while manifestly the proper thing to do is to increase the continuous rating.

About a year ago the author had occasion to estimate on a 24-ton locomotive to meet some very severe conditions. The haul was long and the grade against the loads. One manufacturer had three 85-h.p. motors as the maximum available for the equipment. According to calculations, this equipment was not large enough although on a horse-power per ton basis it seemed amply large (a little over 10 h.p. per ton). A second manufacturer offered a 25-ton locomotive equipped with three 115-h.p. motors.

The customer decided to try out both kinds and two locomotives of each make were installed.

The following tests, made some time after the locomotives were installed, clearly indicate that the high one-hour rating of 115 h.p. was obtained at the expense of the continuous rating, so that the 85-h.p. motor is really the larger of the two.

Both locomotives were operated in all-day service and a complete record kept of the cars handled, the grades, the distances and the weights. This service was, however, much lighter than was originally specified. Table I. shows the results of the test made with the locomotive equipped with three 85-h.p. motors.

The temperatures given are actual temperatures, so that the rise indicates that the equipment is working right up to the limit and any further load added would shorten the life of the motors so that satisfactory service could not be obtained. The actual number of cars handled was about 75 per cent. of the number originally specified.

Table II. shows the results with the 25-ton locomotive using three 115-h.p. motors. It will be noted from this table that the work done by the 24-ton locomotive was 42 per cent. greater than the 25-ton locomotive equipped with the larger motors. The temperature of the motors on the 25-ton locomotive will average but two degrees lower than that of the motors on the 24-ton locomotive, showing that although the latter was doing 42 per cent. more work, the temperature of its motor was practically the same as on the 25-ton locomotive, whose motors are supposed to have 37 per cent. greater capacity. No doubt some of the increase in actual capacity of the 85-h.p. over the 115-h.p. motor is due to the fact that the 24-ton locomotive is equipped with the open steel bar frame which allows considerable ventilation around the motor frames, while the 25-ton locomotive is equipped with a slab steel frame which pockets the air and permits of very little ventilation. The temperature of one motor of a second 24-ton locomotive, operating at the same time and doing about 10 per cent. more work than the first, was found to have practically the same rise.

As before stated, the service conditions are becoming more severe each year until conditions are sometimes submitted that cannot be met with by any of the standard equipments from a heating standpoint. The author has had in mind for the last few years that the time is coming when forced ventilation would be necessary to meet such cases. Forced ventilation has been used very successfully for the last nine or ten years on large main line locomotives. As this particular installation seemed to be such a case, permission was requested of the operating company to allow the manufacturer to install a small fan at one end of the locomotives to blow air through a duct to be so mounted that air could be delivered to the rear end of each motor. The commutator lid was raised around the edges a small amount to permit the air to escape. From 200 to 300 cu. ft. of air per minute was supplied to each motor. The motor driving the fan required about one h.p.

Before installing the fan in the locomotive a test was made on a single motor mounted on the test floor at the factory. The result of the test showed that with about 300 cu. ft. of air per minute passing through the motor the continuous rating could be nearly doubled. Since the continuous rating of a large slow-speed motor of this type without ventilation is only about 40 per cent. of the one-hour rating it will be seen that with ventilation this continuous rating is still considerably below the one-hour rating.

Owing to the dusty condition of the mine it was thought that trouble would be experienced by the motors being filled with dirt. During the heavy pull when bringing the trip out a great deal of dust is raised and the operators decided to run the fan only while the locomotive was going in with the empty trip.

The results have been surprising, both in regard to temperature rise and the condition of the motors.

Table I.—24-ton Locomotive.

Equipment, three 85-h.p. 500-volt motors.

Distance.	Grade.	Pull in lbs. per car.	Work done in lb.-ft.
700	0	47·5	33,300
1,400	2·5	142·5	200,000
1,800	1.0	85·5	153,000
1,600	0.425	63·5	101,100
2,400	2·5	142·5	342,000
1,450	1.1	89·5	130,000
1,750	2·5	142·5	249,000
1,880	1.06	88.0	165,500
600	3·3	173·0	104,000
Total			1,477,900
Total pound-miles per car ...			279
Total pound-miles for 725 cars			202,300

Air Temperature 20 Deg. Cent.

	Armature.	Commutator.
No. 1 motor	95 deg.	97 deg.
No. 3 motor	92 deg.	97 deg.

Table II.—25-ton Locomotive.

Equipment, three 115-h.p. 550-volt motors.

Distance.	Grade.	Pull in lbs. per car.	Work done in lb.-ft.
700	0	47·5	33,300
1,400	2.5	142.5	200,000
1,800	1.0	85·5	153,000
1,600	0.425	63·5	101,000
2,400	2.5	142.5	342,000
600	1.1	89.5	54,000
Total			883,300
Total pound-miles per car			167
Total pound-miles for 851 cars			142,000

Air Temperature 20 deg. Cent.

	Armature.	Commutator.
No. 1 motor	92 deg.	95 deg.
No. 3 motor	92 deg.	95 deg.

Rating of 25-ton locomotive ..... 345 h.p.
Rating of 24-ton locomotive ..... 252 h.p.
Work done by 25-ton locomotive ... 142,000 pound miles
Work done by 24-ton locomotive ... 202,300 pound-miles