higher temperatures than other steels without deterioration, heat-treated vanadium steel is particularly adapted for compressor valves.

Public attention has been called recently to the more economical production of armor-plates. Tests made on armor-plates in which 0.24 per cent. of vanadium was present showed a resistance to perforation by projectiles and to splintering not equalled by any other composition of the steel alloys used in armor-plate making.

The high cost of vanadium contained in ferro-alloys has prevented its use in this important application. Cast iron treated with a vanadium addition of 0.1 per cent. has its tensile strength raised from 6 to 13 tons per sq. in., whilst the resistance to crushing is proportionately increased. The making of a high quality of cast iron will open a wide field to the use of vanadium. Cast iron thus alloyed is an excellent metal for making crushing-rolls and many other cast-iron articles. This vanadium cast iron is very compact and free from blow-holes, and it has a very fine-grained texture. An enormous demand for vanadium will result as soon as the ferro-alloy can be placed on the market at a reasonable price.

REINFORCED CONCRETE TROLLEY POLES FOR MUNICIPAL RAILWAYS.

ACCORDING to "Electric Traction," the city of San Francisco is using reinforced concrete trolley poles on all of the municipally owned street railways, the total length of which lines is about nine miles. Two types of poles are used: those without cross arms, used in connection with a system of underground conduits carrying the feeders; and those with cross arms, used in some districts of the city in which aerial feeders are allowed.

Table I. gives the principal features of the design of poles of both types.

Reinforcement.—All standard poles have six longitudinal bars, ¾-in. square, of which four extend the full length of the poles and two from the bottom to about 6 ft. from the top. All strain poles and riser poles have six longitudinal bars, ⅞-in. square, of which four extend the full length of the poles and two from the bottom to about 6 ft. from the top. All poles have stirrups of ¼-in. round steel wire, with spacing varying from 8 in. to 12 in.

Materials, Construction, Etc.—A machine mixture of one part Portland cement, two parts sand and four parts crushed rock was used. The specifications called for rock "of varying sizes, from that which will pass a screen of 1-in. mesh down to that which will be rejected by a screen of ¼-in. mesh, and not less than 50% shall pass a screen of ½-in. mesh."

The specifications called for square deformed bars or round mechanical bond bars of equivalent net cross-section. Twisted square bars were used.

The forms were of wood and were leveled up in a horizontal position. The only unusual feature of their construction was that the flat octagonal pyramid at the top of the pole was formed by a plaster of paris mold.

The concrete mixture was made of such consistency as to allow it to flow freely into place in the forms and around the reinforcement, with the assistance of some tapping of the bars and spading. The upper side of the pole was given a sidewalk finish, and was then covered with sand, which was wet down twice daily for seven days. The specifications permitted the removal of the side forms two weeks after pouring, but required that the poles should not be moved until 30 days after pouring. Out of a total of over 700 poles poured, only 11 were rejected by the inspector. These were found to be honeycombed, due to insufficient tamping around the reinforcing bars.

No soaping or oiling of the forms was permitted.

After stripping, the exposed concrete surfaces were washed with water and any rough surfaces found were finished with cement mortar consisting of one part cement, one part "Keystone" sand (a coarse white beach sand) and two parts ordinary bank sand. If the poles were sufficiently smooth, with true planes, straight and plumb, and free from pronounced form marks, a coat of cement grout, applied with a brush, was accepted as an adequate finish before painting. The poles are painted after erection with two coats of an approved concrete paint.

The poles were hauled from the yards in which they were manufactured to their places in the streets by lumber trucks, and erected by means of a derrick mounted on a truck. Standard poles were set 6 ft. 6 in. in the ground and strain poles 7 ft. The rake is ¼ in. per ft. of height, measured on the street face of the pole, the rake of the centre line being less by the amount of the taper. The hole in which the pole was set was made large enough to give the concrete backfill around the pole base a minimum thickness of about 6 in.

	Prices, each. Poles with provision for cross arms.	Poles without provision for cross arms.
Standard poles	$33.55	$32.90
Standard poles with one conduit	.....	39.00
Strain poles	38.10	35.75
Strain poles with one conduit	.....	41.85
Riser poles with one conduit	43.23	.....
Riser poles with two conduits	48.07	.....

The additional price for hauling and erecting poles is $17.60.

TABLE I.

	Poles with cross arms.			Poles without cross arms.	
	Standard poles.	Strain poles.	Riser poles.	Standard poles.	Strain poles.
Dimensions at base (square)	12 in.	16 in.	14 in.	12 in.	16 in.
Dimensions at top (square)	9 in.	10 in.	10 in.	19 in.	10 in.
Length over all, for P-1	32 ft. 7½ in.	33 ft. 1½ in.	32 ft. 7½ in.	30 ft. 2½ in.	30 ft. 8½ in.
Length over all, for P-2	33 ft. 7½ in.	34 ft. 1½ in.	.....	31 ft. 2½ in.	31 ft. 8½ in.
Length in ground	6 ft. 6 in.	7 ft.	6 ft. 6 in.	6 ft. 6 in.	7 ft.
Height of span wire eyebolt above ground, for P-1	22 ft.	22 ft.	22 ft.	22 ft.	22 ft.
Height of span wire eyebolt above ground, for P-2	23 ft.	23 ft.	.....	23 ft.	23 ft.

(P-1 and P-2 designate poles of different lengths: P-1 is used on streets of ordinary width, with a span of about 50 ft., and P-2, which is one foot longer than P-1, is used on the wider streets.)