nature of the overhead ground, whether all sand, a mixture of clay and sand or these two occurring in layers. It depends also on whether the ground contains any old sewers, mains, conduits, etc. Roughly, ½ lb. of air to the foot of depth is assumed, but conditions of the ground vary so much that it is never possible to go

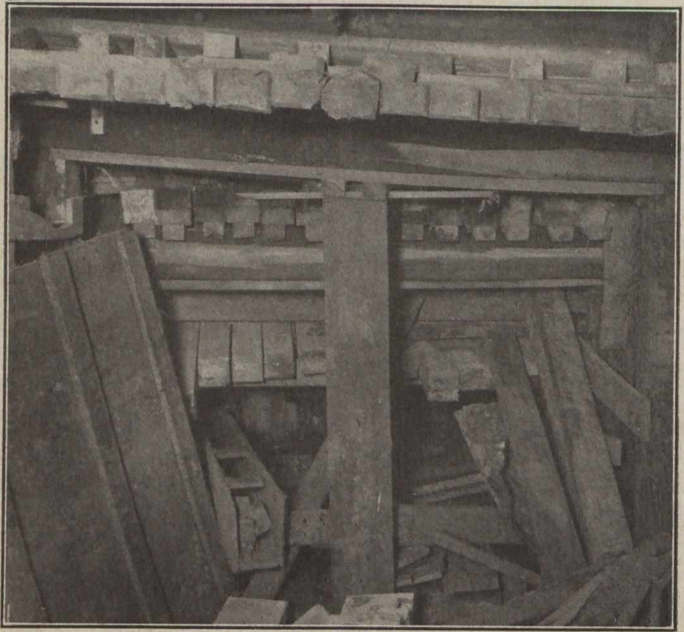

Fig. 2.—Wet Soil Caused Timbering to Sink.

entirely by this figure. Another estimate is ½ lb. of air for each foot of hydrostatic head. Sometimes, where a large sewer is under construction, a greater pressure of air is required to dry the lower part of the tunnel than is required to dry the upper portion, and the overhead ground may not retain this added pressure. Then it is necessary to load this ground down. For this purpose, several feet of earth may be spread on top of it. Cases have been noted where an asphalt pavement has risen over ½ inch when the air pressure was on in a tunnel underneath, and has subsided again when the pressure was taken off. Where there is no pavement, the ground has been seen to rise 1 in. to 2 ins. A person walking over it would find it very much like the first coating of ice on a pond in autumn—rubber ice, as it has been called.

When it is necessary thus to increase the pressure for the lower part of the tunnel, the sand in the upper portion becomes so dry that it falls from the roof like flour. Then, hay or similar material is used, it being stuffed into the cracks of the sheeting to prevent this sand from falling.

The first sewer tunnel built in Toronto with compressed air was that portion of the high level interceptor which runs from King Street and Fraser Avenue, along Fraser Avenue, Liberty Street and Dufferin Street to Springhurst Avenue. It was a 4-ft. 6-in., 2-ring, circular brick sewer, with an average depth of 25 ft. From 6 to 12 lbs. of compressed air were used. The contract was carried out by an American firm, the Gawne Contracting Co. A shaft was sunk and compressors erected on Liberty Street, near Dufferin Street. Work proceeded from each end of the shaft. At the east end, towards King Street, the lower pressure (6 or 7 lbs.) was used, this being sufficient to prepare the ground. The Dufferin Street end required 11 or 12 lbs. pressure to prepare the ground for tunnelling. More than an average quantity of air escaped owing to the close proximity of an old sewer and some other mains. In one case the air escaped through the joints of an old brick sewer on Dufferin Street, one which was built in the days when lime mortar was used instead of cement. It carried the surrounding sand with it into the sewer. The latter settled, spread and then collapsed. The earth over and around it was carried away and about 15 ft. x 30 ft. of pavement undermined. Fortunately, this happened in winter when the electric street railway tracks leading to the Exhibition Grounds were not in use. The rails acted as reinforcement for the pavement and heavy trucks passed over without having any appreciable effect. The cavity was finally discovered by the sewer maintenance men who, noticing a small depression between the tracks, sounded the pavement and so discovered the break.

The next tunnel in which compressed air was used was on Woodville Avenue in the West Toronto system previously mentioned in these pages. This was an 8-ft. circular, 4-ring, brick sewer, the details of the construction of which will be given in a later article. Then followed the main sewer in Moore Park on Sight Hill and Oakmount Boulevard, and another on Danforth Avenue, in East Toronto. A small air pressure was found sufficient on these contracts. Then it was used in West Toronto again and it is there that compressed air has been of greatest value. The ground in this area is all composed of sand and generally carries a great quantity of water at the elevation of the trunk sewers.

The cost of setting up a compressed air plant naturally varies with its size.

Besides the units costing more in a large plant, the cost of the foundations, wiring and all the fixtures will vary. The actual operation of setting up the plant, excavating for and building the locks requires from three to four weeks. The material required is, besides the units, concrete foundations for the compressors, foundation for

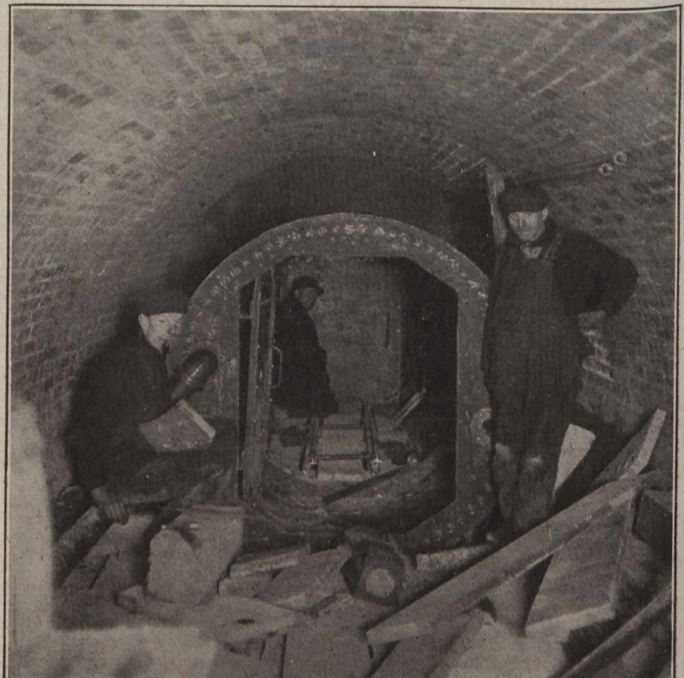

Fig. 4.—Steel Cylinder Air Lock.

the motors or engines if they be used, wiring, pipes for air lines, and buildings. If electricity is used, connections are made with the 500-volt system of, if possible, two companies. In Toronto, connections are made with both the Hydro and Toronto Electric Light Co. This is done so