A ½ in. return connection and ½ in. thermostatic trap is ample for any coil or heating unit except ironers and tumblers which should be ¾ in. return with ¾ in. thermostatic trap. Return mains having an area one half the combined area of the branches is ample, ¾ in. being the minimum pipe size.

Occasionally it may be necessary to run return mains at the laundry ceiling, but this should be avoided if possible. In such cases mechanical traps instead of thermostatic traps are used, the condensation being lifted from floor to the return by the pressure of the steam.

Cold water and hot water connections to washing machines are 1½ in. to 2 in. according to size; ½ in. to soap tank and starch cooker and ¾ in. to each laundry tray. These are sufficiently large with water pressures ordinarily found.

The so-called *high duty* washing machines usually have two connections each same size as for standard washers of corresponding size. Quick filling is a necessary requirement to secure the extra capacity claimed for these machines.

Water Softening

Fairly soft water, the softer the better, is an absolute necessity if a clean white wash is to result. With hard water the soap forms insoluble compounds with calcium, magnesium and iron which cling to the washed fibres and after they have been through the flat work ironer the spots turn various colors. In addition to this more soap is required with hard waters than with soft, the excess depending upon the amount of hardness present. Before any lather is formed the soap must neutralize the hardness of the water. One pound of average soap will soften (bring to point of producing lather) 167 gal. of water when the hardness is 20 parts per million, but only 40 gal. when the hardness is 100 parts per million. Seventeen parts per million is equivalent to one grain of hardness, by weight, per gallon.

From 15 to 25 per cent more water is used when it is very soft than when it is very hard for the reason that in rinsing, the hard water immediately precipitates the excess soap used in the washing process.

Arrangement of Equipment

For efficient operation the arrangement of equipment must be given careful study so that it will fit in with the natural sequence of operations from receiving to delivery. Any backward movement of material that might involve possible contact of washed materials with unwashed material must be guarded against.

Whenever possible the laundry should be a separate building. The ceilings of the building should be high and the rooms well ventilated by large windows and adequate roof ventilators. Ventilating fans will frequently be required.

All operations except receiving, mending, storing and delivery should be carried on in one room.

KITCHEN EQUIPMENT

The equipment covered herein includes the usual cooking equipment found in the ordinary institution or hotel kitchen. There are other

special appliances found in all kitchens, but for the most part such appliances require small space, nominal amounts of steam and in many cases none at all. They are frequently added and may be placed in any properly designed kitchen with little or no disturbance to existing equipment.

Character of Equipment

Nearly all *steam* kitchen equipment such as steam tables, dishwashing machines, warmers, kettles, etc., can be obtained either for gas or steam heat.

For a small kitchen, where gas is available, and a separate steam boiler would be required for the kitchen, it is probably better to use the direct gas-fired equipment. If the kitchen is large it is better to install the usual steam equipment even if a separate steam boiler is required.

Steam heated equipment has certain inherent advantages over gas for steam tables, dishwashers, kettles, etc. It is more nearly fool-proof and steam can be left on a dry fixture indefinitely without damage but not so with gas. The upkeep and maintenance cost of steam equipment is less than with gas equipment and the fuel costs are generally less, even with a gas-fired steam boiler.

The range may be fired with wood, coal, oil or gas, preference being given to the latter. Electricity will be considered as always available for power purposes and for small hot-plates, broilers, etc. The use of electricity for the range is practicable, and for that matter ideal, but too expensive except in isolated cases.

Proportioning Equipment

It is difficult to lay down general rules for proportioning equipment. So much depends upon the technique employed by the management and the partial preparation of food at points other than in the main kitchen. The proportions laid down here are subject to wide variation to meet requirements for a specific case. They are based on steam heated equipment but no substantial difference in capacity exists if gas heated equipment is used.

Ranges

The smallest practicable gas or coal range has a top surface of about 7½ sq. ft. and an oven volume of about 4000 cu. in., which is sufficient for about 25 persons on the theory that no kettles, roasting ovens, etc., would be installed in such a small kitchen, and that all such cooking would be done on the range. About 15 sq. ft. top surface and 8000 cu. in. oven space is good for 100 persons. For each additional 100 persons allow about 7½ sq. ft. top surface and 4000 cu. in. oven space.

A steel hood with a good draft is required over the range and generally a fan is used to produce sufficient dependable draft. The range generally stands against a wall and the hood should project 12 in. or more beyond the edge of the range at ends and front. The best type of hood is a double hood as shown in Fig. 2. The slot is 2 in. wide and is the full periphery of the hood on front and sides. The volume of air should be sufficient to