".



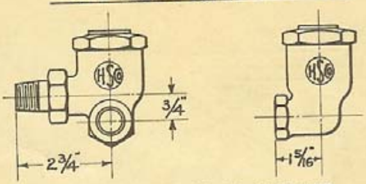
½" No 8 ANGLE



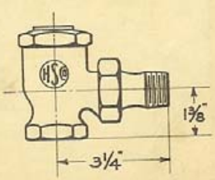
½" No 8 STRAIGHTWAY



No 8 RIGHT HAND OFFSET

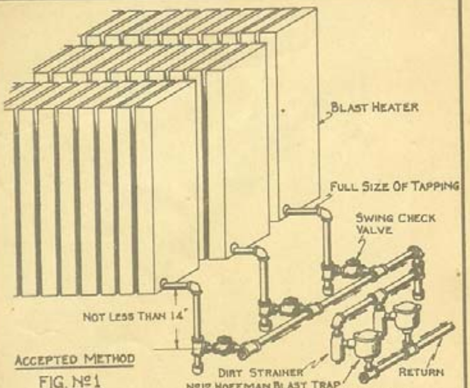


No 8 LEFT HAND OFFSET



¾" No 9 ANGLE

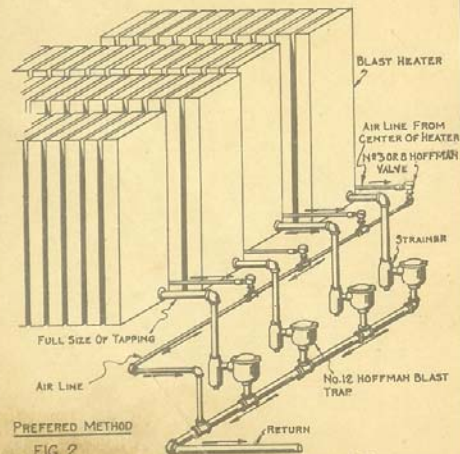
Return Connections To Blast Coils



Accepted Method

Fig. No1

Connections To Blast Coils Having Less Than 12 Sections



Prefered Method

Fig. 2

Connections To Blast Coils Having More Than 12 Sections

Return Connections To Blast Coils

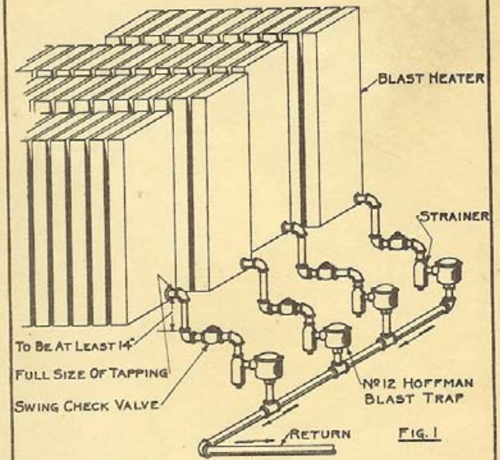
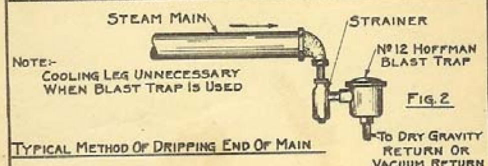


Fig. 1

Typical Connections To Blast Coils Having Less Than 12 Sections



Note:- Cooling Leg Unnecessary When Blast Trap Is Used

Fig. 2

Typical Method Of Dripping End Of Main

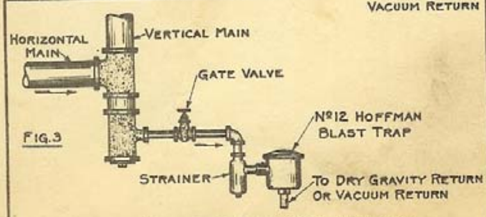
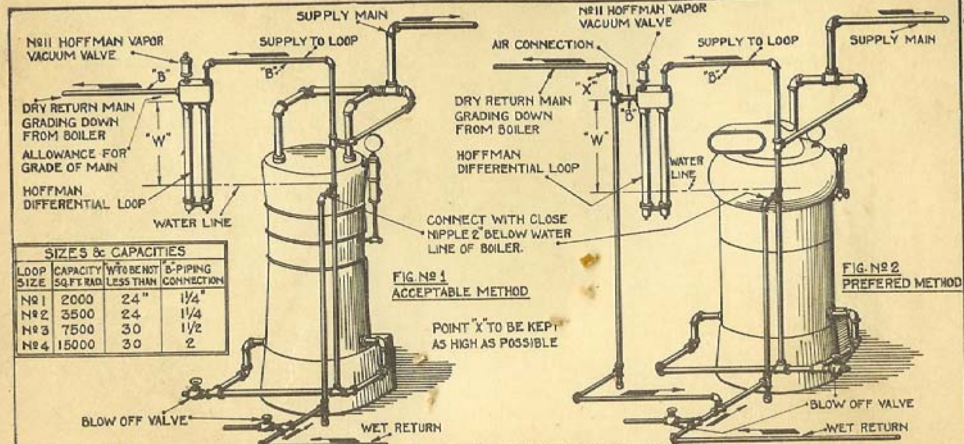


Fig. 3

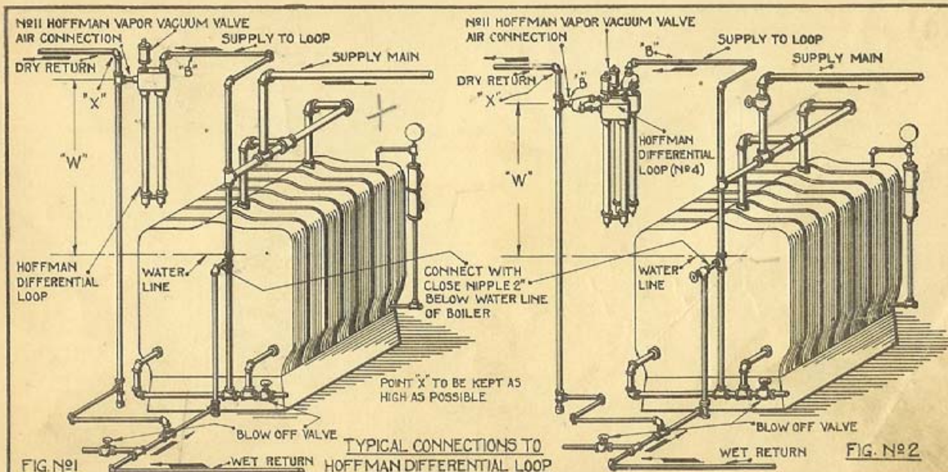
Typical Methods Of Dripping End Of Mains



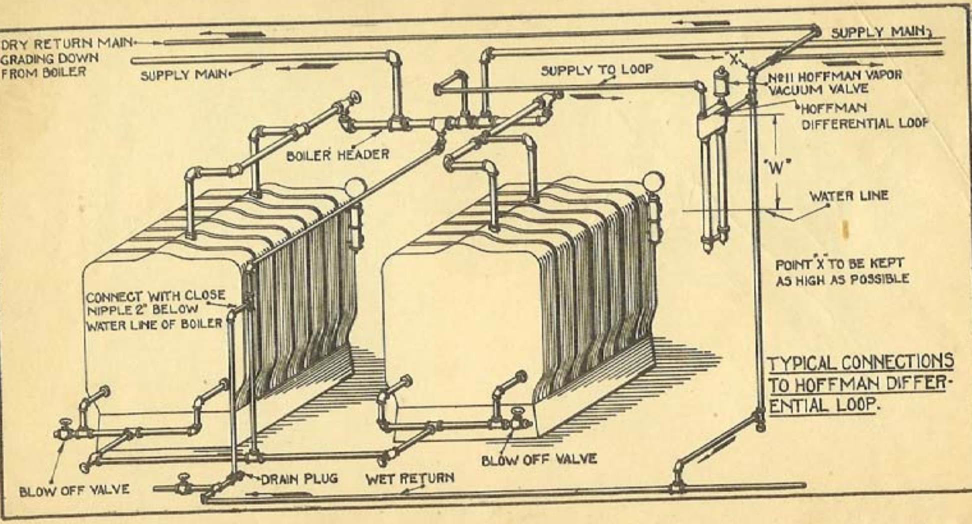
SIZES & CAPACITIES

LOOP SIZE	CAPACITY SQ.FT. RAD.	"W" TO BE NOT LESS THAN	"B"-PIPING CONNECTION
Nº 1	2000	24"	1¼"
Nº 2	3500	24	1¼
Nº 3	7500	30	1½
Nº 4	15000	30	2

TYPICAL CONNECTIONS TO HOFFMAN DIFFERENTIAL LOOP

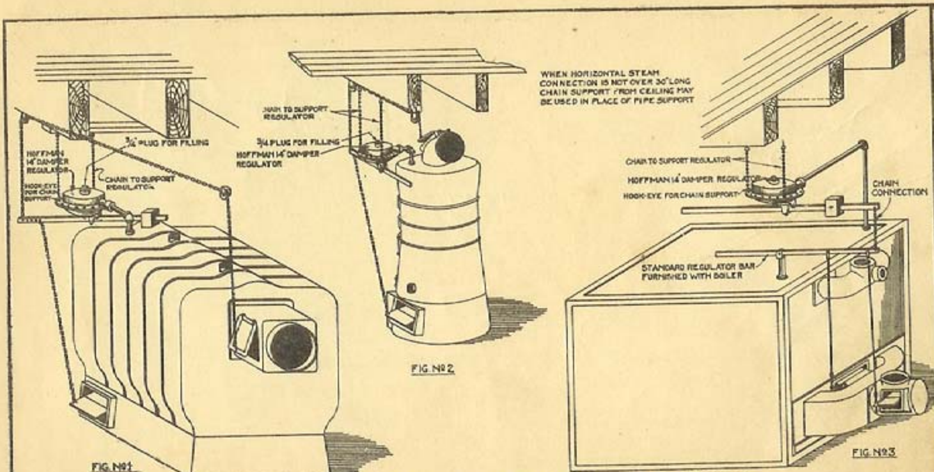


TYPICAL CONNECTIONS TO HOFFMAN DIFFERENTIAL LOOP

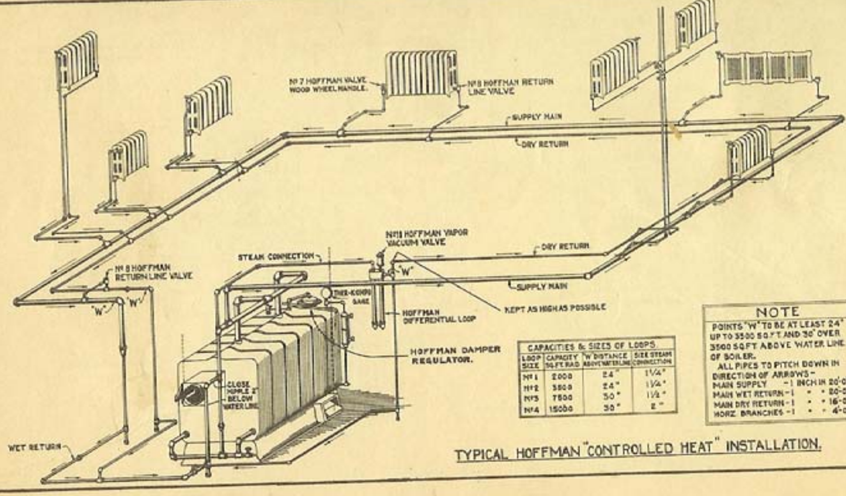


TYPICAL CONNECTIONS TO HOFFMAN DIFFERENTIAL LOOP.

HOFFMAN Controlled Heat



METHODS OF CONNECTING HOFFMAN 14" DAMPER REGULATORS TO DIFFERENT TYPES OF BOILERS



CAPACITIES & SIZES OF LOOPS.			
LOOP SIZE	CAPACITY SQ.FT.RAD.	"W" DISTANCE ABOVE WATERLINE	SIZE STEAM CONNECTION
Nº 1	2000	24"	1¼"
Nº 2	3500	24"	1¼"
Nº 3	7500	30"	1½"
Nº 4	15000	30"	2"

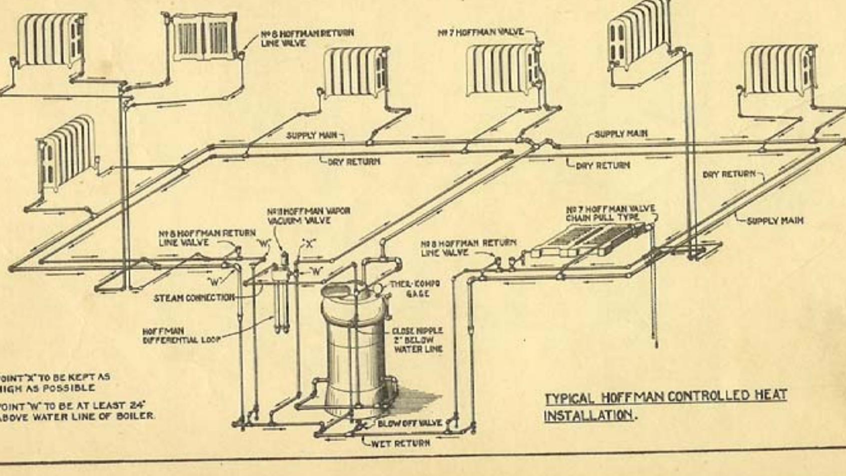
NOTE

POINTS "W" TO BE AT LEAST 24" UP TO 3500 SQ.FT. AND 30" OVER 3500 SQ.FT. ABOVE WATER LINE OF BOILER.

ALL PIPES TO PITCH DOWN IN DIRECTION OF ARROWS –

MAIN SUPPLY	– 1 INCH IN	20'-0"
MAIN WET RETURN	– 1 " "	20'-0"
MAIN DRY RETURN	– 1 " "	16'-0"
HORZ. BRANCHES	– 1 " "	4'-0"

TYPICAL HOFFMAN "CONTROLLED HEAT" INSTALLATION.

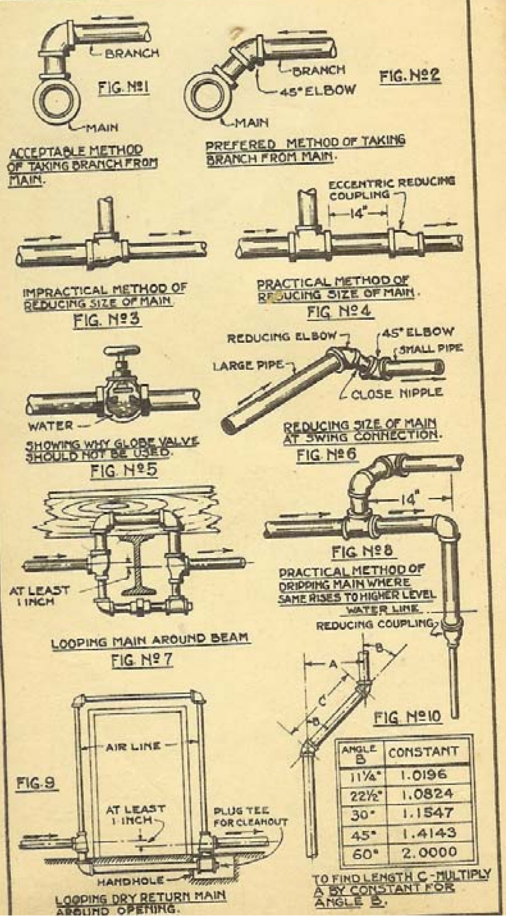


POINT "X" TO BE KEPT AS HIGH AS POSSIBLE

POINT "W" TO BE AT LEAST 24" ABOVE WATER LINE OF BOILER.

TYPICAL HOFFMAN CONTROLLED HEAT INSTALLATION.

HOFFMAN "Controlled Heat"



ANGLE B	CONSTANT
11¼°	1.0196
22½°	1.0824
30°	1.1547
45°	1.4143
60°	2.0000

TO FIND LENGTH C - MULTIPLY A BY CONSTANT FOR ANGLE B.

SUGGESTION FOR ESTIMATE BLANK

Building............... Location...............

Owner............... Date..................

1	Boiler		
2	Foundation		
3	Pit		
4	Smoke Pipe		
5	Water Heater		
6	Sq. Ft. Direct Rad.		
7	" " Wall "		
8	" " Semi Direct Rad.		
9	" " Indirect Rad.		
10	Radiator Shields		
11	Pipe & Fittings		
12	Sleeves & Hangers		
13	Floors & Ceiling Plates		
14	Valves, Cocks & Checks		
15	Boiler Covering		
16	Pipe Covering		
17	Painting & Bronzing		
18	No. 7 Hoffman Mod. Valves		
19	No. 8 " Return Line Valves		
20	Basement Specialties:—		
21	Indirect Casing		
22	Sheet Metal Work		
23	Registers & Grills		
24	Fitter		
25	Helper		
26	Extra		
27	Carpenter Work		
28	Mason Work		
29	Board and Carfares		
30	Freight & Cartage		
31	Gasoline, Candles, etc.		
32	Watchman		
33	Clearing Rubbish		
34	Superintendence		
35	Permits & Insurance & Bond		
36	Plans		
37	Cost		
38	Overhead		
39	Profit		
	Price Submitted		
	Temporary Rad. Connections		

HOFFMAN SPECIFICATIONS.

NOTE:

The following specification is typical for a Hoffman Controlled Heat installation.

Modifications must be made for varying conditions as the judgment of the Architect or Heating Engineer may dictate.

HOFFMAN "CONTROLLED HEAT" SPECIFICATIONS

Drawings and Specifications

These specifications and the Heating Drawings shall be considered as a part of any contract subsequently executed.

The spirit of the specifications shall be followed as well as the letter, and all work shall be executed according to the true intent and meaning of the drawings or specifications, which are intended to include everything requisite for the proper and entire completion of the work.

Should anything be omitted from the drawings and specifications necessary to the proper constructions of the work herein specified, or should any error or disagreement in the specifications exist, or appear to exist, the heating contractor shall not avail himself of such manifestly unintentional error or omission, but must have same explained or adjusted before proceeding with the work in question. In the event of the heating contractor failing to give written notice, he shall, at his own expense, make good any omissions, by supplying the proper material and labor, and making good any damage to, or defect in his work, caused by such omission.

All work must be done in strict accordance with the Rules and Regulations of the Board of Fire Underwriters, and the State, County, or Municipal Building Laws, Ordinances, Rules or Regulations.

Building Construction

The amount of heating surface specified herein or shown on drawings is based on the best known heating constants for good construction of various building materials to be used.

Materials and Workmanship

The materials used throughout shall be the best of their respective kinds, and all work shall be executed in a workmanlike manner.

The heating contractor shall pursue work at all times with the greatest reasonable rapidity consistent with good workmanship.

The heating contractor shall take all necessary and sufficient precautions against the occurrence of any accidents, injuries or damage to any person or property during the progress of the work, and shall be responsible for, and save harmless the owner from the payment of money for any of the above mentioned causes.

Upon completion of the work all remaining waste materials and rubbish resulting from this work shall be removed from the building and premises.

Scope of Work

It is the intent of these specifications to cover a complete Hoffman Controlled Heat installation.

Boilers

Furnish and install on suitable foundation where approximately shown on plans.

(Insert size and make of boiler.)

Consult boiler manufacturer for type and size best adapted.

Boilers to be of steam type complete with all trimmings, including pop safety valve, necessary firing tools, flue brush and handle, water column gauge glass try cocks, 1″ scum cock at water line, etc.

Omit damper regulator and steam gauge as these are furnished with Hoffman Controlled Heat Equipment.

Connect all steam outlets from boiler into header full size.

Boiler must be set so that the water line of same shall be at least a distance of not less than............ inches below the lowest point in the steam or dry return mains. If conditions are such that this is impossible, then heating contractor is to provide pit of proper depth to obtain this water line difference.

Supply and Drain Connections

Make proper connections to the water supply where convenient and run ¾" galvanized iron pipe to boiler through globe valve and swing check valve. Install at lowest points of system brass blow-off cocks for draining, of size marked on plans.

Chimney

The chimney is to be of size, height and construction approved by the boiler manufacturer.

Smoke Pipe

Connect boiler to chimney with No............ gauge black iron smoke pipe, closely fitted and of the same size and area as smoke hood on boiler, same to be provided with hand damper, having quadrant and set screw.

Pipe and Fittings

A complete and ample system of piping shall be installed, properly graded, and supported to prevent water pockets forming, and to insure the noiseless circulation of vapor throughout the system and return of condensation to the boiler.

All piping to be full weight National or equal make. All ends reamed, threads sharp and true. Fittings to be standard cast iron, flat headed, screw pattern, and tapped true with full threads. All unions must have ground joints unless flanged unions are used.

The flow main shall rise to the highest point above boiler, or as may be indicated, and pitch down in direction of arrow. The return lines to which the branches from all radiators are connected shall be run as high as possible, and pitch down in direction of arrows.

All branches leading from the mains to the risers to be taken off on an angle of 45°, except where otherwise directed. These branches to be arranged with swing connections to allow for expansion and contraction. All branches from steam mains to risers to be one size larger than the riser, unless otherwise noted on the plans.

All mains reducing in size in direction of flow must be dripped into wet return, or reduced with

eccentric reducing fittings, unless otherwise noted on the plans.

Grading Pipes

All supply, dry return and wet return mains to pitch down at least 1" in 20', in directions of arrows.

All branch connections from the main to pitch back into mains at least 1" in 4' 0", unless otherwise noted on the plans.

All branch connections from risers to radiators to pitch as much as posible and at least 1" in 4' 0".

Pipe Supports

All piping to be substantially supported by approved type of expansion hangers, placed not over 10' 0" apart.

Basement Specialties

Unless otherwise noted all Check Valves shall be No. 34 Crane, or equal, and all other valves to be Crane Co. make, or equal.

Furnish and install as per detail drawings, Class Hoffman Basement Specialties.

(Insert Class A, B, C or D according to size of installation.)

Radiator Valves

All radiator supply valves shall be No. 7 Hoffman Adjustable Modulating, unless otherwise noted on the plans.

Return Line Valves

All radiator return traps shall be No. 8, ½" Hoffman Return Line Valves, unles otherwise noted on plans.

All drip traps to be as noted on the plans.

All radiator valves must be properly protected from dirt and dust after being installed until installation is ready to be turned over to the owner.

Radiators

All radiator sizes are shown on the plans. Heating contractor to take measurements at the building before ordering radiators, as he is to be responsible or radiators fitting in spaces allotted and in no case must radiators located under windows be of height higher than window sill.

All radiators to be tapped ¾"x½" top and bottom, opposite ends, with ½" tapping eccentric, turned down, except where otherwise noted on plans. All radiators to be washed clean and then plugged at factory before shipping. All radiators to be plain pattern, cast iron, as manufactured by

(Insert manufacturer's name.)

Floor and Ceiling Plates

Where pipes pass through floors or partitions nickel plated cast iron or pressed steel plates and galvanized iron sleeves must be provided where necessary.

Covering

Boiler to be covered with plastic asbestos cement 1½" thick, applied in two coats over wire net properly wired to boiler, same to be applied while fire is in the boiler, so that it may be properly trowelled and finished to a smooth hard surface, except in case the boiler covering is furnished as part of the boiler by the manufacturer.

Supply mains and branches, except where otherwise noted, to be covered with three-ply air-cell covering, with ends of sections butted together with cement and then banded on. Fittings to be covered with plastic asbestos cement, canvassed on with paste.

All risers running in outside walls or partitions to be covered with two-ply air cell covering, banded on. All branches run below roof spaces or between floors are to be covered with two-ply air-cell covering, banded on. Dry returns are not to be covered, except where marked on the plans.

Painting and Bronzing

All exposed iron work, except in finished portions of basement, to be painted with two coats of black asphaltum paint.

All radiators, and exposed piping in finished portions of building, to be neatly painted with two coats of bronze or color, as selected by the owner, which must be applied when radiators are warm.

Blowing Off

Upon completion of the entire system the boiler is to be blown off in order to rid it from all accumulation of oil, grease, or grit. If one blowing off does not result in a clean boiler, proper generation of steam and steady water line, the system is to be blown off a sufficient number of times to produce these results.

Testing

The piping system must be subjected to an air or water test of not less than 20 pounds to the square inch, for a period of at least five hours, to insure its being thoroughly tight. Any leaks, or imperfections that might develop must be repaired.

When system is completed and thoroughly blown off, so that boiler holds a steady water line when under steam pressure, the heating contractor will place it in operation in the presence of the owner or his representative to demonstrate and instruct them in its proper operation before acceptance.

All fuel for this test will be furnished by the owner.

Guarantee

The manufacturer of the CONTROLLED HEAT specialties will furnish the owner, through the heating contractor, a written five-year guarantee, covering the satisfactory service of all their specialties as used in this installation.

The heating contractor is to keep all work embraced in these specifications in repair and proper working order without charge for a period of one year from date of completion, except from damage beyond his control.

The system is guaranteed to heat all rooms in which radiators are installed to a temperature of 70° F., at the breathing line, except where otherwise noted on the plans, when the outside temperature is ...., with a pressure at the boiler of not over 8 oz., when continuously operated.

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