No. 2 Shaft Collar commenced February, 1907, completed August 1907.

No. 3 Shaft Collar commenced June, 1910, completed August, 1910.

No. 4 Shaft Collar commenced March, 1911, completed August, 1911.

Cost per Foot—	Labor.	Supplies	Total.
No. 2 shaft	$47.47	$43.70	$91.17
No. 3 shaft	16.77	16.66	33.43
No. 4 shaft	15.04	7.25	22.29

Fig. 2 illustrates a reinforced concrete collar designed by Mr. W. F. Hartman for No. 6 shaft, Mohawk mine, where the dip is very flat (about 38 deg.). The reinforcement was rods and wire rope. The collar was built in 17 days and the total cost was $3,931.00. The length of the collar was 100 feet. The pit was first excavated at the shaft site. Then the forms were started at the bottom and built up as the work progressed. The concrete was mixed on surface and run down to the working platform in an iron trough. The use of concrete for plat floors, levelers, stringers and dividers is becoming quite common.

put in, reinforced with old rails and wire rope. The concrete extended across the hanging and down on both ends, and sometimes across the foot, and there were also heavy concrete dividers 4 feet high by 10 in. thick, placed 10 or 12 feet apart. At several levels the whole plat was arched over with reinforced concrete. This lining has been in place about two years and has proven satisfactory.

Drift sets built of concrete have been tried to some extent at the Wolverine and Mohawk mines in some of their cross-cuts, where loose ground was encountered. These sets consisted of legs 6x6 inches in section, and a cap 6x8 inches, reinforced with ½ inch rods and wire rope. Concrete planks, reinforced with Kahn expanded metal, or woven wire, were used for lagging. Above the caps they were 4x14 inches in section and behind the legs 2½x14 inches.

The use of reinforced concrete in the form of shaft sets and lagging is well described in a paper read before the Michigan College of Mines Club, at Houghton, Mich., by Mr. E. R. Jones, who has kindly given his permission for the use of the following excerpt:

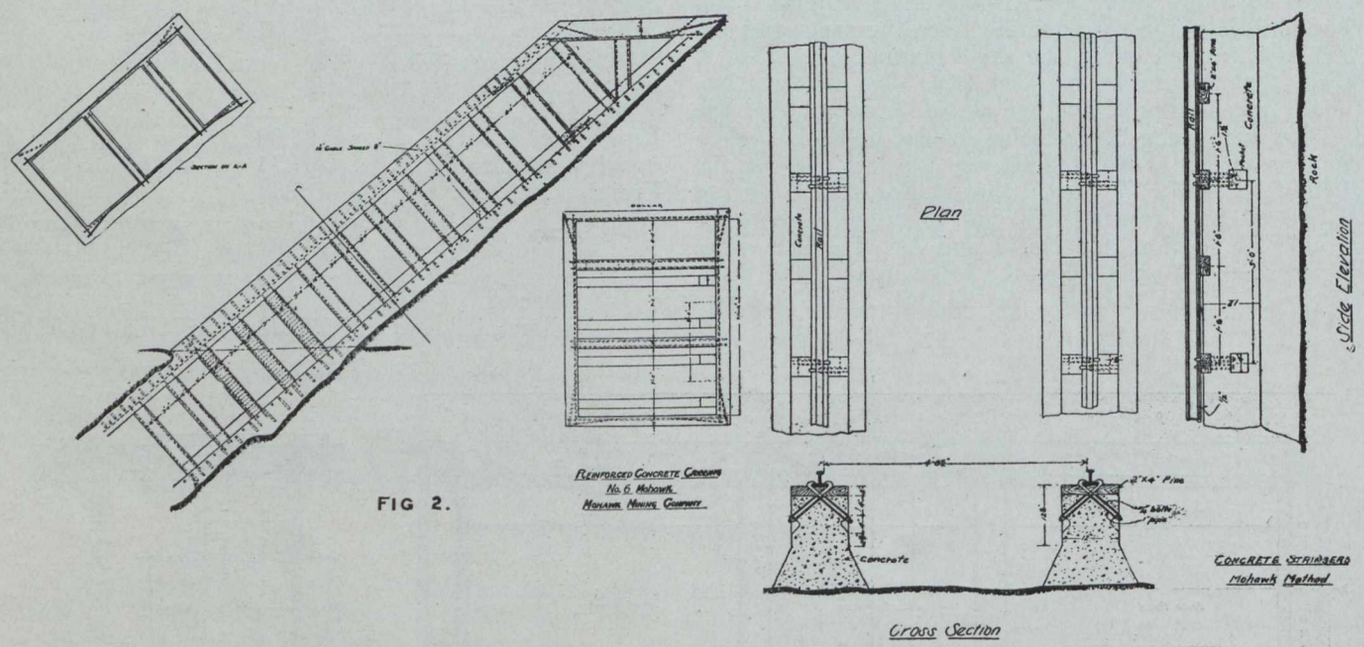

FIG 2.

Concrete Stringers and reinforced concrete cribbing, Mohawk mine

Fig. 4 shows a station or plat in one of the Champion Copper Company's shafts, and indicates the manner in which the levelers are reinforced. This illustration also shows the method used for concrete stringers. At first an all concrete stringer was built after the manner in use at Ahmeek mine, as designed by Mr. W. J. Uren, to which the rail was bolted by means of bolts and clips, but because of the hard rigid roadbed thus formed the wear and tear on skip and rails was very great, and the bolts and clips were continually working loose. The scheme was therefore abandoned in favor of a combination wood and concrete stringer.

Fig. 4 shows the method in use at the Copper Range Consolidated Company's mines, and the Mohawk and Wolverine scheme is illustrated in Fig. 6. Both methods made a very satisfactory roadbed.

At some of the mines where the foot is subject to "heaving" concrete stringers cannot be used advantageously.

In sinking through some loose ground at one of the Champion shafts it became necessary to close-timber, or line the shaft. Concrete 12 to 18 inches thick was

"For a number of years solid concrete and reinforced concrete shaft collars and shafts have been in vogue where the conditions warranted a shaft of any degree of permanence, but not until 1909 was reinforced concrete tried as a substitute to take the form and similar methods of installation as the long-used timber sets for shaft purposes; namely, at the Nos. 3 and 4 shafts of the Ahmeek Mining Company. At first, two distinct kinds of material were used; a good grade of gravel and natural sand from a local pit; and the trap rock, through which the shafts were sinking, together with clean conglomerate sand from the Calumet and Hecla mill. Sets were moulded from these two classes of material and installed with equal partiality and subsequent service has proven both to be equal to the demands made upon them. Pieces set aside for the purpose were allowed to season sufficiently that they might be given a fair competitive test, and it was found on comparing the fractures in the two combinations of material, that the sand and cement filling the spaces between the rounded pebbles broke away from them, while the fracture in the trap-conglomerate same