capacity for quick heating by running the temperature up higher, which would not be possible with the smaller outfit, which is already working at about its maximum capacity.

At Urbana it was found that by making the return air duct to the furnace the same size, or even larger than the combined area of all the leaders, and at the same time avoiding abrupt or right angle turns in this duct, that the capacity of the furnace can be increased as much as 50 per cent. It was further demonstrated that the furnace is affected much more by any restriction to the flow of air in the recirculating duct, than by a similar restriction in the leaders from the furnace to the registers.

One frequently finds installations where there are two or more recirculating ducts leading back to one furnace. This generally fails to give

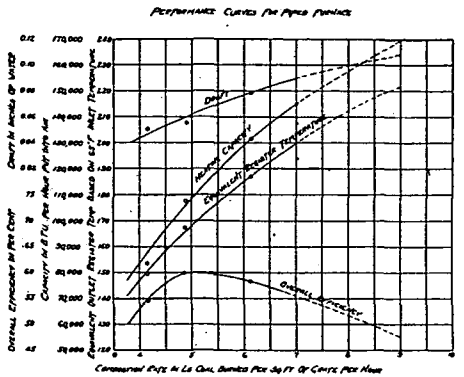

FIG. 3. CHART WILL GIVE FURNACE SIZE, FUEL AND DRAFT NEEDED, TEMPERATURE ATTAINABLE, HEATING CAPACITY AND OVERALL EFFICIENCY

as good results as one duct. It is perfectly obvious why this should be so. For example, one duct 32 in. dia., has about 8 per cent less area than would two 23 in. ducts, yet the total circumference of the two 23 in. pipes is 44 per cent more than the one 32 in. pipe; hence, for a similar length the two pipes present 44 per cent more frictional surface.

One frequently settles on the area to have and because it may be easier to install, uses a rectangular duct instead of a round one. At Urbana there was an opening 17 x 47½ in. behind a register face, with a right angle elbow to a vertical riser of the same dimensions, the lower end of which connected to a horizontal duct 12 x 67 in., the opposite end of which was attached to the base of the furnace. This is indicated in Fig. 2 as shown by *A* at the left. The modified recirculating duct is indicated by *B* on the right.

Both of the above ducts are exactly the area of a 32 in. round pipe, but the drop leg is only equal to a pipe 30.6 in. in diameter as a conductor of air, owing to the shape of it, and the horizontal leg is only equal to a pipe 29.2 in. diameter for the same reason. In other words,

the latter can only convey 83 per cent of the air that a 32 in. round pipe will convey because of the additional friction, when both have the same pressure head. Besides this, the right angle elbow alone presents an amount of resistance equal to 12 ft. of straight pipe 17 x 47½ in. in size, and the right angle at the base will add as much more. In view of all this, is it surprising that the capacity of a furnace can be increased 50 per cent by a few changes in the recirculating duct? Hardly anyone would knowingly set out to install a recirculating duct measuring 17 x 47½ in. that would be nearly 50 ft. in length with a standard register

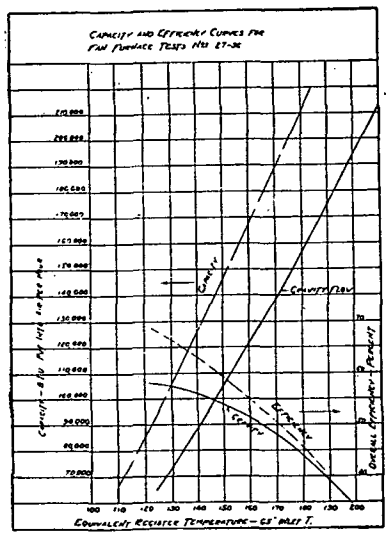

FIG. 4. CHART SHOWS COMPARATIVE RESULTS OF FURNACE TESTED WITH FORCED AND GRAVITY CIRCULATION

face on the opposite end of it. He would at least feel very uncertain of the results he would get, yet that is exactly what the resistance amounts to in the installation as it was first put in Urbana and it was in no way unusual, as it is being unconsciously done every day. The restrictions in the recirculating duct and the limited area of the flues in the walls are accountable for many of the poor results obtained from furnace installations. That a furnace fails to perform satisfactorily is by no means an accident. When one knows what its limitations are and then sees what is sometimes attempted, it seems like an accident if a furnace works at all.

SOME FACTS ABOUT CIRCULATION STIMULATORS

When the occupant of a house finds it impossible to heat his place, he does a little experimenting on his own account, he then calls in the furnaceman who does some more, usually without producing any marked