

from the results of the tests at St. Louis, that a locomotive of this type equipped with a superheater will give a saving of 15% in water consumption and 11% in fuel consumption over a similar simple expansion engine. An interesting comparison made during the test was the increase in tonnage that could be handled by the superheater in proportion to the simple engine, and the absence of water in the cylinders resulting in decreased trouble with the rod packing. No trouble was experienced in the lubrication of the balanced slide valves with the ordinary sight feed lubricator.

With the exception of the more extended application of the Vauclain superheater during the past year, evidently but little interest has been manifested in superheating, and yet the replies from those roads on which superheater engines have been in service do not condemn them. The Great Northern Ry., which has one passenger and one freight engine equipped with the Schmidt smoke-tube superheater, reports two coal tests between the superheater engines and simple engines of practically identical construction. In passenger service a test on the Kalispell Division showed a saving of 13% in water and 14½% in coal per car mile, while in freight service on the Willmar Division the saving was 30½% in water and 28½% in coal per ton mile, the coal figures being 137½ for the simple and 98 lbs. for the superheaters per 1,000 ton miles, both very satisfactory figures for Prairie type engines in freight service on an undulating road. They also report a comparison for nine months between a superheater freight engine and a similar simple engine, showing 137 lbs. of coal per 1,000 ton miles for the superheater against 171 for the simple, and a cost for repairs of 4c. per mile against 3.87c., a reduction in the coal consumption of 20%, with practically the same cost for repairs.

The Boston and Maine reports on one passenger engine equipped with the Cole superheater, that while the original arrangement gave them considerable trouble from leaking and from breakage of the superheater pipes near the header castings, when the engine was in good condition it has given excellent service, and they are taking steps to substitute improved details. They favor further improvement until better results are obtained rather than the abandonment of superheating.

The Chicago and North-Western Ry. reports with reference to one passenger engine with the original Cole superheater, which originally gave trouble from header joints leaking, that by the substitution of ground header joints this trouble has been overcome, and states that the results have been very satisfactory the last twelve months.

The New York Central reports on one passenger engine equipped with the Cole superheater, a slight reduction in the coal consumption, but no conclusion.

The Soo Line reports on one freight engine equipped with the original Cole superheater, that they have experienced no trouble except with leaks in the header connections, and while they cannot give accurate figures showing consumption of coal, there is evidently a saving, and the engine handles a train better than other engines.

The Lake Shore and Michigan Southern Ry. reports on two passenger engines, one equipped with the original Cole and the other with the Vaughan-Horsey superheater, that no further tests have been made. They have experienced difficulty in their operation as follows: 1. The lubrication. This was first attempted with the forced feed lubricator, and afterward the ordinary sight-feed lubricator was found to give entire satisfaction. 2. On the Vaughan-

Horsey superheater the top header broke, due to faulty design, which has been overcome by changes in the cross section from square to round. 3. A number of the superheater tubes have cracked, but no remedy has been suggested. Their conclusion is that the superheater passenger engines have on the whole been satisfactory, and that while certain defects have developed, they are not of a nature that presents any serious difficulty. The engines have proved distinctly superior to simple engines of corresponding types both in economy in fuel and their capacity for handling their trains. They consider superheating a very promising improvement and intend to apply it to a considerably greater extent.

The C.P. Railway, which, as this report states, has a large number of superheater engines in service, is operated in two systems, the Lines East and West of Fort William respectively, and Grant Hall, Superintendent of Motive Power of the Lines West, has furnished a report from the master mechanics of the three divisions under his charge, having a total of 103 superheater engines at the commencement and 143 at the end of the year. As these statements cover a fairly extended experience with the original Cole, Schmidt and Vaughan-Horsey superheaters, extracts from them are quoted as follows:

"We experience trouble in keeping large superheater tubes free and clear from cinders; if this is not done the benefit of the superheater is lost. I find that the large tube fills up and becomes choked, starting from firebox end and extending about two feet in it if not kept after and cleaned out regularly; to do this we pull back the deposit with a rod with a bent end and then finish up by blowing through air. We also find that the small steam pipes get coated with soot, which also prevents us getting full benefit of the heat passing through the tube, which is only partly overcome by repeated blowing out with air.

"The Schmidt type is giving us very little trouble on this division, perhaps not so noticeable on account of only having one engine of this type. The main top header on this engine, however, has failed twice by cracking around the neck between the header and the flange which bolts to tube sheet. The jointing arrangement of small superheater pipes has not given us any trouble whatever from leaking or slackening back, which is frequent with other types.

"The Cole type is a constant trouble from leakage at joints where small headers bolt to main header and cannot be maintained tight for any length of time. In tightening them up, which is frequently done, the studs, which were enlarged from ¾ to 7/8 inch, are strained, broken and pulled out from main header. When leaking, the flat face on main header, as well as the grooved bed in the small headers, are cut by steam leaks, necessitating plugging, etc., making it very costly to maintain, not saying anything about holding engine out of service or extra fuel consumption.

"The Vaughan-Horsey type causes trouble by the union joints leaking, caused by nuts slackening off them where joined to main header, and have to be opened up as often as business will permit and gone over to avoid failures; this being the only trouble we have with this type outside of the returns burning out occasionally, which is equal on all types."

"I am in favor of superheated steam in both passenger and freight service, and consider that we get good results when the arrangement is working satisfactorily and free from leaks. The system should be improved on to lessen the maintenance work, and the question of lubrication most

thoroughly gone into with a view of reducing the number of piston and valve rings that are being used. With the quality of the oil we are using we find it necessary to renew piston rings every four or five weeks and the valve rings every two months. When piston rings are removed, if not broken, they are worn down to about 3/8 inch thick. Have had very little difficulty with respect to superheater tubes stopping up, but it is absolutely necessary that the damper in smoke-box be kept in working order.

"With the Schmidt superheaters we experience considerable difficulty in keeping flange joints tight where bolted on header. Have had one header broken off close outside of flange where bolted on to round head. With the Vaughan-Horsey type we have quite a lot of trouble with the brass ring nut at connections, but using the mild steel nut, I think, will overcome this to a great extent.

"My experience with superheated steam in freight service is satisfactory; have no engines in passenger service equipped with superheated steam.

"In regard to the superheater tubes blocking up in the smoke tube class. We have had some difficulty in keeping the smoke tube clean, and the only way to get good results is to blow them out each trip with air; doing so we have been able to keep them in good condition.

"We have had considerable trouble with the piston and valve rings of the superheater type. This trouble has been eliminated to a large extent by making a more rigid examination of rings and feed attachments to valves and cylinders, also by making a perfect fit of new rings when applied to piston. Another important feature toward the maintenance is the superheater dampers and their attachments. To keep these in working condition it is necessary to inspect them thoroughly every week, which will prevent any trouble from defective dampers. The worst feature is the possibility of engine failures on account of superheater pipes bursting and leaking; they give no warning, and it is impossible to detect them before giving out.

"In connection with superheaters in freight service, the only difficulty was in the large tubes leaking badly, making it necessary to expand them every round trip. In passenger service I consider them very satisfactory, both in efficiency for this class of work and for the light maintenance of same."

Mr. Hall has also written a general statement of his experience from which the following are extracts: "We find that the superheater tubes plug up to a certain extent, but we overcome this by blowing out with air. The Cole type only has given us trouble maintaining header joints. In passing I might say, for your information, that the Cole superheater has given us so much trouble in this respect that I would not recommend its use. We have had very little trouble with the Schmidt type, the principal trouble being one that can be overcome, namely, the cracking of the superheater header through the neck. The only difficulty that has been experienced with the Vaughan-Horsey has been the slackening off of the nuts coupling up the superheater pipe to the header; this type of superheater is an easy proposition to maintain. In regard to lubrication. We have had nothing in the shape of forced feed that gave satisfaction, and have none now in service, being replaced entirely by sight-feed lubrication. It is not necessary that we have separate cylinder connections, but I do consider it necessary to have connection to each end of the valve bushing when using superheated steam. My experience with superheated steam in both passenger and freight service is satisfactory."