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Freight Brake Maintenance.

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My first purpose in this paper is to show that freight brake maintenance is generally unsatisfactory; next to show why; and then to suggest how to improve it. As is generally known, the Westinghouse Air Brake Co. maintains a large, selected and trained organization for the special purpose of co-operating with customers in obtaining good and economical installation, maintenance and operation of brake equipment. Several years ago, while two of us Westinghouse men and two railway air brake experts were giving particular attention to reducing freight train break-in-twos, we became convinced that freight train brakes in interchange service were not being maintained as well as the needs and the time and money spent on them would warrant, but to effect an improvement the proof and the causes were required.

The proof of unsatisfactory conditions was finally obtained at a "dead line" division point on a road where, to control an increased tonnage safely, and without aid from hand brakes, down a subsequent steep, descending grade, it was required that at this terminal all brakes in each freight train must apply with the ordinary terminal test application of a 20-lb., continuous service reduction from 70 lb., and that none leak off entirely during the period of inspection. As this application should produce approximately 50 lb. in every brake cylinder; as brake pipe leakage causes more to be fed in from the auxiliary reservoirs during the inspection, as the inspection is finished ordinarily in 12 to 14 minutes; as 1 in. recession of piston travel means the loss of all effective holding power; as 5 or 6 lb. in a brake cylinder will hold the brake cylinder in applied position; as no test of the retaining valves was included; and as no brake was considered ineffective unless entirely off when inspected, it will be appreciated that this test requirement was very moderate, yet, when the rule was first put in force, and although division terminals in advance of this one did more brake cleaning than before, 10 to 12% of the cars had to be set out for brake repairs.

The even more disturbing feature noted was the short time since a large proportion of these defective brakes had, as indicated by the stencils, been supposedly put in good condition. This was in 1913. That you may appreciate not only how bad the situation was, but also the great possibilities remaining after two years of special and unusual work done to improve it, as described later, please see table 1, which shows, out of the total ineffective brakes set out and repaired at the "dead line" point for July of three years, the number of such bearing system stencils, and the elapsed periods since they had supposedly been put in good order. System-cleaned brakes only were taken, because we were seeking to improve the work on this particular road. The foreign-cleaned brakes on it showed a much worse condition. In fact, a check made in Oct. and Nov., 1917, of freight trains yet uninfluenced by steep grade conditions,

the latter resulting in improved brake maintenance, showed that of 1,103 system cars 14.1% had defective brakes, as compared with 25.3% on 659 foreign cars.

aged 22 lb. or 44% of a full service application.

Regarding the present general condition of freight brakes in interchange ser-

Table 1—Brakes Cleaned at "Dead Line" Point.

System	July Stencils	% system work recleaned in months.												
		1	2	3	4	5	6	7	8	9	10	11	12	
1913	596	21.3	35.7	44.7	51.9	56.9	63.0							
1914	823	18.9	28.1	36.2	43.0	48.2	52.6	58.4	65.1	76.1	84.9	93.5	96.9	
1915	630	8.8	16.1	23.8	30.9	36.3	44.6	47.7	54.1	65.2	75.7	85.4	95.4	

In this tabulation the average car months since previous brake cleaning were 6.6 for 1914 and 7.1 for 1915, a gain of 7.5%. But these brakes had not suddenly become inefficient. Hence, with more "dead lines," which would have caught the defective brakes sooner, these averages would have been lower. Even so, note in 1913 that 44.7% of the defective brakes were inefficient three months after cleaning; that this was 23.8% in 1915; and that with but one "dead line" and it operating in one direction only, less than 5% had run over 12 months.

Although a special effort was made in 1914 to improve conditions, and in spite of the encouraging results shown in table 1, a gauge test for brake cylinder leakage made at various division terminals in 1915 on 164 freight brakes showed that of 52 tested immediately after cleaning 46.1% leaked down over 5 lb. in one minute. The customary method of lubricating had been followed, this including filling the expander space, next to the inside of the packing leather, with the lubricating grease. As this temporarily stops or reduces leakage through a defective packing leather, the unfavorable results stated were minimized.

As illustrating this feature, a special gauge test was made of a packing leather, that the average cleaner would judge by inspection to be good, but which we had found to be very porous. With a dry surface on the expander side and a lubricated cylinder wall it leaked 38 lb. from 50 lb. in one minute. This was reduced to 7 lb. leakage by filling the expander space with lubricant. After being under pressure of from 50 lb. down to about 30 lb. for 90 minutes, representing not over 2 or 3 days' ordinary service, the leakage had increased to 37 lb. The lubricating grease on the porous portion had been forced through the packing.

Reverting to the gauge tests, 12 brakes just cleaned leaked up over 3 lb. from 50 lb. in one minute, due to faults in the triple valves or their gaskets. A limit of 3 lb. should certainly not be exceeded. From this cause and excessive cylinder leakage 40.6% of these 64 brakes were defective immediately after cleaning. The average leakage was 8.4 lb. A gauge test of 76 brakes that, caught at random in 1915, had run from one to three months since cleaned, showed the following leakage from 50 lb. in one minute:

71.0% leaked over 5 lb.
59.2% leaked over 10 lb.
40.7% leaked over 15 lb.
21.0% leaked over 20 lb.

The 50.2% that leaked over 10 lb. aver-

vice, thorough terminal tests and inspections made personally by the four of us air brake men on freight trains in transit during Oct. and Nov., 1917, covering 51 trains far removed from mountain grade service and 26 others ready for or having recently come down steep, descending grades, indicated a very noticeable improvement in the brakes of the 26 trains, as compared with 1915, but absolutely none in the others. The 51 trains had 2,276 cars, and 14.1% of these cars had inefficient brakes. This emphasizes the statement in the report of the Chief of the Bureau of Safety to the Interstate Commerce Commission for the year ended June 30, 1917, that: "The maintenance of the air brakes to the point of maximum efficiency is a consummation to be striven for by all carriers, regardless of whether the grade on a particular line of road demands such efficiency in the ordinary movement of trains. Level roads should maintain their air brake equipment to the same degree as those having steep mountain grades."

Causes for unsatisfactory condition.—As will doubtless appeal to you, the "dead line" data for 1913 (see table 1) gave ample proof that freight brake maintenance was very unsatisfactory, but we required the causes to effect a betterment. It may be said, in passing, that "cleaning with the stencil" was not an explanation. After failing in an attempt to learn the causes by having brake cleaners report their findings, the four of us in 1914 took our over-clothes, wrenches, and test gauges and spent six weeks working with the brake cleaners at the various division terminals. We made gauge and soap suds tests of a large number of brakes, including those just cleaned and others that had run for various periods. With each brake found to have over 5 lb. brake cylinder leakage per minute from an initial pressure of 50 lb. we personally located and remedied the faults, thereby instructing the accompanying, local brake cleaners. Other existing defects were treated similarly. The Air Brake Association recommends that no newly repaired brake be considered satisfactory until it will pass the above cylinder leakage test, as well as other tests. This work disclosed such opportunities for betterment that we repeated it in 1915 and 1916. It has convinced me that large roads should have a special man giving it regular attention, as more particularly referred to later.

The more common causes for brakes failing to apply or leaking off quickly, as indicated by tables 1 and 2, are, in the order of their estimated proportions:—