driven down one foot below subgrade. This facilitated excavation and reduced the amount of water.

In constructing the locks, a concrete slab was placed and braced down; when this concrete was well set the invert forms were placed and more concrete poured. When this had set sufficiently to allow the removal of forms, they were reversed and used for the arch. Prior to placing concrete in the arch, all the pipes for the air lines and the iron frames for the lock doors were put in place, so that a bond would be obtained between the iron



and concrete, thereby eliminating any loss of air at such points.

After the locks were completed, the trench was backfilled, care being taken that it was tamped and watered well, so that the least possible amount of air would be lost.

Two compressors were put in place, so that if one was not able to supply sufficient air, the second could be used. It was found necessary to use the two nearly all the time owing to loss of air through private drains which connected the houses on the east side of the street to the local sewer.

With the aid of the compressed air, very good headway was made and the 888 feet of sewer were completed in less than seven weeks. Three of the five manholes were partly constructed from below and afterwards excavated from the surface and finished.



The method of construction was practically the same as in the first section. As material excavated was sand, sheeting of the crown was required throughout. The square base design was used so that when the compressed air was removed there would be a good bearing surface for the sewer, with less danger of settlement of the sewer after the water returned.

The entire contract was executed by the Fussell and McReynolds Co., Limited, Toronto, and was completed in 4½ months. The work was under the direction of the Works Department of the city of Toronto, of which R. C. Harris is Works Commissioner and George Powell, Principal Deputy City Engineer. W. R. Worthington is engineer of sewers; W. G. Cameron, engineer of maintenance and construction; and W. S. Harvey, engineer in charge of design. The writer was resident engineer for the city.

Unit Costs

In the following unit costs, for convenience a "key" is used in reference to the distribution of labor, as follows:—

A-Sinking and timbering shafts.

C—Backfilling.

E-Placing forms and concreting.

J-Pumping water.

K-Brickwork.

N—Mining.

P-Material handling.

Q-Plant.

Z-Miscellaneous labor (cleaning out sewer).

S-Compressor operators (mining).

T-Compressor operators (brickwork).

U-Compressor oilers (mining).

V-Compressor oilers (brickwork).

CP-Setting up compressor plant.

TD-Taking down compressor plant.

D-Handling surplus excavation.

Quantities, Shaft No. 1

4-ft. two-ring brick sewer			495	lin.	ft.
Excavation in tunnel			425	cu.	yds.
Excavation in shaft	•••		58.5	cu.	yds.
Surplus excavation			425	cu.	yds.
Brickwork			205	cu.	yds.
Concrete in chamber			7.0	cu.	yds.
Bricks in tunnel		93	3,725		
Bricks in manhole	• •	:	3,275		
Brick packers	••	•• !	5,625		
Cement			1,150	bag	ŗs
Sand;	• •		115	cu.	yds.
24-in. tile pipe (chamber)	••		16 f	t. ,	

Unit Costs in Hours, Shaft No. 1

Distribution	Time in Hrs.	Hours per Cu. Yd.	Hours per Lin. Ft.
A	60	1.03	1.2
A	45	.77	.08
A	45	.77	.08
A	288	4.75	.58
D	310	.73	.63
P	239		.50
P	180	San States	.40
Z	230	A REAL PLAN	.47
N	300	.75	.60
N	1,140	2.45	2.30
N	1,155	2.50	2.33
N	300	.75	.60
K	336	1.60	.68
K	231	I.12	.47
K	1,432	7.00	2.90
Q	54		
Q	85	Contraction of the second second	.18
Q	85	THE MANTER THE	.18:
	Distribution A A A D P P P Z N N N N K K Q Q	Distribution Time in Hrs. A 60 A 45 A 288 D 310 P 239 P 180 Z 230 N 300 N 1,140 N 1,155 N 300 K 231 K 1,432 Q 54 Q 85	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$