# EFFICIENCY OF MODERN LOCOMOTIVES.

Mr. Alvin B. Johnson, of the Baldwin Locomotive Works, Phila., U. S.A., recently made the following statement:—

"A locomotive is not subject to an annual reduction of efficiency. So long as its boiler is in condition to carry the pressure for which it was designed, and so long as the locomotive is maintained in a proper state of repair, it is capable of doing its maximum work. With the great improvements which have been made in boiler construction there should be no necessity for reducing the working pressure until the locomotive is, from other causes, about ready for withdrawal from service. There is not, therefore, an annual reduction of 10 per cent., nor of any other percentage, by reason of the depreciation of the efficiency of existing locomotives. The percentage of reduction of power caused by the retirement of old locomotives is much less than the ratio which the number of such locomotives bears to the whole number in service, because most of the locomotives now being withdrawn from service are light in weight and obsolete in type. Experience has shown that at intervals of about 20 years there come revolutionary changes in railway equipment. Thus we have seen the transition of carloads from 20,000 to 40,000, from 40,000 to 60,000 and from 60,000 to 100,000 pounds capacity each, accompanied by corresponding changes in the weight of rail and in the capacity of locomotives. So certain is the further development of railway science that it is unsafe for any railroad manager to count upon the efficiency of the best known appliances for a period of more than 20 years in the future. Modern locomotives should maintain their maximum efficiency for at least 20 years, and should then be available for a good many years' service on branch lines. The depreciation is, therefore, less than 5 per cent., and instead of 4,600 locomotives being required annually to make good the depreciation in existing equipment, approximately 2,300 will be sufficient.

The locomotives now doing the greater portion of the work of the country have been constructed during the past ten years. They are of enormously greater capacity than those which they have replaced. Twenty years ago the heaviest standard freight locomotive had a weight on driving wheels of from 100,000 to 110,000 pounds. At present the average weight on driving wheels of heavy freight locomotives is about 180,000 pounds an increase of fully 75 per cent.

One of the most conspicuous facts in railroad work during the past few years has been the vast sums spent in reducing grades, straightening curves and otherwise so improving the conditions of traffic as to reduce the power required for its movement. Such reduction of grades and curves is equivalent to a large increase in the effective capacity of locomotives, while the introduction of gravity yards also largely reduces switching engine mileage. It is difficult to convert this into the terms of a definite percentage of increased locomotive power, but it must be a very considerable factor both in increased efficiency and in reduced cost of operation, and tends to lessen the number of locomotives required for a given freight tonnage.

The average number of miles of track locomotive for the whole country is approximately five, but this includes all of the old established lines where traffic is concentrated and trains are numerous. Rarely do new roads provide themselves so liberally with power; one locomotive for each ten miles of track is nearer to the usual allowance. Therefore 600 locomotives per annum should be sufficient to provide for new construction of 6,000 miles.

It is difficult to determine what number of locomotives is required annually to provide for increase of traffic, exclusive of renewals of existing equipment and equipment for new mileage. During the seven years from 1897, when the total number of locomotives in the country was 36,080, to 1904, when the total number of locomotives in the country was 44,529, the increase was 8,449, or an average of 1,207 per annum. This annual increase, of course, covered also new mileage and increased tonnage. It would be a liberal allowance to assume that 1,000 locomotives per annum are required for increasing tonnage.

Summarizing the foregoing, the total requirements of American railroads appear to be:—

| | |
|---|---|
| Number required for renewal of existing equipment.. | 2,300 |
| Number required for equipping new mileage.......... | 600 |
| Assumed requirements for increasing annual tonnage.. | 1,000 |
| | 3,900 |

During 1903 the American Locomotive Company built in its eight shops 2,216 locomotives, and the Baldwin Locomotive Works built in their shops in Philadelphia 2,022. Although having contracts sufficient to operate to their maximum capacity throughout that year, a number of causes contributed to prevent both concerns from realizing their maximum production. Both were engaged largely in rebuilding their shops, and both were greatly hampered during a considerable portion of the year by difficulties in obtaining supplies of materials. The Rogers Locomotive Works were operating as a third competitor, but their production was not made public. Since then the American Locomotive Company has acquired the Rogers Locomotive Works, and now advertises its capacity of 3,000 locomotives per annum. The Baldwin Locomotive Works are endeavoring to maintain a production of 50 locomotives per week. During March, 1905, they actually turned out 216 locomotives. It is, therefore, apparent that the combined capacity of these two concerns is approximately 5,500 locomotives per annum, or sufficient to renew the entire locomotive stock of the country each eight years. Not only is their capacity sufficient for all the needs of our American railroads, but as appears from the foregoing, there exists a surplus capacity of something like 1,600 locomotives per annum out of which to provide for increasing future demands, for exports to foreign countries and for sales to those buyers whose purchases do not figure in the statistics."
—Railway and Locomotive Engineering.

---

# AMOUNT OF AIR REQUIRED FOR VENTILATION.

Under the general conditions of outdoor air, namely, 70 degrees temperature, and 70 per cent. of complete saturation, an average adult man, when sitting at rest in an audience, makes 16 respirations per minute of 30 cubic inches each, or 480 cubic inches per minute. With 70 degrees temperature and 70 per cent. humidity, the air thus inhaled will consist of about 1-5 oxygen and 4-5 nitrogen, together with about ·1 7-10 per cent. of aqueous vapor, and 4-100 of a per cent. of carbonic acid. By the process of respiration the air will, when exhaled, be found to have lost about 1-5 of its oxygen by the formation of carbonic acid, which will have increased about one hundred fold, thus forming about 4 per cent., while the water vapor will form about 5 per cent. of the volume. In addition, the exhaled air will have warmed from 70 degrees to 90 degrees, and, notwithstanding the increased proportion of carbonic acid,—which is about one and one-half times heavier than air,—will, owing to the increase of temperature and the levity of the water vapor, be about three per cent. lighter than when inhaled. Thus it will be seen that this vitiated air will not fall to the ground as has often been presumed, but will naturally rise above the level of the breathing line, and the carbonic acid will immediately diffuse itself into the surrounding air. In addition to the carbonic acid exhaled in the process of respiration, a small amount is given off by the skin. Furthermore, 1½ to 2½ lbs. of water are evaporated daily from the surface of the skin of a person in still life. If the air supply at 70 degrees is assumed to have a humidity