account of the amount of silt and dirt collected in the pits. Another reason is the complication of the construction of these inlets which is not adaptable to the simplicity which should always be attempted to attain in ventilation and sewerage systems.

The second method is that of using the gullies. The theory is advanced that there are a greater number of gullies on a street than there are manholes, and the perforations of the manhole covers are not nearly the area of the openings in the gulley grating, and that these perforations, if not properly made, are liable to become clogged. This method has its advantages, as in dry weather there would be a greater number of air inlets, but it is questionable whether the gulley as a vent outlet in times of heavy rain accomplishes its purpose. The opinion of the author is that larger quantities of air are attracted by the discharge of the gullies rather than allowing the

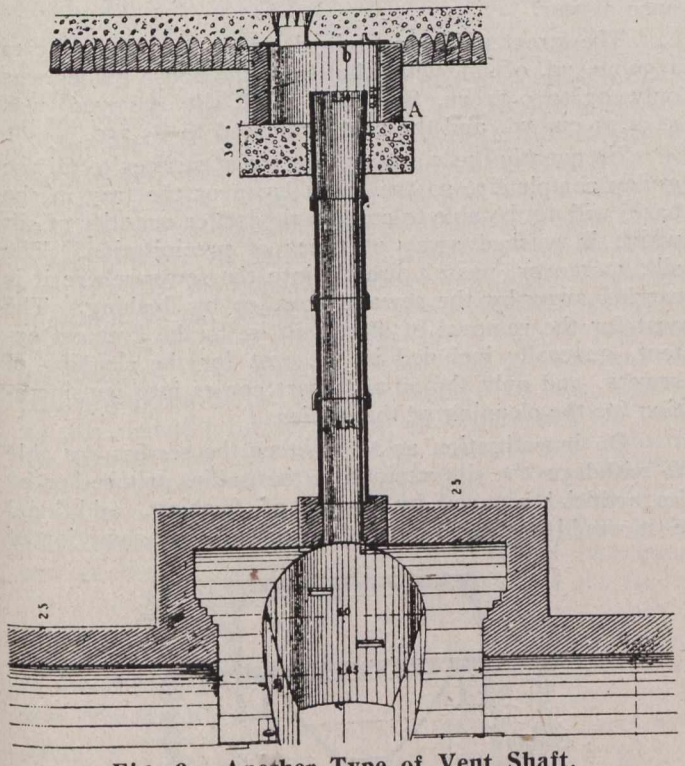

Fig. 3.—Another Type of Vent Shaft.

sewer air to escape. Therefore, the tension in the sewer is increased if gullies are used as ventilators, so that extra precautions must be taken in these circumstances for an efficient ventilation of the sewer. *Per se* there would be no objection to this proposal. On the contrary, by the adoption of the gullies the low level group would be increased by a number of inlets (two gullies usually arranged on a length of street of about thirty yards) thus presenting a double number of low level connections by which, in dry weather, a better circulation would result. It is doubtful, however, if the gulley as a vent outlet during times of storms accomplishes its purpose owing to the house connections being submerged. In the opinion of the author, large air quantities are rather attracted by the discharge of the gullies and the tension of the sewer air is, therefore, increased. If the gullies are used as ventilators, special precautions must be taken for an efficient ventilation of the sewers in these times. This takes us back to the adoption of perforated manhole covers, where in times of rain the displaced sewer air will collect, and by which during the dry weather the renewal, even of the upper air strata, is best obtained.

As already mentioned, the connection of the sewer with the atmosphere at the street level has two disadvantages, the ascending of sewer air during heavy rains, and the danger of the holes in manhole covers to the horses. An emanation of sewer air, however, in a well-ventilated sewer takes place only if the same is filling rapidly. Objection to by-passers cannot occur by this, as a well-ventilated, well-flushed, and above all a properly designed and constructed sewer contains only fresh and no decomposed sewage, and thus no foul air.

It is of absolute importance that the orifices in the manholes should be made small enough to reduce the danger caused by the horses catching the studs of their shoes in the holes. It is a mistake to replace covers with large openings by covers with small ones, as is sometimes done, which are even then ineffective as they become clogged by silt. The author is of the opinion that the manhole covers are the cheapest and most suitable means for low level ventilating orifices, and these openings can be brought into practical form by due consideration. By the suitable selection of orifices in arrangement and construction, accidents would be decreased, but to eliminate them would be practically impossible even with the most approved style of covers. According to an investigation conducted by Herrn Falkenroth with the covers of various designs, he proves that the danger to horses is decreased by the use of large openings and the proper construction of the ventilating orifices. The requirements of an ample air circulation in dry weather and unhindered removal during storms are fulfilled likewise by large openings, which are not so liable to become clogged.

The long segmental, oblong, square, radiated orifices cannot be considered, due to the danger to horses. After Falkenroth's experiments, the manhole covers with circular openings proved to be the most satisfactory. The openings in all cases should be inverted conical so that stones and silt could then fall to the receiving tray placed under the cover, and the selection of sufficiently wide circular orifices (1½-in. or more) will also exclude, or at least restrict to a minimum, the number of cases of traffic troubles or accidents. Simultaneously with the correct choice the requirements of an ample circulation will be fulfilled. Cities that have replaced the former covers with covers having circular openings have succeeded by this innovation, and the openings have met the requirements in reference to favorable circulation, safety to traffic and cleanliness. (See Fig. 4.)

Whilst the most suitable form of ventilation known may be adopted, it cannot be said that the sewer ventilation problem has been solved. In spite of the circular openings it may be necessary to consider the possibility of occasional sewer tension during storms. The great draught in the upward direction retards the adequate air escape. The quick run-off of the sewage requires the installation of sufficient and uniformly distributed openings for the expulsion of the air. Since sewer ventilators are fewer than house drains, comparatively, the ventilating conditions would be much more favorable if a means was found in another group of low level connections to assist the ventilating orifices of the manhole covers during time of storms. This assistance may be obtained by the co-operation of street gullies. The gullies are at present generally constructed in such a manner that the silt washed away by precipitation is retained in special receptacles, and the gullies are trapped from the sewer. This construction has two great disadvantages, viz., the nuisance of foul odors and the danger of silting up. The receptacles of the street gullies, and to a certain extent the house gullies, on hot days and days of atmospherical