ings the thickness shall be not less than 8 in., except that rubble stone masonry shall be not less than 12 in. thick.

b. Every such chimney hereafter erected or altered shall be lined with a flue lining conforming to the requirements below.

c. Flue linings shall be made of fire clay or other refractory clay which will withstand the action of flue gases and resist, without softening or cracking, the temperatures to which they will be subjected, but not less than 2000 F. Flue linings may be of cast iron of approved quality, form and construction.

d. Required clay flue linings shall be not less than $\frac{5}{8}$ in. thick for the smaller flues, and shall increase in thickness for the larger flues.

e. Flue linings shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in Type A, Type B, or fire clay mortar with close fitting joints left smooth on the inside.

f. Flue linings shall start from a point not less than 8 in. below the intake, or, in the case of fireplaces, from the throat of the fireplace. They shall extend, as nearly vertically as possible, for the entire height of the chimney, and be extended 4 in. above the top of cap of the chimney.

g. Cleanouts for flues or fireplaces shall be equipped with cast-iron doors and frames arranged to remain tightly closed when not in use.

h. When two or more flues are contained in the same chimney, at least every third flue shall be separated by masonry at least 4 in. thick bonded into the masonry wall of the chimney. Where flue linings are not so separated, the joints of adjacent flue linings shall be staggered at least 7 in.

6. *Sizes of Flues.*

a. The cross-sectional area of smoke flues shall be designed and proportioned to meet the conditions of temperature, within and without flue, thickness of masonry, exposure, shape and material of flue, and other influences.

b. The cross-sectional areas of flues and vents for gas burning appliances shall be not less than one square inch per 7500 hourly Btu input, and in no case shall this section be less than 3 in. in diameter. Flues and vents shall have cross-sectional areas at least equal to the aggregate areas of the vents of the appliances connected to them.

For *gas appliances* the Building Code specifies lined chimneys and metal smoke stacks for all appliances which may be converted readily to the use of solid or liquid fuel, and also for all boilers and furnaces, except those having a flue-gas temperature not exceeding 550 F at the outlet of the draft hood when burning gas at the manufacturer's rating and which may, therefore, be connected to *Type B* vent piping. Approved *Type B* vent piping is noncombustible, corrosion-resistant piping of adequate strength and heat-insulating value, and having bell and spigot or other acceptable joints. Fig. 7 may be used for selection of vent-pipe size.

Important points to be considered in the use of *Type B* vent piping are:

1. *Type B* flues must be plainly and permanently marked at the point where the vent connection enters the flue: *For Use of Gas Appliances Only.*

2. *Type B* gas vents shall be installed with a clearance to combustible material or construction, whether plastered or unplastered, of not less than one inch, provided that for vents of floor furnaces, such clearance shall be not less than 3 ft from the outlet of the draft hood, measured along the center line of the vent piping.

Other important points that should be considered for flues and vents for gas appliances are as follows:

1. Clearances from combustible material to gas appliance vent piping other than approved *Type B* gas vents shall be in accordance with the Building Code Standards of the *National Board of Fire Underwriters* for the Installation of Heat Producing Appliances, Heating, Ventilating, Air Conditioning, Blower and Exhaust Systems.

2. Every flue-connected appliance, except an incinerator, unless its construction serves the same purpose, shall be equipped with an effective draft hood which either (a) has been approved as part of the appliance or (b) complies with nationally recognized standards for draft hoods. The draft hood shall be attached to the flue collar of the appliance as conditions permit, and in a position for which it is designed with

reference to horizontal and vertical planes. The draft hood shall be so located that the relief opening is not obstructed by any part of the appliance or adjacent construction.

3. No vent pipe from a gas appliance shall be interconnected with any other vent pipe, smoke pipe, or flue, unless such gas appliance is equipped with an automatic device to prevent the escape of unburned gas at the main burner or burners. Where a gas appliance vent pipe is joined with a smoke pipe from an appliance burning some other type of fuel, for connection into a single flue opening, they shall be joined by a Y fitting located as close as practicable to the chimney. With liquefied petroleum gases, the automatic device to prevent the escape of unburned gas shall shut off the pilot light, as well as the main burner or burners.

GENERAL CONSIDERATIONS FOR CHIMNEYS

The draft of domestic chimneys may be subject to a variety of influences not usually encountered in power chimneys[13] because of the low available draft often supplied by a short chimney. Horizontal winds have an aspirating effect as they cross the chimney and are an aid to draft. However, surrounding objects, such as trees or other buildings, may affect the direction of the wind at the chimney top, and may even direct it down the chimney, tending to reduce the draft or even to cause it to change to a positive pressure.

It is not to be assumed that increasing the cross-sectional area of a chimney will always effect a cure for poor draft. The opposite result may occur because of the cooling effect of the larger area, and the effect of recirculation of the flue gases. The flow of gases into the chimney top has been observed at low rates, and recirculation in small residential chimneys has been noted throughout the entire length of a chimney and smoke pipe, with the greater amount of recirculation occurring at the thimble. The effect of recirculation decreases with chimney height and the increase in flue-gas velocity. Sometimes the only practical remedy for a chimney with low draft, when the chimney is of the proper size and is affected by outside conditions beyond control, is to resort to mechanical draft or a chimney ventilator. Often this can be done at small expense, and for mechanical draft the arrangement can be such that the fan or blower need be operated only when draft conditions are adverse.

It is also important to consider the course of the air supply for proper combustion. The boiler or furnace is usually located in the basement. In the majority of cases, the furnace room has windows and doors opening to the outside on two or more sides of the house. Through these enough air leaks into the furnace room to sustain combustion. In some cases, however, windows and doors are so tight as to restrict the flow of combustion air, and thereby affect the correct operation of the chimney. In case the boiler room is fairly tight and is open to the outside on only one side of the house, then the draft will be affected in windy weather even with windows or doors open. If the wind is blowing toward the boiler room, the draft will be increased, but if blowing in the opposite direction, the draft may be decreased.

Two or more chimneys, either large or small, should never be connected together. If connected at the bottom, hot gases in the U-tube thus formed would be in unstable equilibrium. Cold air from the top would descend through one such chimney and drive the hot gases out of the other, thus annulling the draft.

More than one device can be served by one chimney. Batteries of boilers are commonly connected to a single chimney in power plants. However, if two or more chimneys are used, each chimney should be used